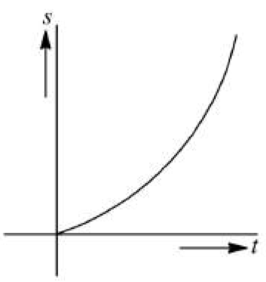
MOTION IN A STRAIGHT LINE

1. From the top of a tower two stones, whose masses are in the ratio $1:2$ are thrown one straight up with an initial speed u and the second straight down with the same speed u. Then, neglecting air resistance
   a) The heavier stone hits the ground with a higher speed
   b) The lighter stone hits the ground with a higher speed
   c) Both the stones will have the same speed when they hit the ground
   d) The speed can't be determined with the give data
2. A body is travelling in a straight line with a uniformly increasing speed. Which one of the plot represents the change in distance (s) travelled with time (t)?

a)


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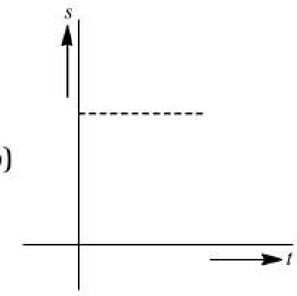

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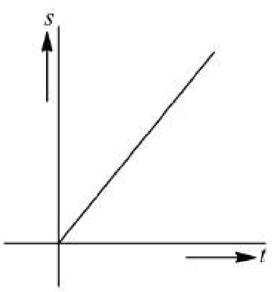

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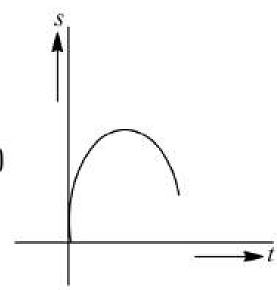
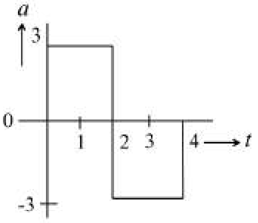


3. A body is thrown vertically upwards. If air resistance is to be taken into account, then the time during which the body rises is
   a) Equal to the time of fall
   b) Less than the time of fall
   c) Greater than the time of fall
   d) Twice the time of fall
4. A body of 5 kg is moving with a velocity of $20m/s$. If a force of $100N$ is applied on it for $10s$ in the same direction as its velocity, what will now be the velocity of the body
   a) 200 m/s
   b) 220 m/s
   c) 240 m/s
   d) 260 m/s
5. A particle when thrown, moves such that it passes from same height at 2 and $10s$, the height is
   a) g
   b) $2g$
   c) $5g$
   d) $10g$
6. Two trains one of 100 m and another of length 125m, are moving in mutually opposite directions along parallel lines, meet each other, each with speed 10m/s.
   If their acceleration are $0.3m/s^2$ and $0.2m/s^2$ respectively, then the time taken to pass each other will be
   a) 5 s
   b) 10 s
   c) 15 s
   d) 20 s
7. A ball is dropped downwards. After 1 second another ball is dropped downwards from the same point. What is the distance between them after 3 seconds
   a) 25 m
   b) 20 m
   c) 50 m
   d) 9.8 m

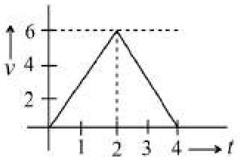
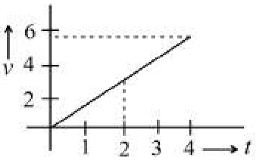
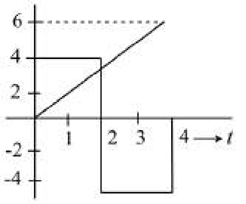
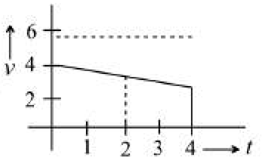
8. A balloon rises from rest with a constant acceleration $g/8$. A stone is released from it when it has risen to height h. The time taken by the stone to reach the ground is

a) $4\sqrt{\frac{h}{g}}$ b) $2\sqrt{\frac{h}{g}}$ c) $\sqrt{\frac{2h}{g}}$ d) $\sqrt{\frac{g}{h}}$

9. A particle starts from rest at $t = 0$ and undergoes an acceleration a in ms^{-2} with time t in seconds which is as shown



Which one of the following plot represents velocity V in ms^{-1} versus time t in seconds

a) 
b) 
c) 
d) 

10. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on the planet B. A man jumps to a height of $2m$ on the surface of A. What is the height of jump by the same person on the planet B

a) 18 m b) 6 m c) $\frac{2}{3}m$ d) $\frac{2}{9}m$

11. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height, did he bail out

a) 293 m b) 111 m c) 91 m d) 182 m

12. Two spheres of same size, one of mas 2 kg and another of mass 4 kg, are dropped simultaneously from the top of Qutub Minar (height = $72m$). When they are 1 m above the ground, the two spheres have the same

a) Momentum b) Kinetic energy c) Potential energy d) Acceleration

13. A boy walks to his school at a distance of $6km$ with constant speed of 2.5 $km/hour$ and walks back with a constant speed of 4 km/hr. His average speed for round trip expressed in $km/hour$, is

a) 24/13 b) 40/13 c) 3 d) 1/2

14. A car moving with a velocity of 10 m/s can be stopped by the application of a constant force F in a distance of 20 m. If the velocity of the car is 30 m/s. It can be stopped by this force in

a) $\frac{20}{3}m$ b) 20 m c) 60 m d) 180 m

15. One car moving on a straight road covers one third of the distance with 20 km/hr and the rest with 60 km/hr. The average speed is

a) 40 km/hr b) 80 km/hr c) $46\frac{2}{3}$ km/hr d) 36 km/hr

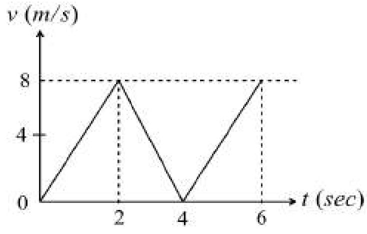
16. A body starts from rest, with uniform acceleration. If its velocity after n seconds is v,then its displacement in the last two seconds is

a) $\frac{2v(n+1)}{n}$ b) $\frac{v(n+1)}{n}$ c) $\frac{v(n-1)}{n}$ d) $\frac{2v(n-1)}{n}$

17. A packet is dropped from a balloon which is going upwards with the velocity 12 m/s , the velocity of the packet after 2 seconds will be

a) -12 m/s b) 12 m/s c) -7.6 m/s d) 7.6 m/s

18. $v - t$ graph for a particle is as shown. The distance travelled in the first 4 s is



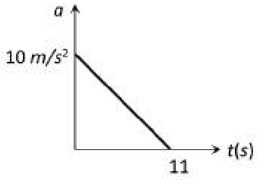
a) $12m$ b) $16m$ c) $20m$ d) $24m$

19. A body, thrown upwards with some velocity, reaches the maximum height of $20m$. Another body with double the mass thrown up, with double initial velocity will reach a maximum height of
a) $200\ m$ b) $16\ m$ c) $80\ m$ d) $40\ m$

20. A body is falling freely under gravity. The distances covered by the body in first, second and third minute of its motion are in the ratio
a) 1 : 4 :9 b) 1 : 2 : 3 c) 1 : 3 : 5 d) 1 : 5 : 6

21. If a body starts from rest and travels 120 cm in the 6th second, then what is the acceleration
a) $0.20\ m/s^2$ b) $0.027\ m/s^2$ c) $0.218m/s^2$ d) $0.03m/s^2$

22. A particle starts from rest. Its acceleration (a) versus time (t) is as shown in the figure. The maximum speed of the particle will be



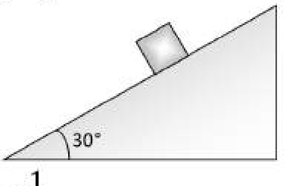
a) $110\ m/s$ b) $55\ m/s$ c) $550\ m/s$ d) $660\ m/s$

23. Two bodies of different masses are dropped from heights of 16 m and 25 m respectively. The ratio of the time taken by them to reach the ground is
a) $\frac{25}{16}$ b) $\frac{5}{4}$ c) $\frac{4}{5}$ d) $\frac{16}{25}$

24. The coordinates of a moving particle at any time t are given by $x = \alpha t^3$ and $y = \beta t^3$. The speed of the particle at time t is given by
a) $3t\sqrt{\alpha^2 + \beta^2}$ b) $3t^2\sqrt{\alpha^2 + \beta^2}$ c) $t^2\sqrt{\alpha^2 + \beta^2}$ d) $\sqrt{\alpha^2 + \beta^2}$

25. A ball is dropped on the floor from a height of 10 m. It rebounds to a height of 2.5m. If the ball is in contact with the floor for 0.01 sec, the average acceleration during contact is
a) 2100 $m/\sec^2$ downwards b) 2100 $m/\sec^2$ upwards
c) 1400 $m/\sec^2$ d) $700m/\sec^2$

26. The time taken by a block of wood (initially at rest)to slide down a smooth inclined plane 9.8 m long (angle of inclination is 30°) is



a) $\frac{1}{2}sec$ b) $2sec$ c) $4sec$ d) $1sec$

27. From the top of a tower, a particle is thrown vertically downwards with a velocity of 10 m/sec. The ratio of the distances, covered by it in the 3rd and 2nd seconds of the motion is (Take $g = 10\ m/s^2$)
a) 5 : 7 b) 7 : 5 c) 3 : 6 d) 6 : 3

28. A particle moves for 20 s with velocity 3 ms^{-1} and then moves with velocity 4 ms^{-1} for another 20 s and finally moves with velocity 5 ms^{-1} for next 20 s. What is the average velocity of the particle?
a) 3 ms^{-1} b) 4 ms^{-1} c) 5 ms^{-1} d) Zero

29. An express train is moving with a velocity v_1. Its driver finds another train is moving on the same track in the same direction with velocity v_2. To escape collision, driver applies a retardation a on the train. The minimum time of escaping collision will be

a) $t = \frac{v_1 - v_2}{a}$ b) $t = \frac{v_1^2 - v_2^2}{2}$ c) None d) Both

30. The initial velocity of a particle is u (at $t = 0$) and the acceleration f is given by at. Which of the following relation is valid

a) $v = u + at^2$ b) $v = u + a\frac{t^2}{2}$ c) $v = u + at$ d) $v = u$

31. A particle travels 10m in first 5 sec and 10m in next 3 sec. Assuming constant acceleration what is the distance travelled in next 2 sec

a) 8.3 m b) 9.3 m c) 10.3 m d) None of above

32. A bus begins to move with an acceleration of 1 ms^{-2}. A man who is 48 m behind the bus starts running at 10 ms^{-1} to catch the bus. The man will be able to catch the bus after

a) 6 s b) 5 s c) 3 s d) 8 s

33. The acceleration of a particle is increasing linearly with time t as bt.The particle starts from the origin with an initial velocity v_0. The distance travelled by the particle in time t will be

a) $v_0t + \frac{1}{3}bt^2$ b) $v_0t + \frac{1}{3}bt^3$ c) $v_0t + \frac{1}{6}bt^3$ d) $v_0t + \frac{1}{2}bt^2$

34. A bullet fired into a fixed wooden block loses half of its velocity after penetration 40 cm. it comes to rest after penetrating a further distance of

a) $\frac{22}{3}$cm b) $\frac{40}{3}$cm c) $\frac{20}{3}$cm d) $\frac{22}{5}$cm

35. A particle is moving on a straight line path with constant acceleration directed along the direction of instantaneous velocity. Which of the following statements are false about the motion of particle?

a) Particle may reverse the direction of motion

b) Distance covered is not equal to magnitude of displacement

c) The magnitude of average velocity is less than average speed

d) All of the above

36. A body, thrown upwards with some velocity reaches the maximum height of 50 m. Another body with the double the mass thrown up with double the initial velocity will reach a maximum height of

a) 100 m b) 200 m c) 300 m d) 400 m

37. A body is thrown vertically up with a velocity u. It passes three points A, B and C in its upward journey with velocities $\frac{u}{2}, \frac{u}{3}$ and $\frac{u}{4}$ respectively. The ratio of the separations between points A and B between B and C, ie, $\frac{AB}{BC}$ is

a) 1 b) 2 c) $\frac{10}{7}$ d) $\frac{20}{7}$

38. A train started from rest from a station and accelerated at 2 ms^{-2} for 10 s. Then, it ran at constant speed for 30 s and thereafter it decelerated at 4 ms^{-2} until it stopped at the next station. The distance between two stations is

a) 650 m b) 700 m c) 750 m d) 800 m

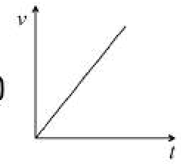
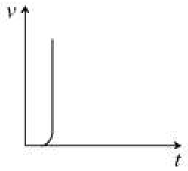
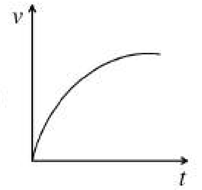
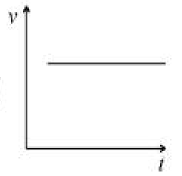
39. A ball is dropped downwards. After 1 second another ball is dropped downwards from the same point. What is the distance between them after 3 seconds

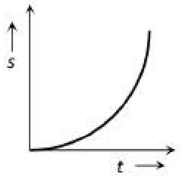
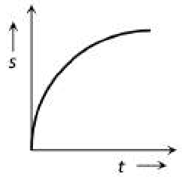
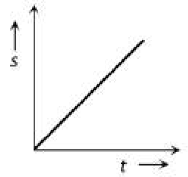
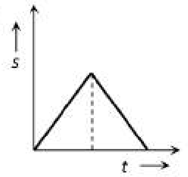
a) 25 m b) 20 m c) 50 m d) 9.8 m

40. You drive a car at seed of 70 km/hr in a straight road for 8.4 km, and then the car runs out of petrol. You walk for 30 min to reach a petrol pump at a distance of 2 km. The average velocity from the beginning of your drive till you reach the petrol pump is

a) 16.8 km/hr b) 35 km/hr c) 64 km/hr d) 18.6 km/hr

41. An object is dropped from rest. Its v-t graph is

a) 
b) 
c) 
d) 

42. A particle is thrown vertically upwards. If it velocity at half of the maximum height is 10 m/sec, then maximum height attained by it is (Take $g = 10\ m/\sec^2$)
a) 8 m b) 10 m c) 12 m d) 16 m
43. Which graph represents the uniform acceleration
a) 
b) 
c) 
d) 

44. What is the relation between displacement, time and acceleration in case of a body having uniform acceleration
a) $S = ut + \frac{1}{2}ft^2$ b) $S = (u + f)\,t$ c) $S = v^2 - 2fs$ d) None of these
45. The acceleration 'a' in m/s^2 of a particle is given by $a = 3t^2 + 2t + 2$ where t is the time. If the particle starts out with a velocity $u = 2m/s$ at $t = 0$, then the velocity at the end of 2 *seconds* is
a) 12 m/s b) 18 m/s c) 27 m/s d) 36 m/s
46. Two bodies are thrown simultaneously from a tower with same initial velocity v_0: one vertically upwards, the other vertically downwards. The distance between the two bodies after time t is
a) $2v_0t + \frac{1}{2}gt^2$ b) $2v_0t$ c) $v_0t + \frac{1}{2}gt^2$ d) v_0t
47. An aeroplane files 400 m north and 300 m south and then files 1200 m upwards then net displacement is
a) 1200 m b) 1300 m c) 1400 m d) 1500 m
48. The displacement of a particle undergoing rectilinear motion along the x-axis is given by $x = (2t^2 + 21t^2 + 60t + 6)$. The acceleration of the particle when its velocity is zero is
a) 36ms^{-2} b) 9ms^{-2} c) -9ms^{-2} d) -18ms^{-2}
49. A river is flowing from W to E with a speed of 5 m/min. A man can swim in still water with a velocity 10 m/min. In which direction should the man swim so as to take the shortest possible path to go to the south
a) 30° with downstream
b) 60° with downstream
c) 120° with downstream
d) South
50. The numerical ratio of displacement to the distance covered is always
a) Less than one b) Equal to one
c) Equal to or less than one d) Equal to or greater than one
51. From the top of tower, a stone is thrown up. It reaches the ground in t_1 second. A second stone thrown down with the same speed reaches the ground in t_2 second. A third stone released from rest reaches the ground in t_3 second. Then
a) $t_3 = \frac{(t_1 + t_2)}{2}$ b) $t_3 = \sqrt{t_1t_2}$ c) $\frac{1}{t_3} = \frac{1}{t_1} - \frac{1}{t_2}$ d) $t_3^2 = t_2^2 - t_1^2$
52. One car moving on a straight road covers one third of the distance with 20 km/hr and the rest with 60 km/hr. The average speed is
a) 40 km/hr b) 80 km/hr c) $46\frac{2}{3}$ km/hr d) 36 km/hr

53. A particle starts from rest, acceleration at 2 m/s^2 for 10 s and then goes with constant speed for 30 s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it

a) 750 m b) 800 m c) 700 m d) 850 m

54. Acceleration of a particle changes when

a) Direction of velocity changes
b) Magnitude of velocity changes
c) Both of above
d) Speed changes

55. A cat moves from X to Y with a uniform speed v_u and returns to X with a uniform speed v_d. The average speed for this ground trip is

a) $-\frac{2v_d v_u}{v_d + v_u}$ b) $\sqrt{v_u v_d}$ c) $\frac{v_d v_u}{v_d + v_u}$ d) $\frac{v_u + v_d}{2}$

56. A boat takes two hours to travel 8 km and back in still water. If the velocity of water 4 kmh^{-1}, the time taken for going ups tream 8km and coming back is

a) 2h
b) 2 h 40 min
c) 1 h 20 min
d) Cannot be estimated with the information given

57. A person travels along a straight road for the first half time with a velocity v_1 and the next half time with a velocity v_2

The mean velocity V of the man is

a) $\frac{2}{V} = \frac{1}{v_1} + \frac{1}{v_2}$ b) $V = \frac{v_1 + v_2}{2}$ c) $V = \sqrt{v_1 v_2}$ d) $V = \sqrt{\frac{v_1}{v_2}}$

58. A particle is projected with velocity v_0 along $x - axis$.The deceleration on the particle is proportional to the square of the distance from the origin i.e., $a = -\alpha x^2$.The distance at which the particle stops is

a) $\sqrt{\frac{3v_0}{2\alpha}}$ b) $\left(\frac{3v_0}{2\alpha}\right)^{\frac{1}{3}}$ c) $\sqrt{\frac{3v_0^2}{2\alpha}}$ d) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$

59. Two balls are dropped to the ground from different heights. One ball is dropped 2 s after the other but they both strike the ground at the same time. If the first ball takes 5 s to reach the ground, then the difference in initial heights is ($g = 10\ ms^{-2}$)

a) 20 m b) 80 m c) 170 m d) 40 m

60. A body starts from origin and moves along x-axis such that at any instant velocity is $v_t = 4t^3 - 2t$ where t is in second and v_t in ms^{-1}. The acceleration of the particle when it is 2m from the origin is

a) $28ms^{-2}$ b) $22ms^{-2}$ c) $12ms^{-2}$ d) $10ms^{-2}$

61. A truck and a car are moving with equal velocity. On applying the brakes both will stop after certain distance, then

a) Truck will cover less distance before rest
b) Car will cover less distance before rest
c) Both will cover equal distance
d) None

62. A body freely falling from the rest has a velocity 'v' after it falls through a height 'h'.

The distance it has to fall down for its velocity to become double, is

a) $2h$ b) $4h$ c) $6h$ d) $8h$

63. Two trains travelling on the same track are approaching each other with equal speeds of $40 m/s$. The drivers of the trains begin to decelerate simultaneously when they are just $2.0 km$ apart. Assuming the decelerations to be uniform and equal, the value of the deceleration to barely avoid collision should be

a) 11.8 m/s^2 b) 11.0 m/s^2 c) 2.1 m/s^2 d) 0.8 m/s^2

64. The numerical ratio of displacement to the distance covered is always

a) Less than one
b) Equal to one
c) Equal to or less than one
d) Equal to or greater than one

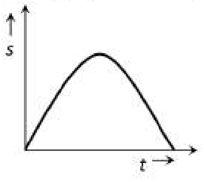
65. A student is standing at a distance of 50 m from the bus. As soon as the bus begins its motion with an acceleration of 1 ms^{-2}, the students starts running towards the bus with a uniform velocity u. Assuming the motion to be along a straight road, the minimum value of u, so that the student is able to catch the bus is

a) 8 ms^{-1} b) 5 ms^{-1} c) 12 ms^{-1} d) 10 ms^{-1}

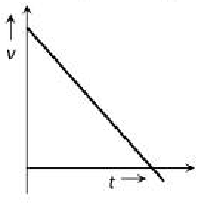
66. A cat moves from X to Y with a uniform speed v_u and returns to X with a uniform speed v_d. The average speed for this ground trip is

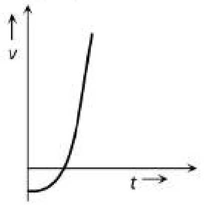
a) $-\frac{2v_d v_u}{v_d + v_u}$ b) $\sqrt{v_u v_d}$ c) $\frac{v_d v_u}{v_d + v_u}$ d) $\frac{v_u + v_d}{2}$

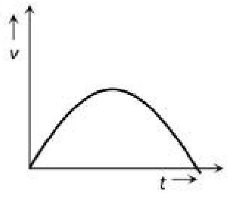
67. The graph of displacement v/s time is

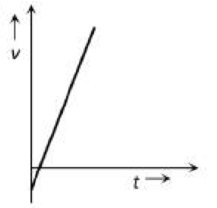


Its corresponding velocity-time graph will be

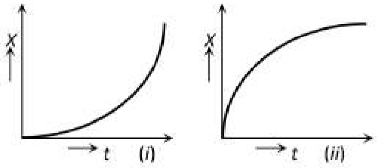
a) 

b) 

c) 

d) 

68. Figures (i) and (ii) below show the displacement-time graphs of two particles moving along the x-axis. We can say that



a) Both the particles are having a uniformly accelerated motion

b) Both the particles are having a uniformly retarded motion

c) Particle (i) is having a uniformly accelerated motion while particle (ii) is having a uniformly retarded motion

d) Particle (i) is having a uniformly retarded motion while particle (ii) is having a uniformly accelerated motion

69. Consider the acceleration, velocity and displacement of a tennis ball as it falls to the ground and bounces back. Directions of which of these changes in the process

a) Velocity only b) Displacement and velocity

c) Acceleration, velocity and displacement d) Displacement and acceleration

70. A lift in which a man is standing, is moving upward with a speed of $10 ms^{-1}$. The man drops a coin from a height of 4.9m and if $g = 9.8 ms^{-2}$, then the coin reaches the floor of the lift after a time

a) $\sqrt{2}$s b) 1 s c) $\frac{1}{2}$ s d) $\frac{1}{\sqrt{3}}$ s

71. Two balls are dropped to the ground from different heights. One ball is dropped $2s$ after the other but they both strike the ground at the same time. If the first ball takes $5s$ to reach the ground, then the difference in initial heights is $(g = 10\ ms^{-2})$

a) $20m$ b) $80m$ c) $170m$ d) $40m$

72. The displacement of a particle starting from rest $(at\ t = 0)$ is given by $s = 6t^2 - t^3$. The time in seconds at which the particle will attain zero velocity again, is

a) 2 b) 4 c) 6 d) 8

73. A body falls from rest in the gravitational field of the earth. The distance travelled in the fifth second of its motion is $(g = 10\ m/s^2)$

a) $25m$ b) $45m$ c) $90m$ d) $125m$

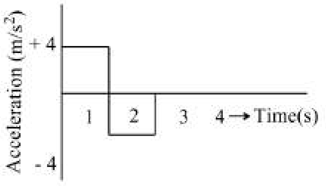
74. A body is moving with uniform acceleration covers 200 m in the first 2 s and 220 m in the next 4 s. find the velocity in ms^{-1} after 7 s.

a) 10 b) 15 c) 20 d) 30

75. A ball is dropped on the floor from a height of 10m. It rebounds to a height of 2.5m. If the ball is in contact with the floor for 0.01 s, the average acceleration during contact is nearly [Take $g = 10ms^{-2}$]
a) $500\sqrt{2}\ ms^{-2}$upwards b) $1800\ ms^{-2}$downwards
c) $1500\sqrt{5}\ ms^{-2}$upwards d) $1500\sqrt{2}\ ms^{-2}$downwards

76. A ball is thrown vertically upwards with an initial velocity $1.4\ ms^{-1}$ returns in 2 s. The total displacement of the ball will be
a) 22.4 m b) Zero c) 33.6 d) 44.8 m

77. A particle starts from rest at $t = 0$ and moves in a straight line with an acceleration as shown below. The velocity of the particle at $t = 3s$ is



a) $2\ ms^{-1}$ b) $4\ ms^{-1}$ c) $6\ ms^{-1}$ d) $8\ ms^{-1}$

78. A bus begins to move with an acceleration of $1ms^{-2}$. A man who is $48m$ behind the bus starts running at $10\ ms^{-1}$ to catch the bus. The man will be able to catch the bus after
a) $6s$ b) $5s$ c) $3s$ d) $8s$

79. A truck and a car are moving with equal velocity. On applying the brakes both will stop after certain distance, then
a) Truck will cover less distance before rest b) Car will cover less distance before rest
c) Both will cover equal distance d) None

80. Velocity of a body on reaching the point from which it was projected upwards, is
a) $v = 0$ b) $v = 2u$ c) $v = 0.5u$ d) $v = u$

81. A train is moving slowly on a straight track with a constant speed of $2\ ms^{-1}$. A passenger in that train starts walking at a steady aped of a $2\ ms^{-1}$ to the back of the train in the opposite direction of the motion of the train. So to an observer standing on the platform directly in front of that passenger. The velocity of the passenger appears to be
a) $4\ ms^{-1}$ b) $2\ ms^{-1}$
c) $2\ ms^{-1}$ in the opposite direction of the train d) Zero

82. A body starting from rest moves with constant acceleration. The ratio of distance covered by the body during the 5^{th} *sec* to that covered in 5 *sec* is
a) 9/15 b) 3/5 c) 25/9 d) 1/25

83. An object start sliding on a frictionless inclined plane and from same height another object start falling freely
a) Both will reach with same speed b) Both will reach with the same acceleration
c) Both will reach in same time d) None of above

84. A car moving with speed of 40 km/h can be stopped by applying brakes after atleast 2 m. If the same car is moving with a speed of 80 km/h, what is the minimum stopping distance
a) 8 m b) 2 m c) 4 m d) 6 m

85. The position x of a particle varies with time t as $x = at^2 - bt^3$. The acceleration of the particle will be zero at time t equal to
a) $\frac{a}{b}$ b) $\frac{2a}{3b}$ c) $\frac{a}{3b}$ d) Zero

86. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by $x = 40 + 12t - t^3$
How long would the particle travel before coming to rest
a) 24 m b) 40 m c) 56 m d) 16 m

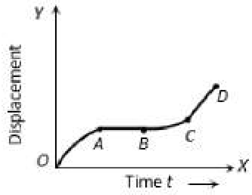
87. A stone dropped from a balloon which is at a height h, reaches the ground after t second. From the same balloon, if two stones are thrown, one upwards and the other downwards, with the same velocity u and they reach the ground after t_1 and t_2 second respectively, then

a) $t = t_1 - t_2$ b) $t = \frac{t_1 + t_2}{2}$ c) $t = \sqrt{t_1 t_2}$ d) $t = \sqrt{t_1^2 - t_2^2}$

88. The acceleration of a particle increases linearly with time t as $6t$. If the initial velocity of the particle is zero and the particle starts from the origin, then the distance travelled by the particle in time t will be

a) t b) t^2 c) t^3 d) t^4

89. The graph between the displacement x and t for a particle moving in a straight line is shown in figure. During the interval OA, AB, BC and CD, the acceleration of the particle is



OA, AB, BC, CD

a) + 0 + +

b) - 0 + 0

c) + 0 - +

d) - 0 - 0

90. The distance travelled by a particle is proportional to the square of time, then the particle travels with

a) Uniform acceleration b) Uniform velocity

c) Increasing acceleration d) Decreasing velocity

91. Two balls A and B of same masses are thrown from the top of the building. A, thrown upward with velocity V and B, thrown downward with velocity V, then

a) Velocity of A is more than B at the ground b) Velocity of B is more than A at the ground

c) Both A & B strike the ground with same velocity d) None of these

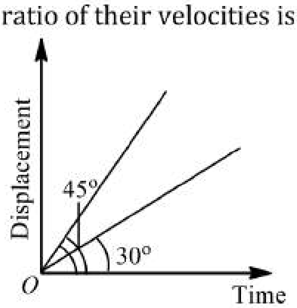
92. A man drops a ball downside from the roof of a tower of height 400 m. At the same time another ball is thrown upside with a velocity 50 m/s. From the surface of the tower, then they will meet at which height from the surface of the tower

a) 100 m b) 320 m c) 80 m d) 240 m

93. If the velocity of particle is given by $v = (180 - 16x)^{1/2}\ m/s$, then its acceleration will be

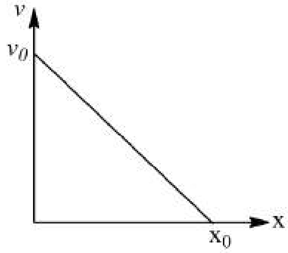
a) Zero b) 8 m/s^2 c) $-8\ m/s^2$ d) 4 m/s^2

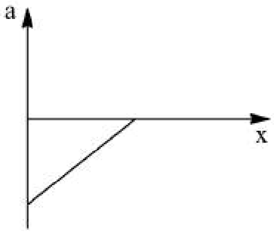
94. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x –axis. The ratio of their velocities is

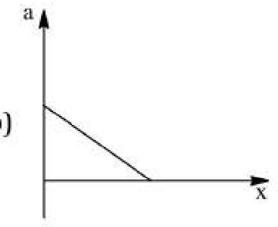


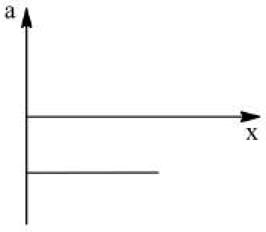
a) $1 : \sqrt{3}$ b) $1 : 2$ c) $1 : 1$ d) $\sqrt{3} : 2$

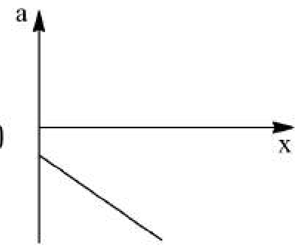
95. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement?



a) 

b) 

c) 

d) 

96. A balloon starts rising from the ground with an acceleration of 1.25 m/s^2 after 8s, a stone is released from the balloon. The stone will ($g - 10\ m/s^2$)

a) Reach the ground in 4 second
b) Begin to move down after being released
c) Have a displacement of 50 m
d) Cover a distance of 40 m in reaching the ground

97. In a race for 100m dash, the first and the second runners have a gap of one metre at the mid way stage. Assuming the first runner goes steady, by what percentage should the second runner increases his speed just to win the race.

a) 2%
b) 4%
c) More than 4%
d) Less than 4%

98. The driver of a car moving with a speed of 10ms^{-1} sees a red light ahead, applies breaks and stops after covering 10m distance. If the same car were moving with a speed of 20 ms^{-2}, the same driver would have stopped the car after covering 30 m distance. Within what distance the car can be stopped if travelling with a velocity of 15ms^{-1}? Assume the same reaction time and the same deceleration in each case.

a) 18.75 m
b) 20.75 m
c) 22.75 m
d) 25 m

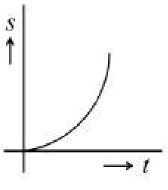
99. A particle has an initial velocity $3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}$ and an acceleration of $0.4\hat{\mathbf{i}} + 0.3\hat{\mathbf{j}}$. Its speed after 10 s is

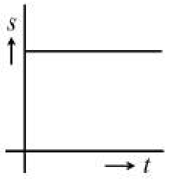
a) 10 unit
b) 7 unit
c) $7\sqrt{2}$unit
d) 8.5 unit

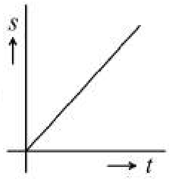
100. A particle moving in a straight line covers half the distance with speed of 3 m/s. The other half of the distance is covered in two equal time intervals with speed of 4.5 m/s and 7.5 m/s respectively. The average speed of the particle during the motion is

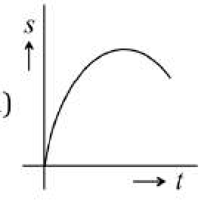
a) 4.0 m/s
b) 5.0 m/s
c) 5.5 m/s
d) 4.8 m/s

101. A body is travelling in a straight line with a uniformly increasing speed. Which one of the plot represents the changes in distance (s) travelled with time (t)

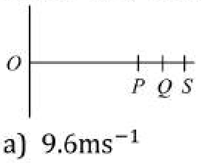
a) 

b) 

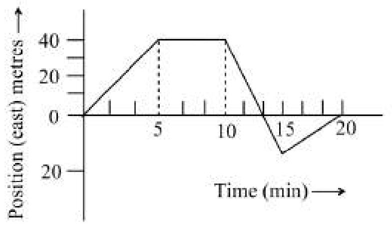
c) 

d) 

102. A stone is shot straight upward with a speed of 20 m/sec from a tower 200 m high. The speed with which it strikes the ground is approximately
a) 60 m/sec b) 65 m/sec c) 70 m/sec d) 75 m/sec
103. A stone dropped from of the tower touches the ground in 4 sec. The height of the tower is aboout
a) 80 m b) 40 m c) 20 m d) 160 m
104. A wheel of radius 1 m rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of wheel initially in contact with the ground is
a) 2π
b) $\sqrt{2}\pi$
c) $\sqrt{\pi^2+4}$
d) π
105. Two stones of equal masses are dropped from a rooftop of height h one after another. Their separation distance against time will
a) Remain the same b) Increase c) Decrease d) Be zero
106. If the velocity of a particle is $(10+2t^2)m/s$, then the average acceleration of the particle between $2s$ and $5s$ is
a) $2m/s^2$ b) $4m/s^2$ c) $12m/s^2$ d) $14m/s^2$
107. A train of 150 m length is going towards north direction at a speed of $10m/\text{sec}$. A parrot flies at the speed of 5 m/sec towards south direction parallel to the railway track. The time taken by the parrot to cross the train is
a) 12 sec b) 8 sec c) 15 sec d) 10 sec
108. The engine of motorcycle can produce a maximum acceleration 5 m/s^2. Its brakes can produce a maximum retardation 10 m/s^2. What is the minimum time in which it can over a distance of 1.5 km
a) 30 sec b) 15 sec c) 10 sec d) 5 sec
109. A stone dropped from of the tower touches the ground in 4 sec. The height of the tower is aboout
a) 80 m b) 40 m c) 20 m d) 160 m
110. A police jeep is chasing with velocity of 45 km/h a thief in another jeep moving with velocity 153 km/h. Police fires a bullet with muzzle velocity of 180 m/s. The velocity with which it will strike the car of the thief is
a) 150 m/s b) 27 m/s c) 450 m/s d) 250 m/s
111. A body having uniform acceleration of 10ms^{-2} has a velocity of 100ms^{-1}. In what time, the velocity will be doubled?
a) 8 s b) 10 s c) 12 s d) 14 s
112. A bullet is fired with a speed of 1000 m/sec in order to hit a target 100 m away. If $g=10\ m/s^2$, the gun should be aimed
a) Directly towards the target b) 5 cm above the target
c) 10 cm above the target d) 15 cm above the target
113. A particle is moving with uniform acceleration along a straight line. The average velocity of the particle from P to Q is 8ms^{-1} and that from Q to S is 12ms^{-1}. If $QS-PQ$, then the average velocity from P to S is

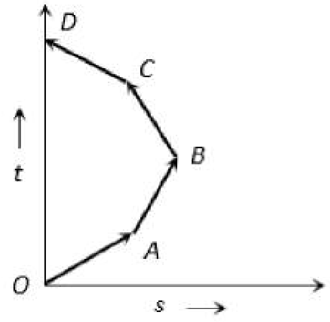


a) 9.6ms^{-1} b) $12.87\ \text{ms}^{-1}$ c) $64\ \text{ms}^{-1}$ d) $327\ \text{ms}^{-1}$
114. The displacement of a body is given by $2s=gt^2$, where g is a constant. The velocity of the body at any time t is
a) gt b) $\frac{gt}{2}$ c) $\frac{gt^2}{2}$ d) $\frac{gt^3}{2}$
115. A body begins to walk eastward along a street in front of his house and the graph of his position from home is shown in the following figure. His average speed for the whole time interval is equal to



a) 8 m/min b) 6 m/min c) $\frac{8}{3}$ m/min d) 2 m/min

116. Which of the following options is correct for the object having a straight line motion represented by the following graph



a) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity
b) Velocity of the object increases uniformly
c) Average velocity is zero
d) The graph shown is impossible

117. A ball which is at rest is dropped from a height h metre. As it bounces off the floor its speed is 80% of what it was just before touching the ground. The ball then rise to nearly a height
a) 0.94 h b) 0.80 h c) 0.75 h d) 0.64 h

118. A point starts moving in a straight line with a certain acceleration. At a time t after beginning of motion the acceleration suddenly becomes retardation of the same value. The time in which the point returns to the initial point is
a) $\sqrt{2t}$ b) $(2+\sqrt{2})t$
c) $\frac{t}{\sqrt{2}}$ d) Cannot be predicted unless acceleration is given

119. An elevator car, whose floor to ceiling distance is equal to $2.7m$, starts ascending with constant acceleration of $1.2ms^{-2}$. 2 sec after the start, a bolt begins falling from the ceiling of the car. The free fall time of the bolt is
a) $\sqrt{0.54}s$ b) $\sqrt{6}\,s$ c) 0.7 s d) 1 s

120. A man walks on a straight road from his home to a market 2.5 km away with a speed of 5 km/h. Finding the market closed, he instantly turns and walks back home with a speed of 7.5 km/h. The average speed of the man over the interval of time 0 to 40 min. Is equal to
a) 5 km/h b) $\frac{25}{4}$ km/h c) $\frac{30}{4}$ km/h d) $\frac{45}{8}$ km/h

121. A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after traversing $4cm$ inside it. What velocity is needed for travelling distance of $9cm$ in same block
a) 100 cm/s b) $136.2cm/s$ c) $300cm/s$ d) 250 cm/s

122. The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time $(t = 1) is$
a) $v_0 = 2g + 3f$ b) $v_0 + g/2 + f/3$ c) $v_0 + g + f$ d) $v_0 + g/2 + f$

123. A car accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β and comes to rest. If the total time elapsed is t, then the maximum velocity acquired by the car is

a) $\left(\frac{\alpha t+\beta^2}{\alpha\beta}\right)t$ b) $\left(\frac{\alpha^2-\beta^2}{\alpha\beta}\right)t$ c) $\frac{(\alpha+\beta)t}{\alpha\beta}$ d) $\frac{\alpha\beta t}{\alpha+\beta}$

124. The x and y coordinates of a particles at any time t are given by $x = 7t + 4t^2$ and $y = 5t$, where x and y are in metre and t in second. The acceleration of particle at $t = 5$s is

a) Zero b) 8ms^{-2} c) 20 ms^{-2} d) 40 ms^{-2}

125. A car moves from X to Y with a uniform speed v_u and returns to Y with a uniform speed v_d. The average speed for this round trip is

a) $\frac{2v_d v_u}{v_d+v_u}$ b) $\sqrt{v_u v_d}$ c) $\frac{v_d v_u}{v_d+v_u}$ d) $\frac{v_u+v_d}{2}$

126. An automobile in travelling at 50 kmh^{-1}, can be stopped at a distance of 40 m by applying brakes. If the same automobile is travelling at 90 kmh^{-1}, all other conditions remaining same and assuming no skidding, the minimum stopping distance in metre is

a) 72 b) 92.5 c) 102.6 d) 129.6

127. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 *seconds* is S_1 and that covered in the first 20 *seconds* is S_2, then

a) $S_2 = 2S_1$ b) $S_2 = 3S_1$ c) $S_2 = 4S_1$ d) $S_2 = S_1$

128. An object moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{dv}{dt} = 2.5\sqrt{v}$ where v is the instantaneous speed. The time taken by the object, to come to rest would be

a) 1s b) 2s c) 4s d) 8s

129. A body A moves with a uniform acceleration a and zero initial velocity. Another body B, starts from the same point moves in the same direction with a constant velocity v. The two bodies meet after a time t. The value of t is

a) $\frac{2v}{a}$ b) $\frac{v}{a}$ c) $\frac{v}{2a}$ d) $\sqrt{\frac{v}{2a}}$

130. Two spheres of same size, one of mas 2 kg and another of mass 4 kg, are dropped simultaneously from the top of Qutub Minar (height = 72m). When they are 1 m above the ground, the two spheres have the same

a) Momentum b) Kinetic energy c) Potential energy d) Acceleration

131. A body of mass 10 kg is moving with a constant velocity of 10 ms^{-1}. When a constant force acts for 4 s on it, it moves with velocity 2 ms^{-1} in the opposite direction. The acceleration produced in it is

a) 3 ms^{-2} b) −3 ms^{-2} c) 0.3 ms^{-2} d) −0.3 ms^{-2}

132. The velocity of a body depends on time according to the equation $v = 20 + 0.1t^2$. The body is undergoing

a) Uniform acceleration b) Uniform retardation

c) Non-uniform acceleration d) Zero acceleration

133. Two balls of same size but the density of one is greater than that of the other are dropped from the same height, then which ball will reach the earth first (air resistance is negligible)

a) Heavy ball b) Light ball

c) Both simultaneously d) Will depend upon the density of the balls

134. A body thrown vertically upwards with an initial velocity u reaches maximum height in 6 seconds. The ratio of the distances travelled by the body in the first second and the seventh second is

a) 1 : 1 b) 11 : 1 c) 1 : 2 d) 1 : 11

135. The motion of a particle is described by the equation $x = a + bt^2$ where $a = 15$ cm and $b = 3$ cm/s^2.Its instantaneous velocity at time 3 sec will be

a) 36 cm/sec b) 18 cm/sec c) 16 cm/sec d) 32 cm/sec

136. A man throws a ball vertically upward and it rises through 20 m and returns to his hands. What was the initial velocity (u) of the ball and for how much time (T) it remained in the air [$g = 10m/s^2$]

a) $u = 10m/s, T = 2s$ b) $u = 10m/s, T = 4s$ c) $u = 20m/s, T = 2s$ d) $u = 20m/s, T = 4s$

137. A stone dropped from a building of height h and it reaches after t seconds on earth. From the same building if two stones are thrown (one upwards and other downwards) with the same velocity u and they reach the earth surface after t_1 and t_2 seconds respectively, then

a) $t = t_1 - t_2$ b) $t = \frac{t_1 + t_2}{2}$ c) $t = \sqrt{t_1 t_2}$ d) $t = t_1^2 t_2^2$

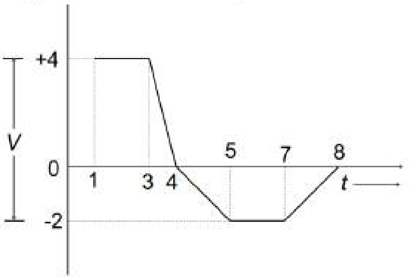
138. The relation $3t = \sqrt{3x} + 6$ describes the displacement of a particle in one direction where x is in *metres* and t in sec. The displacement, when velocity is zero, is

a) 24 *metres* b) 12 *metres* c) 5 *metres* d) Zero

139. A body of mass m moving along a straight line covers half the distance with a speed of 2ms^{-1}. The remaining half of distance is covered in two equal time intervals with a speed of 3 ms^{-1} and 5 ms^{-1} respectively. The average speed of the particle for the entire journey is

a) $\frac{3}{8} \text{ms}^{-1}$ b) $\frac{8}{3} \text{ms}^{-1}$ c) $\frac{4}{3} \text{ms}^{-1}$ d) $\frac{16}{3} \text{ms}^{-1}$

140. The velocity-time graph of a particle in linear motion is shown. Both v and t are in SI units. What is the displacement of the particle from the origin after 8 s?

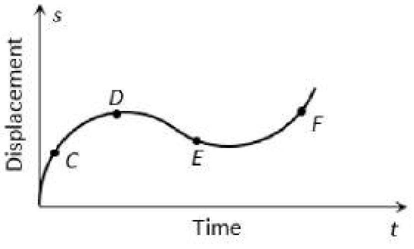


a) 6m b) 8m c) 16m d) 18m

141. The distance travelled by an object along a straight line in time t is given by $s = 3 - 4t + 5t^2$, the initial velocity of the object is

a) 3 unit b) -3 unit c) 4 unit d) -4 unit

142. The displacement-time graph of moving particle is shown below



The instantaneous velocity of the particle is negative at the point

a) D b) F c) C d) E

143. Spotting a police car, you brake a parsche from a speed of 100kmh^{-1} to a speed of 80.0 kmh^{-1} during a displacement of 88.0m, at a constant acceleration. What is the acceleration?

a) -2.5ms^{-2} b) 1.58 ms^{-2} c) -1.58ms^{-2} d) 2.5 ms^{-2}

144. An aircraft is flying at a height of $34000m$ above the ground. If the angle subtended at a ground observation point by the aircraft positions $10s$ apart is $30°$, then the speed of the aircraft is

a) $19.63 ms^{-1}$ b) $1963 \ ms^{-1}$ c) $108 \ ms^{-1}$ d) $196.3 \ ms^{-1}$

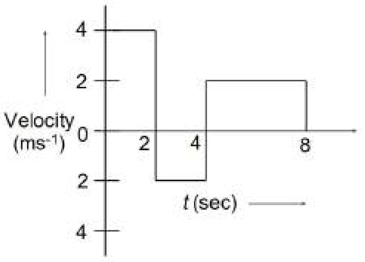
145. A particle is projected up with an initial velocity of $80 \ ft/sec$. The ball will be at a height of $96 \ ft$ from the ground after

a) 2.0 and 3.0 *sec* b) Only at 3.0 *sec* c) Only at 2.0 *sec* d) After 1 and 2 *sec*

146. A ball A is thrown up vertically with speed u and at the same instant another ball B is released from a height h. At time t, the speed of A relative to B is

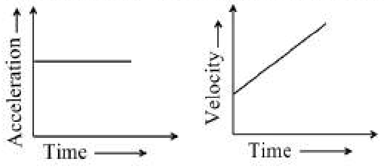
a) u b) $2u$ c) $u - gt$ d) $\sqrt{(u^2 - gt)}$

147. A body is moving in a straight line a shown in velocity-time graph. The displacement and distance travelled by in 8s are respectively

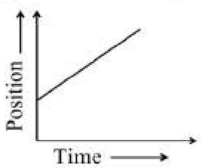


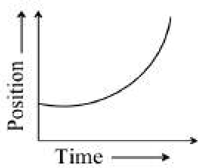
a) 12 m, 20 m b) 20m, 12 m c) 12 m, 12 m d) 20 m, 20 m

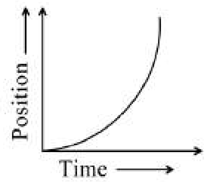
148. The velocity-time and acceleration-time graphs of a particle are given as

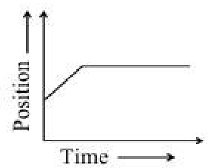


Its position-time graph may be given as

a) 

b) 

c) 

d) 

149. A stone thrown upward with a speed u from the top of the tower reaches the ground with a velocity $3u$. The height of the tower is

a) $3u^2/g$ b) $4u^2/g$ c) $6u^2/g$ d) $9u^2/g$

150. A particle is projected with velocity v_0 along $x - axis$.The deceleration on the particle is proportional to the square of the distance from the origin i.e., $a = -ax^2$.The distance at which the particle stops is

a) $\sqrt{\frac{3v_0}{2\alpha}}$ b) $\left(\frac{3v_0}{2\alpha}\right)^{\frac{1}{3}}$ c) $\sqrt{\frac{3v_0^2}{2\alpha}}$ d) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$

151. A ball is thrown vertically upwards with a velocity of 25 ms^{-1} from the top of a tower of height 30 m. How long will it travel before it hits ground?

a) 6 s b) 5 s c) 4 s d) 12 s

152. The motion of a particle along a straight line is described by equation :

$x = 8 + 12t - t^3$

Where x is in metre and t in second. The retardation of the particle when its velocity becomes zero, is

a) $24ms^{-2}$ b) Zero c) $6ms^{-2}$ d) $12ms^{-2}$

153. A particle starting from rest falls from a certain height. Assuming that the value of acceleration due to gravity remains the same throughout motion, its displacement in three successive half second intervals are S_1 , S_2, S_3.

Then,

a) $S_1{:}S_2{:}S_3{:}\ 1{:}5{:}9$ b) $S_1{:}S_2{:}S_3{:}\ 1{:}2{:}3$ c) $S_1{:}S_2{:}S_3{:}\ 1{:}1{:}1$ d) $S_1{:}S_2{:}S_3{:}\ 1{:}3{:}5$

154. Two bodies are thrown simultaneously from a tower with same initial velocity v_0: one vertically upwards, the other vertically downwards. The distance between the two bodies after time t is

a) $2v_0t + \frac{1}{2}gt^2$ b) $2v_0t$ c) $v_0t + \frac{1}{2}gt^2$ d) v_0t

155. An aeroplane files 400 m north and 300 m south and then files 1200 m upwards then net displacement is

a) 1200 m b) 1300 m c) 1400 m d) 1500 m

156. A particle moving in a straight line with uniform acceleration is observed to be a distance a from a fixed point initially. It is at distances b, c, d from the same point after $n, 2n, 3n$ second. The acceleration of the particle is

a) $\frac{c - 2b + a}{n^2}$ b) $\frac{c + b + a}{9n^2}$ c) $\frac{c + 2b + a}{4n^2}$ d) $\frac{c - b + a}{n^2}$

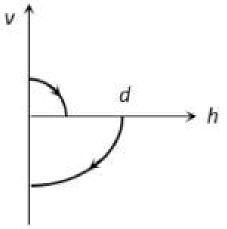
157. The three initial and final position of a man on the x −axis are given as

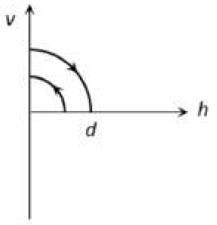
(i) $(-8m, 7m)$ (ii) $(7m, -3m)$ and (iii) $(-7m, 3m)$

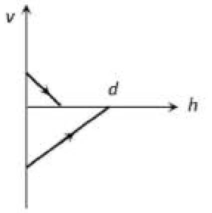
Which pair gives the negative displacement

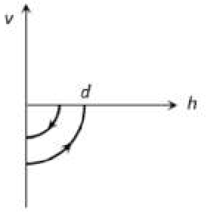
a) (i) b) (ii) c) (iii) d) (i) and (iii)

158. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as

a) 

b) 

c) 

d) 

159. The displacement of a particle is given by $y = a + bt + ct^2 - dt^4$. The initial velocity and acceleration are respectively

a) $b, -4d$ b) $-b, 2c$ c) $b, 2c$ d) $2c, -4d$

160. Four marbles are dropped from the top of a tower one after the other with an interval of one second. The first one reaches the ground 4 seconds. When the first one reaches the ground the distances between the first and second, the second and third and the third and forth will be respectively

a) 35,25 and 15 m b) 30,20 and 10 m c) 20,10 and 5 m d) 40,30 and 20 m

161. A body starts from rest. What is the ratio of the distance travelled by the body during the 4th and 3rd second

a) $\frac{7}{5}$ b) $\frac{5}{7}$ c) $\frac{7}{3}$ d) $\frac{3}{7}$

162. A boat crosses a river from port A to port B, which are just on the opposite side. The speed of the water is V_W and that of boat is V_B relative to still water. Assume $V_B = 2V_W$. What is the time taken by the boat, if It has to cross the river directly on the AB line

a) $\frac{2D}{V_B\sqrt{3}}$ b) $\frac{\sqrt{3}D}{2V_B}$ c) $\frac{D}{V_B\sqrt{2}}$ d) $\frac{D\sqrt{2}}{V_B}$

163. Two cars A and B are travelling in the same direction with velocities v_1 and $v_2 (v_1 > v_2)$. When the car A is at a distance d behind the car B, the driver of the car A applies the brake producing uniform retardation, a. There will be no collision when

a) $d < \left(\frac{v_1 - v_2}{2a}\right)$ b) $d > \frac{v_1^2 - v_2^2}{2a}$ c) $d > \frac{(v_1 - v_2)^2}{2a}$ d) $d < \frac{v_1^2 - v_2^2}{2a}$

164. A bird flies for 4 s with a velocity of $|t - 2| m/s$ in a straight line, where t is time in seconds. It covers a distance of

a) 2 m b) 4 m c) 6 m d) 8 m

165. If a body loses half of its velocity on penetrating 3 cm in a wooden block, then how much will it penetrate more before coming to rest?

a) 1 cm b) 2 cm c) 3 cm d) 4 cm

166. A body, thrown upwards with some velocity, reaches the maximum height of 20m. Another body with double the mass thrown up, with double initial velocity will reach a maximum height of

a) 200 m b) 16 m c) 80 m d) 40 m

167. A bullet comes out of the barrel of gun of length 2m with a speed 80 ms^{-1}. The average acceleration of the bullet is

a) 1.6 ms^{-2} b) 160 ms^{-2} c) 1600 ms^{-2} d) 16 ms^{-2}

168. The position of a particle moving along x-axis at certain times is given below:

$t(s)$	0	1	2	3
$x(m)$	-2	0	6	16

Which of the following describes the motion correctly

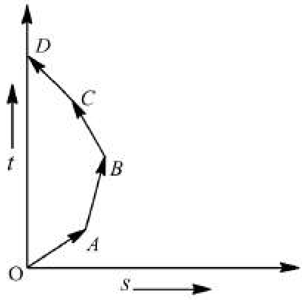
a) Uniform accelerated

b) Uniform decelerated

c) Non-uniform accelerated

d) There is not enough data for generalization

169. Which of the following options is correct for the object having a straight line motion represented by the following graph?



a) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity.

b) Velocity of the object increases uniformly

c) Average velocity is zero

d) The graph shown is impossible

170. A body dropped from top of a tower fall through 60 m during the last two second of its fall. The height of tower is ($g = 10\ ms^{-2}$)

a) 95 m b) 60 m c) 80 m d) 90 m

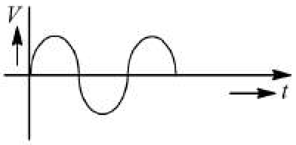
171. A stone is allowed to fall from the top of a tower 100m high and at the same time another stone is projected vertically upwards from the ground with a velocity of 254ms^{-1}. The two stones will meet after

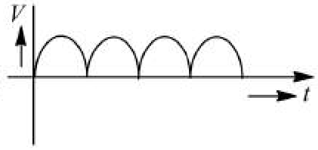
a) 4 s b) 0.4 s c) 0.04 s d) 40 s

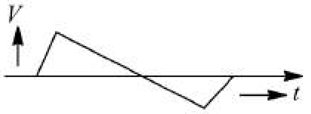
172. Speed of two identical cars u and $4u$ at a specific instant. The ratio of the respective distances in which the two cars are stopped from that instant is

a) 1: 1 b) 1: 4 c) 1: 8 d) 1: 16

173. Which of the following speed-time graphs exist in the nature?

a) 

b) 

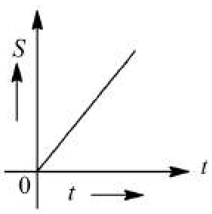
c) 

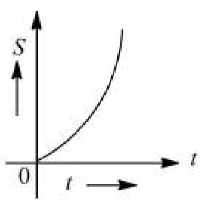
d) All of the above

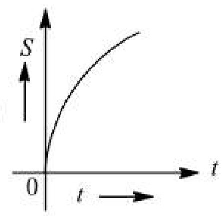
174. The motion of a particle along a straight line is described by equation :
$x = 8 + 12t - t^3$
Where x is in metre and t in second. The retardation of the particle when its velocity becomes zero, is
a) $24 ms^{-2}$ b) Zero c) $6 ms^{-2}$ d) $12 ms^{-2}$

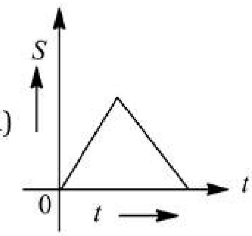
175. If a train travelling at 72 $kmph$ is to be brought to rest in a distance of 200 metres, then its retardation should be
a) $20\ ms^{-2}$ b) $10\ ms^{-2}$ c) $2\ ms^{-2}$ d) $1 ms^{-2}$

176. From a high tower at time $t = 0$, one stone is dropped from rest and simultaneously another stone is projected vertically up with an initial velocity. The graph of the distance S between the two stones, before either his the ground, plotted against time t will be as

a) 

b) 

c) 

d) 

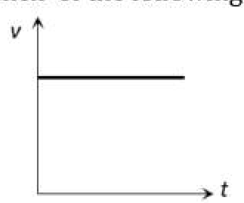
177. Rain drops fall vertically at a speed of $20 ms^{-1}$. At what angle do they fall on the wind screen of a car moving with a velocity of $15 ms^{-1}$, if the wind screen velocity inclined at an angle of 23° to the vertical? $\left(\cot^{-1}\left[\frac{4}{3}\right] \approx 36°\right)$
a) 60° b) 30° c) 45° d) 90°

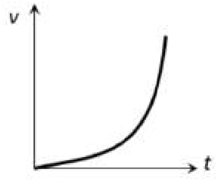
178. Two trains travelling on the same track are approaching each other with equal speeds of $40 ms^{-1}$. The drivers of the trains begin to decelerate simultaneously when they are just 2 km apart. If the decelerations are both uniform and equal, then the value of deceleration to barely avoid collision should be
a) $0.8 ms^{-2}$ b) $2.1\ ms^{-2}$ c) $11.0\ ms^{-2}$ d) $13.2\ ms^{-2}$

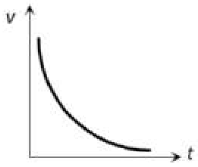
179. A ball of mass m_1 and another ball of mass m_2 are dropped from equal height. If time taken by the balls are t_1 and t_2 respectively, then
a) $t_1 = \frac{t_2}{2}$ b) $t_1 = t_2$ c) $t_1 = 4t_2$ d) $t_1 = \frac{t_2}{4}$

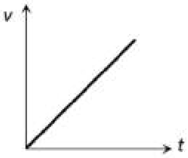
180. A particle moves along a straight line OX. At a time t (in seconds) the distance x (in metres) of the particle from O is given by $x = 40 + 12t - t^3$
How long would the particle travel before coming to rest
a) 24 m b) 40 m c) 56 m d) 16 m

181. Which of the following velocity-time graphs represent uniform motion

a) 

b) 

c) 

d) 

182. The distance-time graphs of a particle at time t makes angle $45°$ with the time axis. After two seconds, it makes an angle $60°$ with the time axis. What is the average acceleration of the particle?

a) $1/2$ b) $\sqrt{3}/2$ c) $(\sqrt{3}-1)/2$ d) $(\sqrt{3}+1)/2$

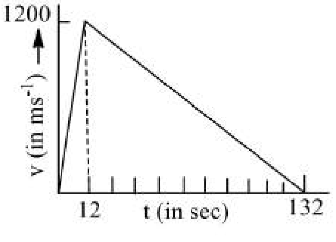
183. A scooterist sees a bus 1 km ahead of him moving with a velocity of $10\ ms^{-1}$. With what speed the scooterist should move so as to overtake the bus in 100 s?

a) $10\ ms^{-1}$ b) $15\ ms^{-1}$ c) $20\ ms^{-1}$ d) $17\ ms^{-1}$

184. A particle has initial velocity $(2\hat{\imath}+3\hat{\jmath})$ and acceleration $(0.3\hat{\imath}+0.2\hat{\jmath})$. The magnitude of velocity after 10 seconds will be

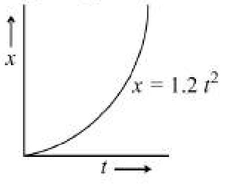
a) $9\sqrt{2}$ units b) $5\sqrt{2}$ units c) 5 units d) 9 units

185. A rocket is fired upwards. Its engine explodes fully is 12s. The height reached by the rocket as calculated from its velocity-time graph is



a) 1200×60m b) 1200×132m c) $\frac{1200}{12}$ m d) 1200×12^2m

186. Figure given shows the distance –time graph of the motion of a car. It follows from the graph that the car is

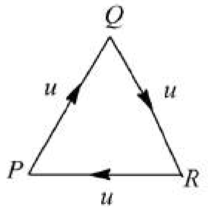


a) At rest b) In uniform motion
c) In non-uniform acceleration d) Uniformly accelerated

187. An object start sliding on a frictionless inclined plane and from same height another object start falling freely

a) Both will reach with same speed b) Both will reach with the same acceleration
c) Both will reach in same time d) None of above

188. Three persons P, Q and R of same mass travel with same speed u such that each one faces the other always. After how much time will they meet each other?



a) d/u sec b) $2d/3u$ sec c) $2d/\sqrt{(3)}u$ sec d) $d/\sqrt{3u}$ sec

189. A body is released from the top of a tower of height h. It takes t sec to reach the ground. Where will be the ball after time $t/2$ sec
a) At $h/2$ from the ground
b) At $h/4$ from the ground
c) Depends upon mass and volume of the body
d) At $3h/4$ from the ground

190. You drive a car at seed of 70 km/hr in a straight road for 8.4 km, and then the car runs out of petrol. You walk for 30 min to reach a petrol pump at a distance of 2 km. The average velocity from the beginning of your drive till you reach the petrol pump is
a) 16.8 km/hr b) 35 km/hr c) 64 km/hr d) 18.6 km/hr

191. A ball P is dropped vertically and another ball Q is thrown horizontally with the same velocities from the same height and at the same time. If air resistance is neglected, then
a) Ball P reaches the ground first
b) Ball Q reaches the ground first
c) Both reach the ground at the same time
d) The respective masses of the two balls will decide the time

192. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 m/s^2. He reaches the ground with a speed of 3 m/s. At what height, did he bail out
a) 293 m b) 111 m c) 91 m d) 182 m

193. A particle moves along a straight line OX. At a time t (in second) the distance x (in metre) of the particle from O is given by $x = 40 + 12t - t^3$. How long would the particle travel before coming to rest?
a) 24 m b) 40 m c) 56 m d) 16 m

194. A man goes 10 m towards North, then 20 m towards east then displacement is
a) 22.5m b) 25m c) 25.5m d) 30m

195. Velocity-time curve for a body projected vertically upwards is
a) Parabola b) Ellipse c) Hyperbola d) Straight line

196. The displacement of the body along $x-$axis depends on time as $\sqrt{x} = t + 1$. Then the velocity of body
a) Increases with time b) Decreases with time c) Independent of time d) None of these

197. A body is thrown vertically up with a velocity u. It passes three points A, B and C in its upward journey with velocities $\frac{u}{2}, \frac{u}{3}$ and $\frac{u}{4}$ respectively. The ratio of the separations between points A and B and between B and C $i.e., \frac{AB}{BC}$ is
a) 1 b) 2 c) $\frac{10}{7}$ d) $\frac{20}{7}$

198. A particle moving in a straight line and passes through a point O with a velocity of $6ms^{-1}$.The particle moves with a constant retardation of $2ms^{-2}$ for 4 s and there after moves with a constant velocity. How long after leaving O does the particle return to O
a) 3s b) 8s c) 6 m d) 8 m

199. A particle moves in a straight line with a constant acceleration. It changes its velocity from 10 $ms^{-1}$to 20 ms^{-1} while passing through a distance 135 m in t second. The value of t is
a) 12 b) 9 c) 10 d) 1.8

200. A car starts from rest and accelerates uniformly to a speed of 180 kmh^{-1} in 10 $seconds$. The distance covered by the car in this time interval is

a) 500 m b) 250 m c) 100 m d) 200 m

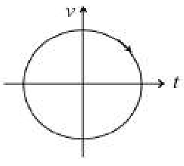
201. A ball is thrown vertically upwards from the surface of earth with a speed of 18kmh^{-1}. If $g = 10 \text{ms}^{-2}$, then the maximum height attained by the ball is

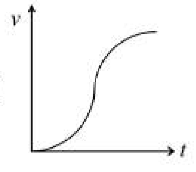
a) 1.25 m b) 3 m c) 10 m d) 180 m

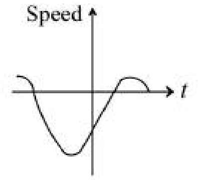
202. A stone falls freely from rest from a height h and it travels a distance $\frac{9h}{25}$ in the last second. The value of h is

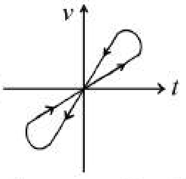
a) 145 m b) 100 m c) 122.5 m d) 200 m

203. Look at the graphs (a) to (d) carefully and indicate which of these possibly represents one dimensional motion of a particle

a) 

b) 

c) 

d) 

204. Two trains are moving with equal speed in opposite directions along two parallel railway tracks. If the wind is blowing with speed u along the track so that the relative velocities of the trains with respect to the wind are in the ratio 1: 2, then the speed of each train must be

a) $3u$ b) $2u$ c) $5u$ d) $4u$

205. The velocity-time relation of an electron starting from rest is given by $v = kt$ where $k = 2\text{ms}^{-1}$. The distance traversed in first 3 s is

a) 9 m b) 16 m c) 27 m d) 36 m

206. The displacement- time graph for two particles A and B are straight lines inclined at angles of 30° and 60° with the time axis. The ratio of velocities of $V_A : V_B$ is

a) 1: 2 b) $1 : \sqrt{3}$ c) $\sqrt{3} : 1$ d) 1: 3

207. A man throws balls with the same speed vertically upwards one after the other at an interval of two seconds. What should be the speed of the throw so that more than two balls are in the sky at any time (Given $g = 9.8 \, m/s^2$)

a) At least 0.8 m/s
b) Any speed less than 19.6 m/s
c) Only with speed 19.6 m/s
d) More than 19.6

208. A body falls from a height $h = 200m$ (at New Delhi). The ratio of distance travelled in each 2 sec during $t = 0$ to $t = 6$ second of the journey is

a) 1 : 4 : 9 b) 1 : 2 : 4 c) 1 : 3 : 5 d) 1 : 2 : 3

209. The wind appears to blow from the north to a man moving in the north-east direction. When he doubles his velocity the wind appears to move in the direction $\cot^{-1}(2)$ east of north. The actual direction of the wind is

a) $\sqrt{2}v$ towards east b) $\frac{v}{\sqrt{2}}$ towards west c) $\sqrt{2}\, v$ towards west d) $\frac{v}{\sqrt{2}}$ towards east

210. Two cars A and B are moving with same speed of 45 kmh^{-1} along same direction. If a third car C coming from the opposite direction with a speed of 36 kmh^{-1} meets two cars in an interval of 5 min, the distance of separation of two cars A and B should be (in km)

a) 6.75 b) 7.25 c) 5.55 d) 8.35

211. A balloon rises from rest with a constant acceleration $g/8$. A stone is released from it when it has risen to height h. The time taken by the stone to reach the ground is

a) $4\sqrt{\frac{h}{g}}$ b) $2\sqrt{\frac{h}{g}}$ c) $\sqrt{\frac{2h}{g}}$ d) $\sqrt{\frac{g}{h}}$

212. A man throws a ball vertically upward and it rises through 20 m and returns to his hands. What was the initial velocity (u) of the ball and for how much time (T) it remained in the air [$g = 10m/s^2$]

a) $u = 10m/s, T = 2s$ b) $u = 10m/s, T = 4s$ c) $u = 20m/s, T = 2s$ d) $u = 20m/s, T = 4s$

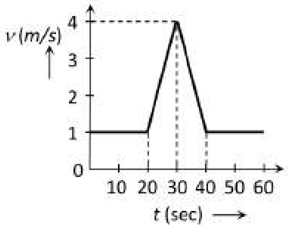
213. A train has a speed of 60 km/h. for the first one hour and 40 km/h for the next half hour. Its average speed in km/h is

a) 50 b) 53.33 c) 48 d) 70

214. A particle moves for 20 *seconds* with velocity 3 m/s and then velocity 4 m/s for another 20 *seconds* and finally moves with velocity 5 m/s for next 20 *seconds*. What is the average velocity of the particle

a) 3 m/s b) 4 m/s c) 5 m/s d) Zero

215. Velocity-time (v-t) graph for a moving object is shown in the figure. Total displacement of the object during the same interval when there is non-zero acceleration and retardation is



a) 60 m b) 50 m c) 30 m d) 40 m

216. From a balloon rising vertically upwards at $5m/s$ a stone is thrown up at 10 m/s relative to the balloon. Its velocity with respect to ground after 2 s is (assume $g = 10m/s^2$)

a) 0 b) 20 m/s c) 10 m/s d) 5 m/s

217. A particle moving in a straight line covers half the distance with speed of 3 m/s. The other half of the distance is covered in two equal time intervals with speed of 4.5 m/s and 7.5 m/s respectively. The average speed of the particle during the motion is

a) 4.0 m/s b) 5.0 m/s c) 5.5 m/s d) 4.8 m/s

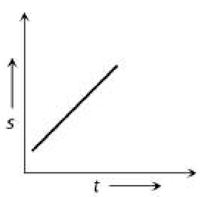
218. The path of a particle moving under the influence of a force fixed in magnitude and direction is

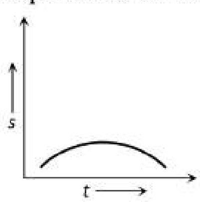
a) Straight line b) Circle c) Parabola d) Ellipse

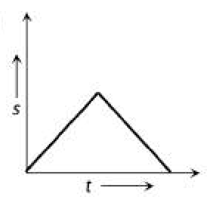
219. If a car at rest accelerates uniformly to a speed of 144 km/h in 20 s. Then it covers a distance of

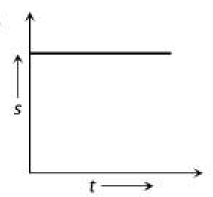
a) 20 m b) 400 m c) 1440m d) 2880 m

220. Which of the following graph represents uniform motion

a)


b)


c)


d)


221. An express train is moving with a velocity v_1. Its driver finds another train is moving on the same track in the same direction with velocity v_2. To escape collision, driver applies a retardation a on the train. The minimum time of escaping collision will be

a) $t = \frac{v_1 - v_2}{a}$ b) $t = \frac{v_1^2 - v_2^2}{2}$ c) None d) Both

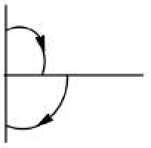
222. A body moving with uniform acceleration, describes 40 m in the first 5 s and 65 m in next 5 s. its initial velocity will be

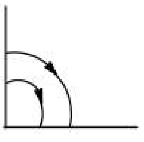
a) 4 ms^{-1} b) 2.5 ms^{-1} c) 3 ms^{-1} d) 11 ms^{-1}

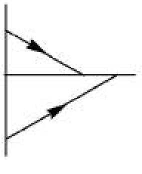
223. A body falls freely from the top of a tower. It covers 36% of the total height in the last second before striking the ground level. The height of the tower is

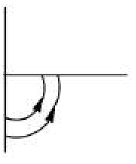
a) 50 m b) 75 m c) 100m d) 125 m

224. A ball is dropped vertically downwards from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its speed varies with the height h above the ground as

a)


b)


c)


d)


225. A body thrown vertically up to reach its maximum height in t second. The total time from the time of projection to reach a point at half of its maximum height while returning (in second) is

a) $\sqrt{2}\,t$ b) $\left(1+\frac{1}{\sqrt{2}}\right)t$ c) $\frac{3t}{2}$ d) $\frac{t}{\sqrt{2}}$

226. The path of a particle moving under the influence of a force fixed in magnitude and direction is

a) Straight line b) Circle c) Parabola d) Ellipse

227. A body freely falling from the rest has a velocity 'v' after it falls through a height 'h'. The distance it has to fall down for its velocity to become double, is

a) $2h$ b) $4h$ c) $6h$ d) $8h$

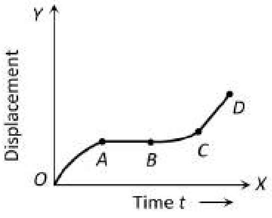
228. A body moves from rest with a constant acceleration of 5 m/s^2. Its instantaneous speed (in m/s) at the end of 10 sec is

a) 50 b) 5 c) 2 d) 0.5

229. A body is thrown vertically up from the ground. It reaches a maximum height of $100m$ in $5sec$. After what time it will reach the ground from the maximum height position

a) 1.2 sec b) 5 sec c) 10 sec d) 25 sec

230. The graph between the displacement x and t for a particle moving in a straight line is shown in figure. During the interval OA, AB, BC and CD, the acceleration of the particle is



OA, AB, BC, CD

a) + 0 + + b) - 0 + 0 c) + 0 - + d) - 0 - 0

231. A car travels half the distance with constant velocity of 40 $kmph$ and the remaining half with a constant velocity of 60 $kmph$. The average velocity of the car in $kmph$ is

a) 40 b) 45 c) 48 d) 50

232. The motion of a particle is described by the equation $u = at$. The distance travelled by the particle in the first 4 seconds

a) $4a$ b) $12a$ c) $6a$ d) $8a$

233. A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate $\frac{f}{2}$ to come to rest. If the total distance traversed is 15 S, then

a) $S = \frac{1}{2}ft^2$

b) $S = \frac{1}{4}ft^2$

c) $S = \frac{1}{72}ft^2$

d) $S = \frac{1}{6}ft^2$

234. A particle located at $x = 0$ at time $t = 0$, starts moving along the positive x-direction with a velocity 'v' that varies as $v = a\sqrt{x}$. The displacement of the particle varies with time as

a) t b) $t^{1/2}$ c) t^3 d) t^2

235. A body starts to fall freely under gravity. The distance covered by it in first, second and third *second* are in ratio

a) 1: 3: 5 b) 1: 2: 3 c) 1: 4: 9 d) 1: 5: 6

236. A particle has an initial velocity of $3\hat{\imath} + 4\hat{\jmath}$ and an acceleration of $0.4\hat{\imath} + 0.3\hat{\jmath}$. Its speed after 10 s is

a) 10 units b) $7\sqrt{2}$ units c) 7 units d) 8.5 units

237. Two cars move in the same direction along parallel roads. One of them is a 100 m long travelling with a velocity of $7.5 ms^{-1}$. How long will it take for the first car to overtake the second car?

a) 24 s b) 40 s c) 60 s d) 80 s

238. A body is thrown vertically upwards with a velocity u. Find the true statement from the following

a) Both velocity and acceleration are zero at its highest point

b) Velocity is maximum and acceleration is zero at the highest point

c) Velocity is maximum and acceleration is g downwards at its highest point

d) Velocity is zero at the highest point and maximum height reached is $u^2/2g$

239. A particle moves along a straight line such that its displacement at any time t is given by $S = t^3 - 6t^2 + 3t + 4\ metres$

The velocity when the acceleration is zero is

a) $3ms^{-1}$ b) $-12ms^{-1}$ c) $42ms^{-1}$ d) $-9ms^{-1}$

240. A ball released from the top of a tower travels $\frac{11}{36}$ of the height of the tower in the last second of its journey. The height of the tower is (Take $g = 10 = ms^{-2}$)

a) 11m b) 36m c) 47m d) 180m

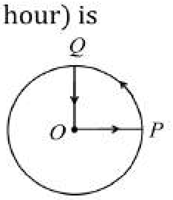
241. A particle moves along x −axis in such a way that its coordinate (x) varies with time t according to the expression $x = 2 - 5t + 6t^2$m, the initial velocity of the particle is

a) $3\ ms^{-1}$ b) $6\ ms^{-1}$ c) $-3\ ms^{-1}$ d) $-5\ ms^{-1}$

242. An automobile travelling with a speed of $60\ kmh^{-1}$, can brake to stop within a distance of 20 m. if the car is going twice as fast, *ie.*, $120\ kmh^{-1}$, the stopping distance will be

a) 20 m b) 40 m c) 60 m d) 80 m

243. A cyclist starts from the centre O of a circular park of radius one kilometre, reaches the edge P of the park, then cycles along the circumference and returns to the centre along QO as shown in figure. If the round trip takes ten minutes, the net displacement and average speed of the cyclist (in metre and kilometre per hour) is

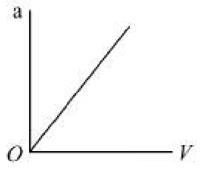


a) 0, 1 b) $\frac{\pi+4}{2}$, 0 c) 21.4, $\frac{\pi+4}{2}$ d) 0, 21.4

244. A bird flies for 4 s with a velocity of $|t-2|m/s$ in a straight line, where t is time in seconds. It covers a distance of

a) 2 m b) 4 m c) 6 m d) 8 m

245. Acceleration velocity graph of a particle moving in a straight line is as shown in figure. The slope of velocity-displacement graph



a) Increases linearly b) Decreases linearly

c) Is constant d) Increases parabolically

246. A point initially at rest moves along x −axis. Its acceleration varies with time as $a = (6t + 5)ms^{-2}$. If it starts from origin, the distance covered in 2 s is

a) 20 m b) 18 m c) 16 m d) 25 m

247. A particle starts from rest and travels a distance s with uniform acceleration, then it travels a distance 2s with uniform speed, finally it travels a distance 3s with uniform retardation and comes to rest. If the

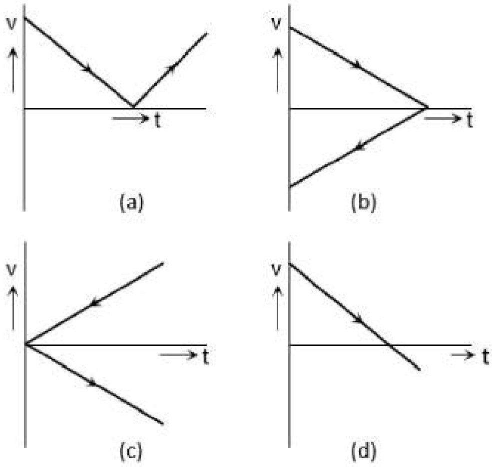
complete motion of the particle in a straight line then the ratio of its average velocity to maximum velocity in

a) 6/7 b) 4/5 c) 3/5 d) 2/5

248. A ball falls from height h. After 1 second, another ball falls freely from a point 20 m below the point from where the first ball falls. Both of them reach the ground at the same time. What is the value of h

a) 11.2 m b) 21.2 m c) 31.2 m d) 41.2 m

249. A ball is thrown vertically upwards. Which of the following graph/graphs represent velocity-time graph of the ball during its flight (air resistance is neglected)



a) A
b) B
c) C
d) D

250. The particles A, B and C are thrown from the top of a tower with the same speed. A is thrown up, B is thrown down and C is horizontally. They hit the ground with speeds V_A, V_B and V_C respectively

a) $V_A = V_B = V_C$ b) $V_A = V_B > V_C$ c) $V_B > V_C > V_A$ d) $V_A > V_B = V_C$

251. A body is moving with uniform acceleration describes 40 m in the first 5 sec and 65 m in next 5 sec. Its initial velocity will be

a) 4 m/s b) 2.5 m/s c) 5.5 m/s d) 11 m/s

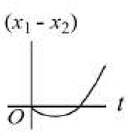
252. A body moves for a total of nine second starting from rest with uniform acceleration and then with uniform retardation, which is twice the value of acceleration and then stops. The duration of uniform acceleration

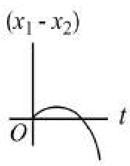
a) 3 s b) 4.5 s c) 5 s d) 6 s

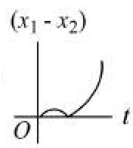
253. A body travelling with uniform acceleration crosses two points A and B with velocities $20ms^{-1}$ and d30 ms^{-1} respectively. The speed of the body at the mid-point of A and B is nearest to

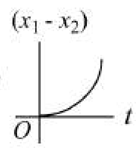
a) 25.5 ms^{-1} b) 25 ms^{-1} c) 24ms^{-1} d) $10\sqrt{6}\ ms^{-1}$

254. A body is at rest at $x = 0$. At $t = 0$, it starts moving in the positive x-direction with a constant acceleration. At the same instant another body passes through $x = 0$ moving in the positive x-direction with a constant speed. The position of the first body is given by $x_1(t)$ after time 't' and that of the second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time 't'

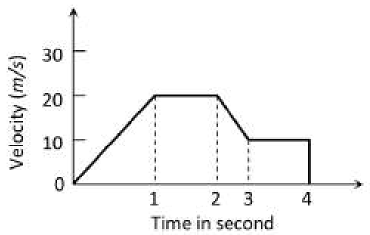
a) 

b) 

c) 

d) 

255. The variation of velocity of a particle with time moving along a straight line is illustrated in the following figure. The distance travelled by the particle in four seconds is

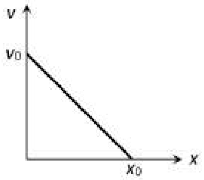


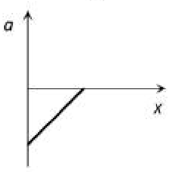
a) 60 m b) 55 m c) 25 m d) 30 m

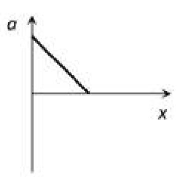
256. A particle is moving with constant acceleration from A to B in a straight line AB. If u and v are the velocities at A and B respectively then its velocity at the midpoint C will be

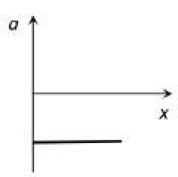
a) $\left(\frac{u^2+v^2}{2u}\right)^2$ b) $\frac{u+v}{2}$ c) $\frac{v-u}{2}$ d) $\sqrt{\frac{u^2+v^2}{2}}$

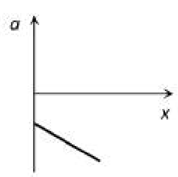
257. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement



a) 

b) 

c) 

d) 

258. A body freely falling from rest has a velocity v after it falls through distance h. The distance it has to fall down further for its velocity to become double is

a) h b) $2h$ c) $3h$ d) $4h$

259. Speed of two identical cars u and $4u$ at a specific instant. The ratio of the respective distances in which the two cars are stopped from that instant is

a) $1:1$ b) $1:4$ c) $1:8$ d) $1:16$

260. A bus start from rest with an acceleration of 1 ms^{-2}. A man who is 48m behind the bus starts with a uniform velocity of $10 ms^{-1}$. The minimum time after which the ma will catch the bus

a) 4.8 s b) 8 s c) 10 s d) 12 s

261. A boat is sent across a river with a velocity of boat is 10 km/hr. If the resultant velocity of boat is 10 km/hr, then velocity of the river is :

a) 10 km/hr
b) 8 km/hr
c) 6 km/hr
d) 4 km/hr

262. An object, moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{dv}{dt} = -2.5\sqrt{v}$ where v is the instantaneous speed. The time taken by the object, to come to rest, would be

a) 2 s b) 4 s c) 8 s d) 1 s

263. From the top of a tower of two stones, whose masses are in the ratio 1 : 2 are thrown on straight up with an initial speed u and the second straight down with the same speed u. Then neglecting air resistance

a) The heavier stone hits the ground with a higher speed
b) The lighter stone hits the ground with a higher speed
c) Both the stones will have the same speed when they hit the ground
d) The speed can't be determined with the given data

264. If a body starts from rest and travels 120 cm in the 6^{th} second, then what is the acceleration

a) $0.20\ m/s^2$ b) $0.027\ m/s^2$ c) $0.218 m/s^2$ d) $0.03 m/s^2$

265. From the top of a tower two stones, whose masses are in the ratio 1: 2 are thrown one straight up with an initial speed u and the second straight down with the same speed u. Then, neglecting air resistance

a) The heavier stone hits the ground with a higher speed

b) The lighter stone hits the ground with a higher speed

c) Both the stones will have the same speed when they hit the ground

d) The speed can't be determined with the give data

266. A body stars from rest and falls vertically from a height of 19.6m. If $g = 9.8 ms^{-2}$, then the time taken by the body to fall through the last metre of its fall, is

a) 2.00 s b) 0.05 s c) 0.45 s d) 1.95 s

267. If a car at rest accelerates uniformly to a speed of 144 km/h in 20 s. Then it covers a distance of

a) 20 m b) 400 m c) 1440m d) 2880 m

268. A body released from a great height falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies two second after the release of the second body is

a) 9.8 m b) 4.9 m c) 24.5 m d) 19.6 m

269. The effective acceleration of a body, when thrown upwards with acceleration a will be:

a) $\sqrt{a-g^2}$ b) $\sqrt{a^2+g^2}$ c) $(a-g)$ d) $(a+g)$

270. A boat crosses a river from port A to port B, which are just on the opposite side. The speed of the water is V_W and that of boat is V_B relative to still water. Assume $V_B = 2V_W$. What is the time taken by the boat, if It has to cross the river directly on the AB line

a) $\frac{2D}{V_B\sqrt{3}}$ b) $\frac{\sqrt{3}D}{2V_B}$ c) $\frac{D}{V_B\sqrt{2}}$ d) $\frac{D\sqrt{2}}{V_B}$

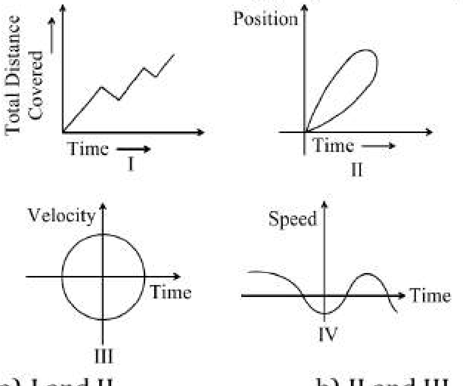
271. If a body is thrown up with the velocity of 15 m/s then maximum height attained by the body is ($g = 10\ m/s^2$)

a) 11.25 m b) 16.2 m c) 24.5 m d) 7.62 m

272. A particle located at $x = 0$ at time $t = 0$, starts moving along the positive x-direction with a velocity 'v' that varies as $v = a\sqrt{x}$. The displacement of the particle varies with time as

a) t b) $t^{1/2}$ c) t^3 d) t^2

273. Which of the following graphs can not possibly represent one dimensional motion of a particle



a) I and II b) II and III c) II and IV d) All four

274. What determines the nature of the path followed by the particle

a) Speed b) Velocity c) Acceleration d) Both (b) and (c)

275. A body falling for 2 seconds covers a distance S is equal to that covered in next second. Taking $g = 10 m/s^2, S =$

a) 30 m b) 10 m c) 60 m d) 20 m

276. A body falls from rest, its velocity at the end of first second is ($g = 32 ft/sec$)

a) 16 ft/sec b) 32 ft/sec c) 64 ft/sec d) 24 ft/sec

277. A body is projected vertically upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2 respectively. Then the velocity of projection is (g is acceleration due to gravity)

a) $g\sqrt{t_1 t_2}$ b) $\frac{g t_1 t_2}{t_1 + t_2}$ c) $\frac{g\sqrt{t_1 t_2}}{2}$ d) $\frac{g(t_1 + t_2)}{2}$

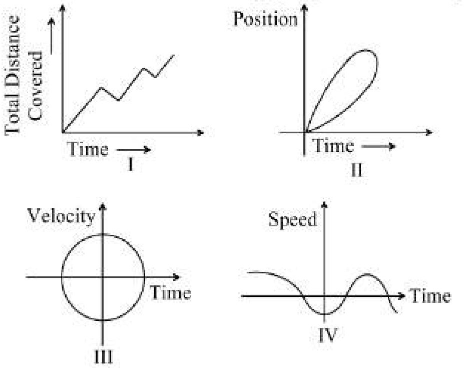
278. When a ball is thrown up vertically with velocity V_0 , it reaches a maximum height of $'h'$. If one wishes to triple the maximum height then the ball should be thrown with velocity

a) $\sqrt{3}V_0$ b) $3V_0$ c) $9V_0$ d) $3/2V_0$

279. A particle moves along a parabolic path $y = 9x^2$ in such a way that the x-component of velocity remains constant and has a value $\frac{1}{3}$ ms^{-1}. The acceleration of the particle is

a) $\frac{1}{3}\hat{j}$ms^{-2} b) $3\hat{j}$ms^{-2} c) $\frac{2}{3}\hat{j}$ms^{-2} d) $2\hat{j}$ms^{-2}

280. Which of the following graphs can not possibly represent one dimensional motion of a particle



a) I and II b) II and III c) II and IV d) All four

281. A Body moves 6 m north. 8 m east and 10 m vertically upwards, what is its resultant displacement from initial position

a) $10\sqrt{2m}$ b) 10 m c) $\frac{10}{\sqrt{2}}m$ d) $10 \times 2m$

282. A particle starts from rest, acceleration at 2 m/s^2 for 10 s and then goes with constant speed for 30 s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it

a) 750 m b) 800 m c) 700 m d) 850 m

283. A motion boat covers a given distance in 6 h moving down stream of a river. It covers the same distance in 10 h moving upstream. The time (in hour) it takes to cover the same distance in still water is

a) 6 b) 7.5 c) 10 d) 15

284. The displacement of a particle is proportional to the cube of time elapsed. How does the acceleration of the particle depends on time obtained

a) $a \propto t^2$ b) $a \propto 2t$ c) $a \propto t^3$ d) $a \propto t$

285. An object moving with a speed of 6.25 m/s, is decelerated at a rate given by $\frac{dv}{dt} = 2.5\sqrt{v}$ where v is the instantaneous speed. The time taken by the object, to come to rest would be

a) 1s b) 2s c) 4s d) 8s

286. An athlete completes one round of a circular track of radius R in 40 sec. What will be his displacement at the end of 2 min. 20 sec

a) Zero b) $2R$ c) $2\pi R$ d) $7\pi R$

287. An athlete completes one round of a circular track of radius R in 40 sec. What will be his displacement at the end of 2 min. 20 sec

a) Zero b) $2R$ c) $2\pi R$ d) $7\pi R$

288. A body moves from rest with a constant acceleration of 5 m/s^2. Its instantaneous speed (in m/s) at the end of 10 sec is

a) 50 b) 5 c) 2 d) 0.5

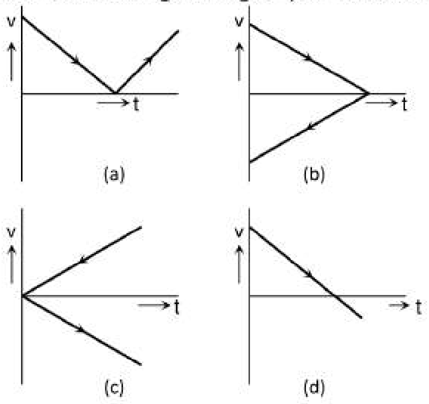
289. A particle travels 10m in first 5 sec and 10m in next 3 sec. Assuming constant acceleration what is the distance travelled in next 2 sec

a) 8.3 m b) 9.3 m c) 10.3 m d) None of above

290. A juggler keeps on moving four balls in the air throws the balls in regular interval of time. When one ball leaves his hand (speed=20ms^{-1}), the position of other ball will be (Take $g = 10ms^{-2}$)

a) 10m, 20m, 10m b) 15m, 20m, 15m c) 5m, 15m, 20m d) 5m, 10m, 20m

291. A ball is thrown vertically upwards. Which of the following graph/graphs represent velocity-time graph of the ball during its flight (air resistance is neglected)



a) A b) B c) C d) D

292. A cricket ball is thrown up with a speed of 19.6 ms^{-1}. The maximum height it can reach is

a) 9.8 m b) 19.6 m c) 29.4 m d) 39.2 m

293. A rocket is fired upward from the earth's surface such that it creates an acceleration of 19.6 $m/\sec^2$. If after 5 sec its engine is switched off, the maximum height of the rocket from earth's surface would be

a) 245 m b) 490 m c) 980 m d) 735 m

294. A stone falls freely from rest and the total distance covered by it in the last second of its motion equals the distance covered by it in the first three seconds of its motion. The stone remains in the air for

a) 6 s b) 5 s c) 7 s d) 4 s

295. A body falls freely from the top of a tower. It covers 36% of the total height in the last second before striking the ground level. The height of the tower is

a) 50 m b) 75 m c) 100m d) 125 m

296. The engine of a train can impart a maximum acceleration of 1$ms^{-2}$and the brakes can give a maximum retardation of 3ms^{-2}. The least time during which a train can go from one place to the other place at a distance of 1.2 km is nearly

a) 108 s b) 191 s c) 56.6 s d) Time is fixed

297. A ball is dropped from top of a building. The ball take 0.5 s to fall past the 3 m length of window some distance from top of building with what speed does the ball pass the top of window?

a) 6 ms^{-1} b) 12 ms^{-1} c) 7 ms^{-1} d) 3.5 ms^{-1}

298. A particle moves along a semicircle of radius 10m in 5 seconds. The average velocity of the particle is

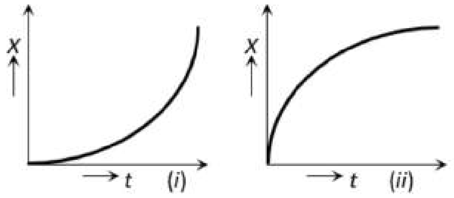
a) 2π ms^{-1} b) 4π ms^{-1} c) 2 ms^{-1} d) 4 ms^{-1}

299. A body is thrown vertically upwards. If air resistance is to be taken into account, then the time during which the body rises is

a) Equal to the time of fall b) Less than the time of fall

c) Greater than the time of fall d) Twice the time of fall

300. Figures (i) and (ii) below show the displacement-time graphs of two particles moving along the x-axis. We can say that



a) Both the particles are having a uniformly accelerated motion
b) Both the particles are having a uniformly retarded motion
c) Particle (i) is having a uniformly accelerated motion while particle (ii) is having a uniformly retarded motion
d) Particle (i) is having a uniformly retarded motion while particle (ii) is having a uniformly accelerated motion

301. The position of a particle x (in metres) at a time t seconds is given by the relation $\vec{r} = (3t\hat{i} - t^2\hat{j} + 4\hat{k})$. Calculate the magnitude of velocity of the particle after 5 seconds
a) 3.55 b) 5.03 c) 8.75 d) 10.44

302. A wheel of radius 1 m rolls forward half a revolution on a horizontal ground. The magnitude of the displacement of the point of wheel initially in contact with the ground is
a) 2π b) $\sqrt{2}\pi$ c) $\sqrt{\pi^2 + 4}$ d) π

303. The position x of a particle with respect to time t along x-axis is given by $x = 9t^2 - t^3$ where x is in metres and t in second. What will be the position of this particle when it achieves maximum speed along the $+x$ direction
a) 32 m b) 54 m c) 81 m d) 24 m

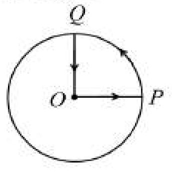
304. If a ball is thrown vertically upwards with speed u, the distance covered during the last t seconds of its ascent is
a) $\frac{1}{2}gt^2$ b) $ut - \frac{1}{2}gt^2$ c) $(u - gt)t$ d) ut

305. A body travels for 15 sec starting from rest with constant acceleration. If it travels distances S_1, S_2 and S_3 in the first five seconds, second five secods and next five seconds respectively the relation between S_1, S_2 and S_3 is
a) $S_1 = S_2 = S_3$ b) $5S_1 = 3S_2 = S_3$ c) $S_1 = \frac{1}{3}S_2 = \frac{1}{5}S_3$ d) $S_1 = \frac{1}{5}S^2 = \frac{1}{3}S_3$

306. The relation $3t = \sqrt{3x} + 6$ describes the displacement of a particle in one direction where x is in *metres* and t in sec. The displacement, when velocity is zero, is
a) 24 *metres* b) 12 *metres* c) 5 *metres* d) Zero

307. Free fall of an object (in vacuum) is a case of motion with
a) Uniform velocity b) Uniform acceleration c) Variable acceleration d) Constant momentum

308. A cyclist starts from the centre O of a circular park of radius one kilometre, reaches the edge P of the park, then cycles along the circumference and returns to the centre along QO as shown in figure. If the round trip takes ten minutes, the net displacement and average speed of the cyclist (in metre and kilometre per hour) is



a) 0, 1 b) $\frac{\pi + 4}{2}$, 0 c) 21.4, $\frac{\pi + 4}{2}$ d) 0, 21.4

309. A particle moving in a straight line and passes through a point O with a velocity of $6ms^{-1}$.The particle moves with a constant retardation of $2ms^{-2}$ for 4 s and there after moves with a constant velocity. How long after leaving O does the particle return to O
a) 3s b) 8s c) 6 m d) 8 m

310. The displacement x of a particle varies with time t, $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will

a) Go on decreasing with time
b) Be independent of α and β
c) Drop to zero when $\alpha = \beta$
d) Go on increasing with time

311. Three different objects of masses m_1, m_2 and m_3 are allowed to fall from rest and from the same point 'O' along three different frictionless paths. The speeds of the three objects, on reaching the ground, will be in the ratio of

a) $m_1 : m_2 : m_3$
b) $m_1 : 2m_2 : 3m_3$
c) $1 : 1 : 1$
d) $\frac{1}{m_1} : \frac{1}{m_2} : \frac{1}{m_3}$

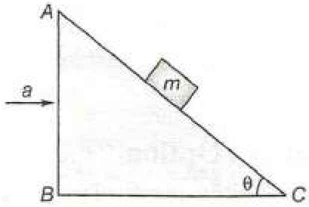
312. The distance travelled by a particle is proportional to the square of time, then the particle travels with

a) Uniform acceleration
b) Uniform velocity
c) Increasing acceleration
d) Decreasing velocity

313. A particle when thrown, moves such that it passes from same height at 2 and 10s, the height is

a) g
b) $2g$
c) $5g$
d) $10g$

314. A body of mass m is resting on a wedge of angle θ as shown in figure. The wedge is given at acceleration α. What is the value of a son that the mass m just falls freely?



a) g
b) g sin θ
c) g tan θ
d) g cot θ

315. An aeroplane is moving with horizontal velocity u at height h.The velocity of a packet dropped from it on the earth's surface will be (g is acceleration due to gravity)

a) $\sqrt{u^2 + 2gh}$
b) $\sqrt{2gh}$
c) $2gh$
d) $\sqrt{u^2 - 2gh}$

316. A small block sides without friction down an inclined plane starting from rest. Let S_n be the distance travelled from time $t = n - 1$ to $t = n$. Then $\frac{S_n}{S_{n+1}}$ is

a) $\frac{2n-1}{2n}$
b) $\frac{2n+1}{2n-1}$
c) $\frac{2n-1}{2n+1}$
d) $\frac{2n}{2n+1}$

317. A body is moving according to the equation $x = at + bt^2 - ct^3$ where $x =$ displacement and a, b and c are constants. The acceleration of the body is

a) $a + 2bt$
b) $2b + 6ct$
c) $2b - 6ct$
d) $3b - 6ct^2$

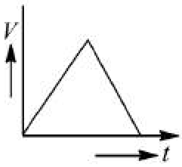
318. A particle has an initial velocity of $3\hat{i} + 4\hat{j}$ and an acceleration of $0.4\hat{i} + 0.3\hat{j}$. Its speed after 10 s is

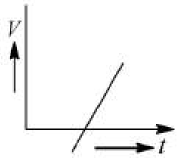
a) 10 units
b) $7\sqrt{2}$ units
c) 7 units
d) 8.5 units

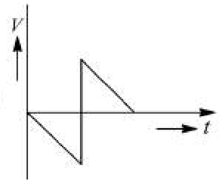
319. From a balloon rising vertically upwards at $5m/s$ a stone is thrown up at 10 m/s relative to the balloon. Its velocity with respect to ground after 2 s is (assume $g = 10m/s^2$)

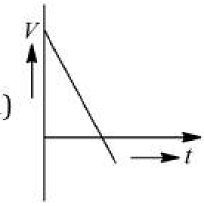
a) 0
b) 20 m/s
c) 10 m/s
d) 5 m/s

320. Which of the following $v - t$ graphs represents the motion of a ball falling freely from rest under gravity and rebounding from a metallic surface?

a) 

b) 

c) 

d) 

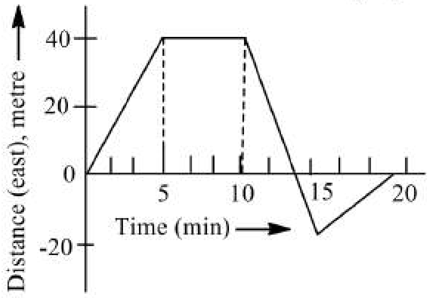
321. A particle moves along x −axis as
$x = 4(t - 2) + a(t - 2)^2$ Which of the following is true?

a) The initial velocity of particle is 4
b) The acceleration of particle is $2a$
c) The particle is at origin at $t = 0$
d) None of the above

322. A particle starts from the origin and moves along the X-axis such that the velocity at any instant is given by $4t^3 - 2t$, where t is in second and velocity is in ms^{-1}. What is the acceleration of the particle when it is 2 m from the origin?

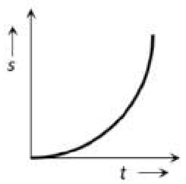
a) $10ms^{-2}$ b) $12ms^{-2}$ c) $22ms^{-2}$ d) $28ms^{-2}$

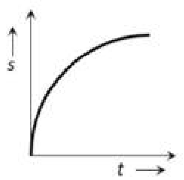
323. A boy begins to walk eastward along a street infront of his house and the graph of his displacement from home is shown in the following figure. His average speed for in the whole time interval is equal to

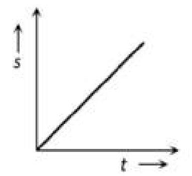


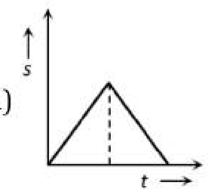
a) 8 $mmin^{-1}$ b) 6 $mmin^{-1}$ c) $\frac{8}{3}mmin^{-1}$ d) 2 $mmin^{-1}$

324. Which graph represents the uniform acceleration

a) 

b) 

c) 

d) 

325. The displacement x of a particle varies with time t, $x = ae^{-\alpha t} + be^{\beta t}$, where a, b, α and β are positive constants. The velocity of the particle will

a) Go on decreasing with time
b) Be independent of α and β
c) Drop to zero when $\alpha = \beta$
d) Go on increasing with time

326. A point initially at rest moves along x-axis. Its acceleration varies with time as $a = (6t + 5)m/s^2$. If it starts from origin, the distance covered in 2 s is

a) 20 m b) 18 m c) 16 m d) 25 m

327. A body is projected up with a speed 'u' and the time taken by it is T to reach the maximum height H. Pick out the correct statement

a) It reaches $H/2$ in $T/2$ sec
b) It acquires velocity $u/2$ in $T/2sec$
c) Its velocity is $u/2$ at $H/2$
d) Same velocity at $2T$

328. A particle starts from rest and traverses a distance $2x$ with uniform acceleration, then moves uniformly over a further distance $4x$ and finally comes to rest after moving a further distance $6x$ under uniform retardation. Assuming entire motion to be rectilinear motion, the ratio of average speed over the journey to the maximum speed on its way is

a) 4/5 b) 3/5 c) 2/5 d) 1/5

329. A body starts from rest. What is the ratio of the distance travelled by the body during the 4th and 3rd second

a) $\frac{7}{5}$ b) $\frac{5}{7}$ c) $\frac{7}{3}$ d) $\frac{3}{7}$

330. The effective acceleration of a body, when thrown upwards with acceleration a will be:

a) $\sqrt{a - g^2}$ b) $\sqrt{a^2 + g^2}$ c) $(a - g)$ d) $(a + g)$

331. Two balls A and B are thrown simultaneously from the top of a tower. A is thrown vertically up with a speed of $4ms^{-1}$. B is thrown vertically down with a speed of 4 ms^{-1}. The ball A and B hit the ground with speed v_A and v_B respectively. Then,

a) $v_A < v_B$ b) $v_A > v_B$ c) $v_A \gtreqless v_B$ d) $v_A = v_B$

332. A body is moving along a straight line path with constant velocity. At an instant of time the distance travelled by it is S and its displacement is D, then

a) D < S   b) $D > S$ c) $D = S$ d) $D \leq S$

333. Two cars A and B at rest at same point initially. If A starts with uniform velocity of 40 m/sec and B starts in the same direction with constant acceleration of $4m/s^2$, then B will catch A after how much time

a) 10 sec b) 20 sec c) 30 sec d) 35 sec

334. A ball falls from height h. After 1 second, another ball falls freely from a point 20 m below the point from where the first ball falls. Both of them reach the ground at the same time. What is the value of h

a) 11.2 m b) 21.2 m c) 31.2 m d) 41.2 m

335. A particle has initial velocity $(2\hat{\imath} + 3\hat{\jmath})$ and acceleration $(0.3\hat{\imath} + 0.2\hat{\jmath})$. The magnitude of velocity after 10 seconds will be

a) $9\sqrt{2}$ units   b) $5\sqrt{2}$ units   c) 5 units   d) 9 units

336. A particle starts its motion from rest under the action of a constant force. If the distance covered in first 10 $seconds$ is S_1 and that covered in the first 20 $seconds$ is S_2, then

a) $S_2 = 2S_1$ b) $S_2 = 3S_1$ c) $S_2 = 4S_1$ d) $S_2 = S_1$

337. Four marbles are dropped from the top of a tower one after the other with an interval of one second. The first one reaches the ground 4 seconds. When the first one reaches the ground the distances between the first and second, the second and third and the third and forth will be respectively

a) 35,25 and 15 m

b) 30,20 and 10 m

c) 20,10 and 5 m

d) 40,30 and 20 m

338. The ratio of the numerical values of the average velocity and average speed of a body is always

a) Unity   b) Unity or less   c) Unity or more   d) Less than unity

339. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on the planet B. A man jumps to a height of $2m$ on the surface of A. What is the height of jump by the same person on the planet B

a) 18 m b) 6 m c) $\frac{2}{3}m$ d) $\frac{2}{9}m$

340. The acceleration a of a particle starting from rest varies with time according to relation $a = \alpha t + \beta$. The velocity of the particle after a time t will be

a) $\frac{\alpha t^2}{2} + \beta$ b) $\frac{\alpha t^2}{2} + \beta t$ c) $\alpha t^2 + \frac{1}{2}\beta t$ d) $\frac{(\alpha t^2 + \beta t)}{2}$

341. A 150 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 850 m is

a) 56 sec b) 68 sec c) 80 sec d) 92 sec

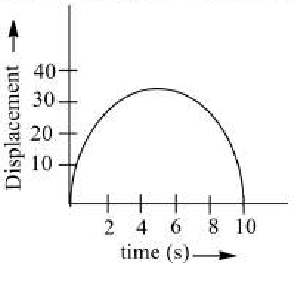
342. Acceleration of a body when displacement equation is $3s = 9t + 5t^2$ is

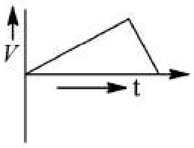
a) 5/3   b) 14/3   c) 10/3   d) 19/3

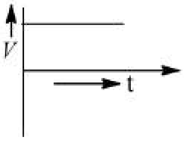
343. A point initially at rest moves along x-axis. Its acceleration varies with time as $a = (6t + 5)m/s^2$. If it starts from origin, the distance covered in 2 s is

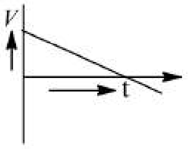
a) 20 m b) 18 m c) 16 m d) 25 m

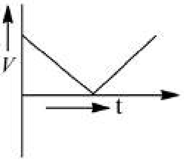
344. The displacement-time graph of a moving object is shown in figure. Which of the velocity-time graphs shown in figure could represent the motion of the same body?



a) 

b) 

c) 

d) 

345. Two boys are standing at the ends A and B of a ground where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

a) $a/\sqrt{v^2 + v_1^2}$

b) $\sqrt{a^2/(v^2 - v_1^2)}$

c) $a/(v - v_1)$

d) $a/(v + v_1)$

346. For a moving body at any instant of time

a) If the body is not moving, the acceleration is necessarily zero

b) If the body is slowing, the retardation is negative

c) If the body is slowing, the distance is negative

d) If displacement, velocity and acceleration at that instant are known, we can find the displacement at any given time in future

347. A steam boat goes across a lake and comes back (i) on a quiet day when the water is still and (ii) on a rough day when there is a uniform current so as to help the journey onwards and to impede the journey back. If the speed of the launch on both days was same, the time required for complete journey on the rough day, as compared to the quiet day will be

a) More b) Less c) Same d) None of these

348. A car moving with a velocity of 10 m/s can be stopped by the application of a constant force F in a distance of 20 m. If the velocity of the car is 30 m/s. It can be stopped by this force in

a) $\frac{20}{3} m$ b) 20 m c) 60 m d) 180 m

349. A body moves for a total of nine second started from rest with uniform acceleration and then with uniform retardation, which is twice the value of acceleration and then stops. The duration of uniform acceleration

a) 3 s b) 4.5 s c) 5 s d) 6 s

350. A body is released from the top of a tower of height h metre. It takes T second to reach the ground. Where is the ball at the time $\frac{T}{2}$ second?

a) At $\frac{h}{4}$ metre from the ground

b) At $\frac{h}{2}$ metre from the ground

c) At $\frac{3h}{4}$ metre from the ground

d) Depends upon the mass and volume of the ball

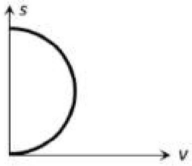
351. A particle crossing the origin of co-ordinates at time $t = 0$, moves in the xy −plane with a constant acceleration a in the y − direction. If its equation of motion is $y = bx^2$ (b is a constant), its velocity component in the x −direction is

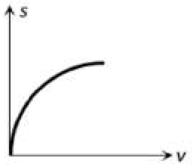
a) $\sqrt{\frac{2b}{a}}$ b) $\sqrt{\frac{a}{2b}}$ c) $\sqrt{\frac{a}{b}}$ d) $\sqrt{\frac{b}{a}}$

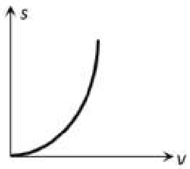
352. A body falls from a height $h = 200m$ (at New Delhi). The ratio of distance travelled in each 2 sec during $t = 0$ to $t = 6$ second of the journey is

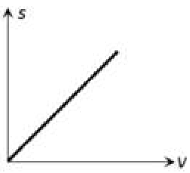
a) 1 : 4 : 9 b) 1 : 2 : 4 c) 1 : 3 : 5 d) 1 : 2 : 3

353. An object is moving with a uniform acceleration which is parallel to its instantaneous direction of motion. The displacement (s) −velocity (v)graph of this object is

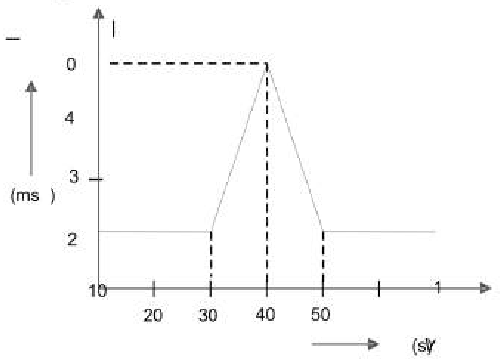
a) 

b) 

c) 

d) 

354. Velocity-time $(v-t)$ graph for a moving object is shown in the figure. Total displacement of the object during the time interval when there is non-zero acceleration and retardation is



a) 60 m b) 50 m c) 30 m d) 40 m

355. A balloon is at a height of $81\ m$ and is ascending upwards with a velocity of $12\ m/s$. A body of $2kg$ weight is dropped from it. If $g=10\ m/s^2$, the body will reach the surface of earth in

a) 1.5 s b) 4.025 s c) 5.4 s d) 6.75 s

356. A balloon is at a height of $81\ m$ and is ascending upwards with a velocity of $12\ m/s$. A body of $2kg$ weight is dropped from it. If $g=10\ m/s^2$, the body will reach the surface of earth in

a) 1.5 s b) 4.025 s c) 5.4 s d) 6.75 s

357. The position of a particle x (in metre) at a time t second is given by the relation $r=(3t\hat{\mathbf{i}}-t^2\hat{\mathbf{j}}+4\hat{\mathbf{k}})$. Calculate the magnitude of velocity of the particle after 5 s.

a) 3.55 m/s b) 5.03 m/s c) 8.75 m/s d) 10.44 m/s

358. A metro train starts from rest and in five seconds achieves 108 kmh^{-1}. After that it moves with constant velocity and comes to rest after travelling 45 m with uniform retardation. If total distance travelled is 395 m, find total time of travelling

a) 12.2 s b) 15.3 s c) 9 s d) 17.2 s

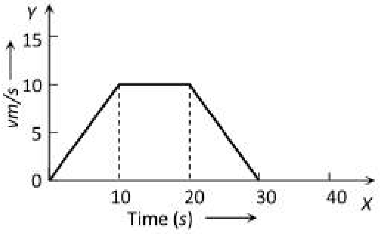
359. A particle moves a distance x in time t according to equation $x=(t+5)^{-1}$. The acceleration of particle is proportional to

a) $(\text{Velocity})^{2/3}$ b) $(\text{Velocity})^{3/2}$ c) $(\text{distance})^2$ d) $(\text{distance})^{-2}$

360. The displacement of a particle starting from rest (at $t = 0$) is given by $s = 6t^2 - t^3$. The time in seconds at which the particle will attain zero velocity again, is

a) 2 b) 4 c) 6 d) 8

361. In the following graph, distance travelled by the body in metres is



a) 200 b) 250 c) 300 d) 400

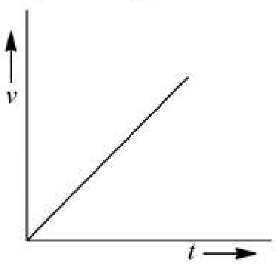
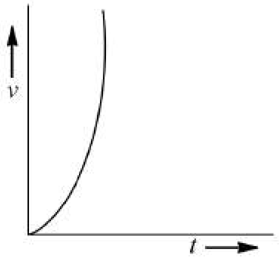
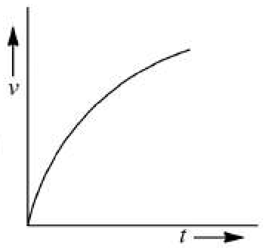
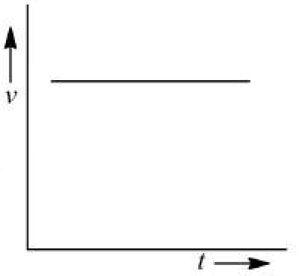
362. A car is travelling at 72 kmh^{-1} and is 20 m from a barrier when the driver puts on the brakes. The car hits the barrier 2s later. What is the magnitude of the constant deceleration?

a) 7.2 ms^{-2} b) 10 ms^{-2} c) 36 ms^{-2} d) 15 ms^{-2}

363. A particle is moving with constant initial velocity 4 ms^{-1} till $t = 1.5$ s. Then it accelerates at 10 ms^{-2} till $t = 3$. The distance covered is (Take $g = 10ms^{-2}$)

a) 17.25 m b) 36.25 m c) 40 m d) 23.25 m

364. An object dropped from rest. Its $v - t$ graph is

a) 
b) 
c) 
d) 

365. A ball A is thrown up vertically with a speed u and at the same instant another ball B is released from a height h. At time t, the speed of A relative to B is

a) u b) $2u$ c) $u - gt$ d) $\sqrt{(u^2 - gt)}$

366. The position x of a particle with respect to time t along x-axis is given by $x = 9t^2 - t^3$ where x is in metres and t in second. What will be the position of this particle when it achieves maximum speed along the $+x$ direction

a) 32 m b) 54 m c) 81 m d) 24 m

367. Select the incorrect statements from the following

S1 : Average velocity is path length divided by time interval

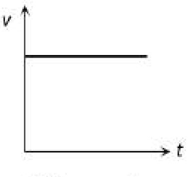
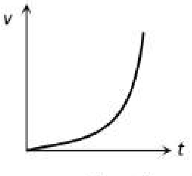
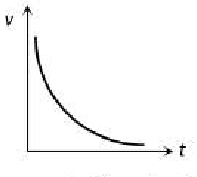
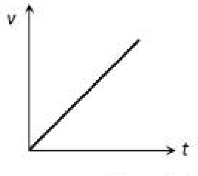
S2 : In general, speed is greater than the magnitude of the velocity

S3 : A particle moving in a given direction with a non-zero velocity can have zero speed

S4 : The magnitude of average velocity is the average speed

a) S2 and S3 b) S1 and S4 c) S1, S3 and S4 d) All four statements

368. Which of the following velocity-time graphs represent uniform motion

a) 
b) 
c) 
d) 

369. A particle moving with a uniform acceleration travels 24 m and 64 m in the first two consecutive interval of 4 s each. Its initial velocity will be

a) 5 ms^{-1} b) 3 ms^{-1} c) 1 ms^{-1} d) 4 ms^{-1}

370. A particle covers half of its total distance with speed v_1 and the rest half distance with speed v_2. Its average speed during the complete journey is

a) $\frac{v_1^2 v_2^2}{v_1^2 + v_2^2}$ b) $\frac{v_1 + v_2}{2}$ c) $\frac{v_1 v_2}{v_1 + v_2}$ d) $\frac{2v_1 v_2}{v_1 + v_2}$

371. The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3} ms^{-2}$, in the third second is

a) $\frac{10}{3} m$ b) $\frac{19}{3} m$ c) $6\ m$ d) $4\ m$

372. A particle moves in a straight line so that its displacement x metre at time t second is given by

$t = \sqrt{x^2 - 1}$

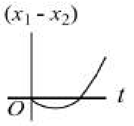
Its acceleration in ms^{-2} at time t second is

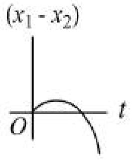
a) $\frac{1}{x^3}$ b) $\frac{t^2}{x^3}$ c) $\frac{1}{x} - \frac{t^2}{x^3}$ d) $\frac{t^2}{x^3} - \frac{1}{x^2}$

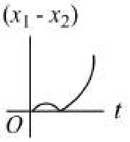
373. A particle moves in a straight line with a constant acceleration. It changes its velocity from $10\ ms^{-1}$ to $20\ ms^{-1}$ while passing through a distance $135\ m$ in t second. The value of t is

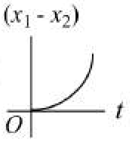
a) 12 b) 9 c) 10 d) 1.8

374. A body is at rest at $x = 0$. At $t = 0$, it starts moving in the positive x-direction with a constant acceleration. At the same instant another body passes through $x = 0$ moving in the positive x-direction with a constant speed. The position of the first body is given by $x_1(t)$ after time 't' and that of the second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes $(x_1 - x_2)$ as a function of time 't'

a) 

b) 

c) 

d) 

375. Two cars A and B are moving with same speed of $45\ km/hr$ along same direction. If a third car C coming from the opposite direction with a speed of $36\ km/hr$ meets two cars in an interval of 5 minutes, the distance of separation of two cars A and B should be (in km)

a) 6.75 b) 7.25 c) 5.55 d) 8.35

376. A body A moves with a uniform acceleration a and zero initial velocity. Another body B, starts from the same point moves in the same direction with a constant velocity v. The two bodies meet after a time t. The value of t is

a) $\frac{2v}{a}$ b) $\frac{v}{a}$ c) $\frac{v}{2a}$ d) $\sqrt{\frac{v}{2a}}$

377. Consider the acceleration, velocity and displacement of a tennis ball as it falls to the ground and bounces back. Directions of which of these changes in the process

a) Velocity only b) Displacement and velocity
c) Acceleration, velocity and displacement d) Displacement and acceleration

378. Starting from rest, acceleration of a particle is $a = 2(t - 1)$. The velocity of the particle at $t = 5s$ is

a) $15\ m/sec$ b) $25\ m/sec$ c) $5\ m/sec$ d) None of these

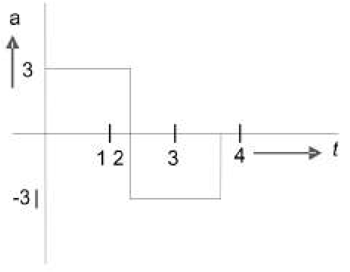
379. A ball P is dropped vertically and another ball Q is thrown horizontally with the same velocities from the same height and at the same time. If air resistance is neglected, then

a) Ball P reaches the ground first
b) Ball Q reaches the ground first
c) Both reach the ground at the same time
d) The respective masses of the two balls will decide the time

380. Two identical metal spheres are released from the top of a tower after t seconds of each other such that they fall along the same vertical line. If air resistance is neglected, then at any instant of time during their fall

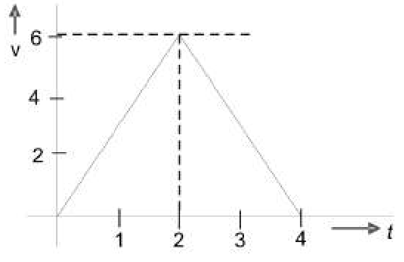
a) The difference in their displacements remains the same
b) The difference between their speeds remains the same
c) The difference between their heights above ground is proportional to t^2
d) The difference between their displacements is proportional to t

381. A particle starts from rest at $t = 0$ and undergoes an acceleration a in ms^{-2} with time t in second which is as shown

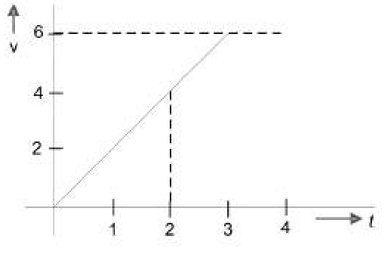


Which one of the following plot represents velocity v in ms^{-1} *versus* time t in second?

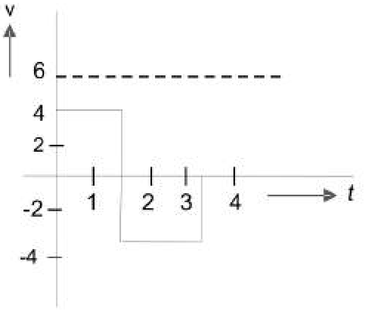
a)



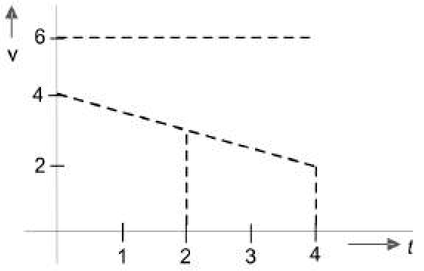
b)



c)



d)

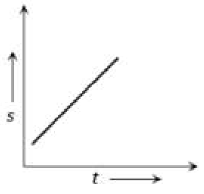


382. A body is thrown vertically upwards with velocity u. The distance travelled by it in the fifth and the sixth seconds are equal. The velocity u is given by ($g = 9.8\ m/s^2$)

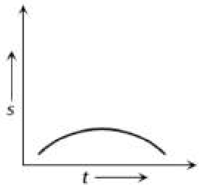
a) 24.5 m/s b) 49.0 m/s c) 73.5 m/s d) 98.0 m/s

383. Which of the following graph represents uniform motion

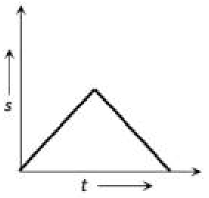
a)



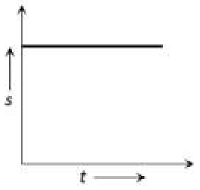
b)



c)



d)



384. A train of 150 m length is going towards north direction at a speed of 10m/sec. A parrot flies at the speed of 5 m/sec towards south direction parallel to the railway track. The time taken by the parrot to cross the train is

a) 12 sec b) 8 sec c) 15 sec d) 10 sec

385. A body is thrown vertically upwards with velocity u. The distance travelled by it in the fifth and the sixth seconds are equal. The velocity u is given by ($g = 9.8\ m/s^2$)

a) 24.5 m/s b) 49.0 m/s c) 73.5 m/s d) 98.0 m/s

386. A ball is dropped from a high rise platform at $t = 0$ starting from rest. After 6 seconds another ball is thrown downwards from the same platform with a speed v. The two balls meet at $t = 18s$. What is the value of v? (taking g $= 10\ m/s^2$)

a) 60 m/s b) 75 m/s c) 55 m/s d) 40 m/s

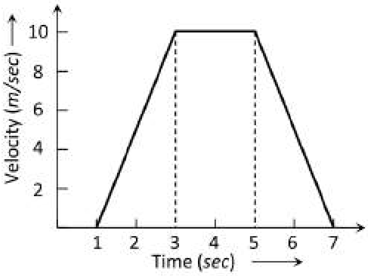
387. Two stones of equal masses are dropped from a rooftop of height h one after another. Their separation distance against time will

a) Remain the same b) Increase c) Decrease d) Be zero

388. A juggler throws balls into air. He throws one whenever the previous one is at its highest point. If the throws n balls each second, the height to which each ball will rise is

a) $\frac{g}{2n^2}$ b) $\frac{2g}{n^2}$ c) $\frac{2g}{n}$ d) $\frac{g}{4n^2}$

389. For the velocity-time graph shown in figure below the distance covered by the body in last two seconds of its motion is what fraction of the total distance covered by it in all the seven seconds



a) $\frac{1}{2}$ b) $\frac{1}{4}$ c) $\frac{1}{3}$ d) $\frac{2}{3}$

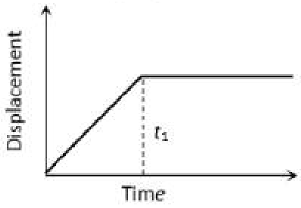
390. Two boys are standing at the ends A and B of a ground where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, where t is

a) $a/\sqrt{v^2 + v_1^2}$ b) $\sqrt{a^2/(v^2 - v_1^2)}$ c) $a/(v - v_1)$ d) $a/(v + v_1)$

391. A body is projected with a velocity v and after some time it returns to the point from which it was projected. The average velocity and average speed of the body for the total time of flight are

a) $\vec{v}/2$ and $v/2$ b) 0 and $v/2$ c) 0 and 0 d) $\vec{v}/2$ and 0

392. The $x - t$ graph shown in the figure represents



a) Constant velocity
b) Velocity of the body is continuously changing
c) Instantaneous velocity
d) The body travels with constant speed upto time t_1 and then stops

393. A body starts from rest, with uniform acceleration a. The acceleration of a body as function of time t is given by the equation $a = pt$ where p is constant, then the displacement of the particle in the time interval $t = 0$ to $t = t_1$ will be

a) $\frac{1}{2}pt_1^3$ b) $\frac{1}{3}pt_1^2$ c) $\frac{1}{4}pt_1^2$ d) $\frac{1}{6}pt_1^3$

394. Velocity-time curve for a body projected vertically upwards is

a) Parabola b) Ellipse c) Hyperbola d) Straight line

395. For a body moving with relativistic speed, if the velocity is doubled, then

a) Its linear momentum is doubled b) Its linear momentum will be less than double
c) Its linear momentum will be more than double d) Its linear momentum remains unchanged

396. A boat is sent across a river with a velocity of boat is 10 km/hr. If the resultant velocity of boat is 10 km/hr, then velocity of the river is :

a) 10 km/hr b) 8 km/hr c) 6 km/hr d) 4 km/hr

397. A particle moves along with x –axis. The position x of particle with respect to time t from origin given by $x = b_0 + b_1t + b_2t^2$. The acceleration of particle is

a) b_0 b) b_1 c) b_2 d) $2b_2$

398. A particle is moving with constant acceleration from A to B in a straight line AB. If u and v are the velocities at A and B respectively, then its velocity at the midpoint c will be

a) $\left(\frac{u^2+v^2}{2u}\right)^2$ b) $\frac{u+v}{2}$ c) $\frac{v-u}{2}$ d) $\sqrt{\frac{u^2+v^2}{2}}$

399. A student is standing at a distance of 50 metres from the bus. As soon as the bus begins its motion with an acceleration of $1\ ms^{-2}$, the student starts running towards the bus with a uniform velocity u. Assuming the motion to be along a straight road, the minimum value of u, so that the student is able to catch the bus is

a) $52\ ms^{-1}$ b) $8\ ms^{-1}$ c) $10\ ms^{-1}$ d) $12\ ms^{-1}$

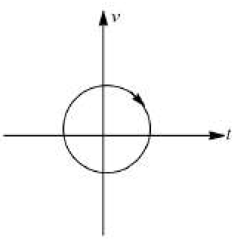
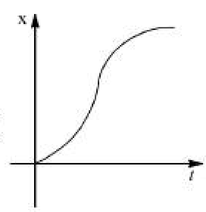
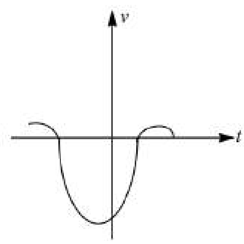
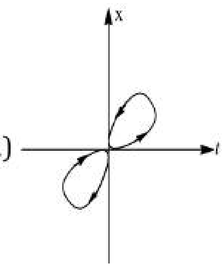
400. A stone is thrown with an initial speed of $4.9\ m/s$ from a bridge in vertically upward direction. It falls down in water after 2 sec. The height of the bridge is

a) $4.9\ m$ b) $9.8\ m$ c) $19.8\ m$ d) $24.7\ m$

401. Two bodies are thrown vertically upwards with their initial speed in the ratio 2 : 3. The ratio of the maximum heights reached by then and the ratio of their time taken by them to return back to the ground respectively are

a) 4 : 9 and 2 : 3 b) 2 : 3 and $\sqrt{2} : \sqrt{3}$ c) $\sqrt{2} : \sqrt{3}$ and 4 : 9 d) $\sqrt{2} : \sqrt{3}$ and 2 : 3

402. Look at the graph (a) to (d) carefully and indicate which of these possibly represents one dimensional motion of a particle?

a) 
b) 
c) 
d) 

403. If the velocity of a particle is $(10 + 2t^2)m/s$, then the average acceleration of the particle between $2s$ and $5s$ is

a) $2m/s^2$ b) $4m/s^2$ c) $12m/s^2$ d) $14m/s^2$

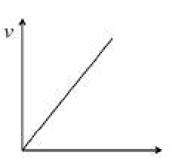
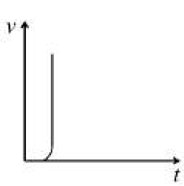
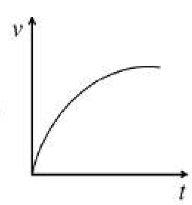
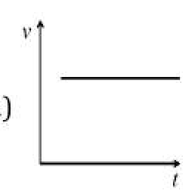
404. The acceleration of a particle is increasing linearly with time t as bt.The particle starts from the origin with an initial velocity v_0. The distance travelled by the particle in time t will be

a) $v_0t + \frac{1}{3}bt^2$ b) $v_0t + \frac{1}{3}bt^3$ c) $v_0t + \frac{1}{6}bt^3$ d) $v_0t + \frac{1}{2}bt^2$

405. A ball is thrown vertically upwards from the top of a tower at $4.9\ ms^{-1}$. It strikes the pond near the base of the tower after 3 $seconds$. The height of the tower is

a) $73.5\ m$ b) $44.1\ m$ c) $29.4\ m$ d) None of these

406. An object is dropped from rest. Its v-t graph is

a) 
b) 
c) 
d) 

407. An object is projected upwards with a velocity of $100m/s$. It will strike the ground after (approximately)

a) 10 sec b) 20 sec c) 15 sec d) 5 sec

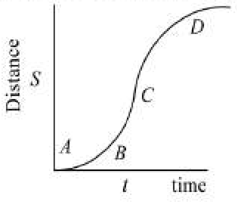
408. A constant force acts on a body of mass $0.9\ kg$ at rest for $10s$. If the body moves a distance of $250\ m$, the magnitude of the force is

a) $3N$ b) $3.5N$ c) $4.0N$ d) $4.5N$

409. The displacement- time graph for two particles A and B are straight lines inclined at angles of 30° and 60° with the time axis. The ratio of velocities of $V_A : V_B$ is

a) $1:2$ b) $1:\sqrt{3}$ c) $\sqrt{3}:1$ d) $1:3$

410. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point



a) D b) A c) B d) C

411. Acceleration of a particle changes when

a) Direction of velocity changes
b) Magnitude of velocity changes
c) Both of above
d) Speed changes

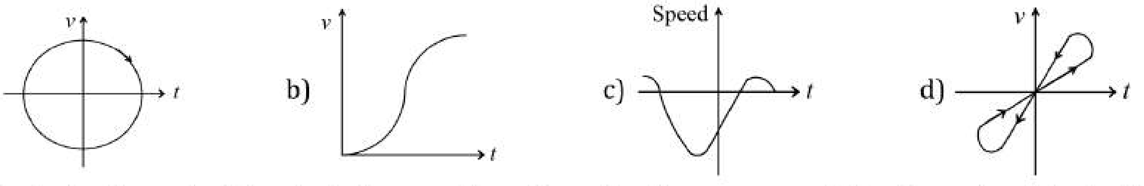
412. A particle is projected upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2 respectively. The velocity of projection will be

a) gt_1 b) gt_2 c) $g(t_1 + t_2)$ d) $\frac{g(t_1 + t_2)}{2}$

413. A particle is projected up with an initial velocity of $80\ ft/sec$. The ball will be at a height of $96\ ft$ from the ground after

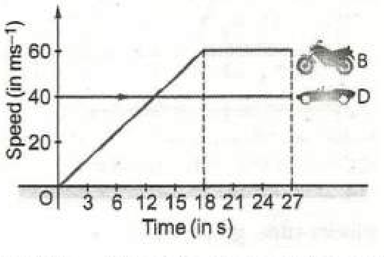
a) 2.0 and 3.0 sec b) Only at 3.0 sec c) Only at 2.0 sec d) After 1 and 2 sec

414. Look at the graphs (a) to (d) carefully and indicate which of these possibly represents one dimensional motion of a particle



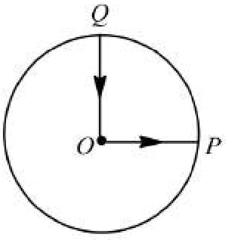
415. At he instant a motor bike starts from rest in a given direction, a car overtakes the motor bike, both moving in the same direction. The speed-time graphs for motor bike and car are represented by OAB and CD respectively.

Then



a) At $t = 18$ s the motor bike and car are 180m apart
b) At $t = 18$ s the motor bike and car are 720m apart
c) The relative distance between motor bike and car reduces to zero at $t = 27$ s and both are 1080m far from origin
d) The relative distance between motor bike and car always remains same

416. A cyclist starts from the centre$O$ of a circular park of radius 1 km, reaches the edge P of the park, then cycles along the circumference and returns to the point O as shown in figure. If the round trip takes 10 min, the net displacement and average speed of the cyclist (in metre and kilometer per hour) are



a) 0, 1
b) $\frac{\pi+4}{2}, 0$
c) $214, \frac{\pi+4}{2}$
d) 0, 21.4

417. An elevator car, whose floor to ceiling distance is equal to $2.7m$, starts ascending with constant acceleration of $1.2ms^{-2}$. 2 sec after the start, a bolt begins falling from the ceiling of the car. The free fall time of the bolt is

a) $\sqrt{0.54}s$
b) $\sqrt{6}\,s$
c) 0.7 s
d) 1 s

418. A packet is dropped from a balloon which is going upwards with the velocity 12 m/s , the velocity of the packet after 2 seconds will be

a) $-12\ m/s$
b) $12\ m/s$
c) $-7.6\ m/s$
d) $7.6\ m/s$

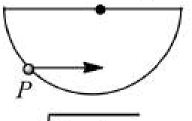
419. A car starts from rest and moves with uniform acceleration a on a straight road from time $t = 0$ to $t = T$. After that, a constant deceleration brings it to rest. In this process the average speed of the car is

a) $\frac{aT}{4}$
b) $\frac{3aT}{2}$
c) $\frac{aT}{2}$
d) aT

420. A ball is thrown vertically upwards with a velocity of 25 ms^{-1} from the top of a tower of height 30 m. How long will it travel before it hits ground

a) $6s$
b) $5s$
c) $4s$
d) $12s$

421. A particle of mass m is initially situated at the point P inside a hemispherical surface of radius r as shown in figure. A horizontal acceleration of magnitude $a_0$is suddenly produced on the particle in the horizontal direction. If gravitational acceleration is neglected, the time taken by particle to touch the sphere again is



a) $\sqrt{\frac{4r\ \sin\alpha}{a_0}}$
b) $\sqrt{\frac{4r\ \tan\alpha}{a_0}}$
c) $\sqrt{\frac{4r\ \cos\alpha}{a_0}}$
d) None of these

422. A body A starts from rest with an acceleration a_1. After 2 seconds, another body B starts from rest with an acceleration a_2. If they travel equal distances in the 5th second, after the start of A, then the ration $a_1 : a_2$ is equal to

a) 5 : 9
b) 5 : 7
c) 9 : 5
d) 9 : 7

423. Which of the following statements is correct?

a) When air resistance is negligible, the time of ascent is less than the time of descent
b) When air resistance is not negligible, time of ascent is less than the time of descent
c) When air resistance is not negligible, the time ascent is greater than the time of descent
d) When air resistance is not negligible, the time of ascent is lesser than the time of descent

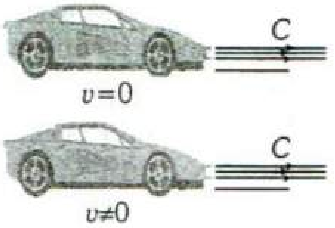
424. A point starts moving in a straight line with a certain acceleration. At a time t after beginning of motion the acceleration suddenly becomes retardation of the same value. The time in which the point returns to the initial point is

a) $\sqrt{2t}$
b) $(2 + \sqrt{2})t$
c) $\frac{t}{\sqrt{2}}$
d) Cannot be predicted unless acceleration is given

425. A ball thrown upward from the top of a tower with speed v reaches the ground in t_1 second. If this ball is thrown downward from the top of he same tower with speed v it reaches the ground in t_2 second. In what time the ball shall reach the ground if it is allowed to falls freely under gravity from the top of the tower?

a) $\frac{t_1 + t_2}{2}$ b) $\frac{t_1 - t_2}{2}$ c) $\sqrt{t_1 t_2}$ d) $t_1 + t_2$

426.



In figure, one car at rest and velocity of the light from head light is c, tehn velocity of light from head light for the moving car at velocity v, would be

a) $c + v$ b) $c - v$ c) $c \times v$ d) c

427. A stone is dropped from a height h. Simultaneously, another stone is thrown up from the ground which reaches a height 4 h. The two stones cross other after time

a) $\sqrt{\frac{h}{8g}}$ b) $\sqrt{8gh}$ c) $\sqrt{2gh}$ d) $\sqrt{\frac{h}{2g}}$

428. A target is made of two plates, one of wood and the other of iron. The thickness of the wooden plate is 4 cm and that of iron plate is 2 cm. A bullet fired goes through the wood first and then penetrates 1 cm into iron. A similar bullet fired with the same velocity from opposite direction goes through iron first and then penetrates 2cm into wood. If a_1 and $a_2$be the retardation offered to the bullet by wood and iron plates respectively, then

a) $t_1 + t_2$ b) $a_2 = 2a_1$ c) $a_1 = a_2$ d) Data insufficient

429. Three balls A, B, C are thrown from a height h with equal speed upwards, downwards and horizontally respectively. What is the relation among speeds v_A, v_B, v_C with which they hit the ground?

a) $v_A = v_B = v_C$ b) $v_A > v_C > v_B$ c) $v_A = v_B > v_C$ d) $v_A < v_C < v_B$

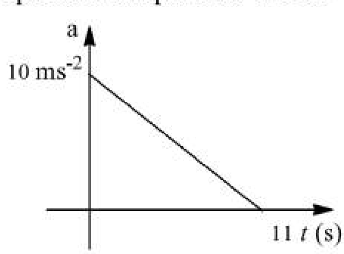
430. A boat travels 50 km east, then 120 km north and finally it comes back to the starting point through the shortest distance. The total time of journey is 3 h. What is the average speed, in kmh^{-1}, over the entire trip?

a) Zero b) 100 c) 17 d) 33.33

431. A stone thrown vertically upward files past a window one second after it was thrown upward and after three second on its way downward. The height of the window above the ground is (Take $g = 10ms^{-2}$)

a) 20 m b) 15 m c) 10 m d) 5 m

432. A particle starts from rest. Its acceleration (a) *versus* time (t) is as shown in the figure. The maximum speed of the particle will be



a) $110\ ms^{-1}$ b) $55\ ms^{-1}$ c) $550\ ms^{-1}$ d) $660\ ms^{-1}$

433. A person travels along a straight road for the first half time with a velocity v_1 and the next half time with a velocity v_2

The mean velocity V of the man is

a) $\frac{2}{V} = \frac{1}{v_1} + \frac{1}{v_2}$ b) $V = \frac{v_1 + v_2}{2}$ c) $V = \sqrt{v_1 v_2}$ d) $V = \sqrt{\frac{v_1}{v_2}}$

434. A body A is thrown up vertically from the ground with a velocity V_0 and another body B is simultaneously dropped from a height H. They meet at a height $\frac{H}{2}$ if V_0 is equal to

a) $\sqrt{2gH}$ b) $\sqrt{gH}$ c) $\frac{1}{2}\sqrt{gH}$ d) $\sqrt{\frac{2g}{H}}$

435. The three initial and final position of a man on the x –axis are given as
(i) $(-8m, 7m)$ (ii) $(7m, -3m)$ and (iii) $(-7m, 3m)$
Which pair gives the negative displacement

a) (i) b) (ii) c) (iii) d) (i) and (iii)

436. A particle starts from rest and experiences constant acceleration for 6 s. if it travels a distance d_1 in the first two second, a distance d_2 in the next two seconds and a distance d_3 in the last two second, then

a) $d_1 : d_2 : d_3 = 1 : 1 : 1$ b) $d_1 : d_2 : d_3 = 1 : 2 : 3$
c) $d_1 : d_2 : d_3 = 1 : 3 : 5$ d) $d_1 : d_2 : d_3 = 1 : 5 : 9$

437. A body is thrown vertically up from the ground. It reaches a maximum height of $100m$ in $5sec$. After what time it will reach the ground from the maximum height position

a) 1.2 sec b) 5 sec c) 10 sec d) 25 sec

438. From a balloon rising vertically upwards as 5 ms^{-1} a stone is thrown up at 10 ms^{-1} relative to the balloon. Its velocity with respect to ground after 2 s is
(assume $g = 10\ \text{ms}^{-2}$)

a) Zero b) 5ms^{-1} c) 10 ms^{-1} d) 20 ms^{-1}

439. A 120 m long train is moving in a direction with speed 20 m/s. A train B moving with 30 m/s in the opposite direction and 130 m long crosses the first train in a time

a) 6 s b) 36 s c) 38 s d) None of these

440. If a freely falling body travels in the last second a distance equal to the distance travelled by it in the first three second, the time of the travel is

a) 6 sec b) 5 sec c) 4 sec d) 3 sec

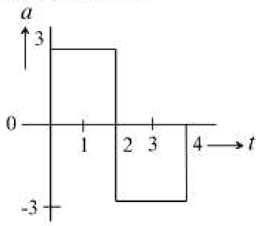
441. The area under acceleration-time graph gives

a) Distance travelled b) Change in acceleration
c) Force acting d) Change in velocity

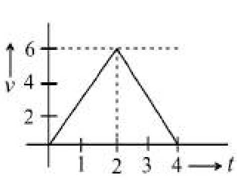
442. A particle is thrown vertically upwards. If it velocity at half of the maximum height is 10 m/sec, then maximum height attained by it is (Take $g = 10\ m/\sec^2$)

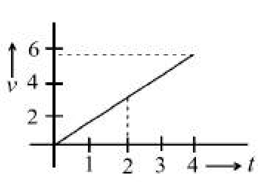
a) 8 m b) 10 m c) 12 m d) 16 m

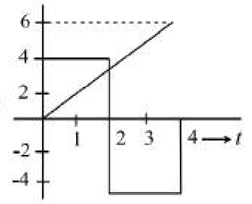
443. A particle starts from rest at $t = 0$ and undergoes an acceleration a in ms^{-2} with time t in seconds which is as shown

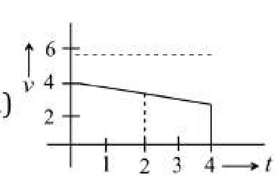


Which one of the following plot represents velocity V in ms^{-1} versus time t in seconds

a) 

b) 

c) 

d) 

444. A train starts from station with an acceleration $1ms^{-2}$. A boy is 48 m behind the train with a constant velocity $10ms^{-1}$, the minimum time after which the boy will catch the train is

a) 4.8 s b) 8 s c) 10 s d) 12 s

445. The displacement of the particle varies with time according to the relation $x = \frac{k}{b}[1 - e^{-bt}]$. Then the velocity of the particle is

a) $k(e^{-bt})$ b) $\frac{k}{b^2 e^{-bt}}$ c) $k\ b\ e^{-bt}$ d) None of these

446. The velocity of a body of mass 20 kg decreases from $20\ ms^{-1}$to $5\ ms^{-1}$ in a distance of 100 m. Force on the body is

a) −27.5 N b) −47.5 N c) −37.5 N d) −67.5 N

447. Two bodies being a free fall from rest, from the same height 2s apart. How long after the first body begins to fall the two bodies will be 40m apart? (Take $g = 10ms^{-2}$)

a) 1 s b) 2 s c) 3 s d) 4 s

448. From an elevated point A, a stone is projected vertically upwards. When the stone reaches a distance h below A, its velocity is double of what was at a height above A. The greatest height attained by the stone is

a) $\frac{h}{3}$ b) $\frac{2h}{2}$ c) $\frac{h}{2}$ d) $\frac{5h}{3}$

449. A bullet is fired with a speed of 1000 m/sec in order to hit a target 100 m away. If $g = 10\ m/s^2$, the gun should be aimed

a) Directly towards the target b) 5 cm above the target

c) 10 cm above the target d) 15 cm above the target

450. A particle moving with a uniform acceleration travels 24 m and 64 m in the first two consecutive intervals of 4 sec each.

Its initial velocity is

a) 1 m/sec b) 10 m/sec c) 5 m/sec d) 2 m/sec

451. A ball is dropped on the floor from a height of 10 m. It rebounds to a height of 2.5m. If the ball is in contact with the floor for 0.01 sec, the average acceleration during contact is

a) 2100 $m/\sec^2$ downwards b) 2100 $m/\sec^2$ upwards

c) 1400 $m/\sec^2$ d) 700$m/\sec^2$

452. A car moves a distance of 200 m. It covers first half of the distance at speed 60 kmh^{-1} and the second half at speed v. If the average speed is 40 kmh^{-1}, the value of v is

a) 30 kmh^{-1} b) 13 kmh^{-1} c) 60 kmh^{-1} d) 40 kmh^{-1}

453. Free fall of an object (in vacuum) is a case of motion with

a) Uniform velocity b) Uniform acceleration c) Variable acceleration d) Constant momentum

454. A projectile is fired vertically upwards with an initial velocity u. After an interval of T seconds a second projectile is fired vertically upwards, also with initial velocity is

a) They meet at time $t = \frac{u}{g}$ and at a height $\frac{u^2}{2G} + \frac{gT^2}{8}$

b) They meet at time $t = \frac{u}{g} + \frac{T}{2}$ and at a height $\frac{u^2}{2g} + \frac{gT^2}{8}$

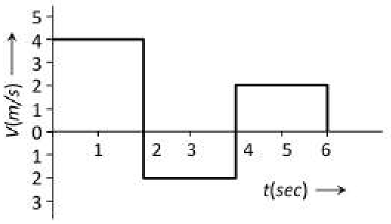
c) They meet at time $t = \frac{u}{g} + \frac{T}{2}$ and at a height $\frac{u^2}{2g} - \frac{gT^2}{8}$

d) They never meet

455. A body starting from rest moves with uniform acceleration. The distance covered by the body in time t is proportional to

a) $\sqrt{t}$ b) $t^{3/2}$ c) $t^{2/3}$ d) t^2

456. The velocity-time graph of a body moving in a straight line is shown in the figure. The displacement and distance travelled by the body in 6 sec are respectively



a) $8\ m, 16\ m$ b) $16\ m, 8\ m$ c) $16\ m, 16\ m$ d) $8\ m, 8\ m$

457. A Body moves $6\ m$ north. $8\ m$ east and $10\ m$ vertically upwards, what is its resultant displacement from initial position

a) $10\sqrt{2m}$ b) $10\ m$ c) $\frac{10}{\sqrt{2}}m$ d) $10 \times 2m$

458. A particle moves along a straight line such that its position x at any time t is $x = 6t^2 - t^3$. Where x in metre ant t is in second, then

a) At $t = 0$ acceleration is $12\ \text{ms}^{-2}$ b) $x - t$ curve has maximum at 4 s

c) Both (a) and (b) are wrong d) Both (a) and (b) are correct

459. Two trains are moving with equal speed in opposite directions along two parallel railway tracks. If the wind is blowing with speed u along the track so that the relative velocities of the trains with respect to the wind are in the ratio 1: 2, then the speed of each train must be

a) $3u$ b) $2u$ c) $5u$ d) $4u$

460. A body is projected with a velocity v and after some time it returns to the point from which it was projected. The average velocity and average speed of the body for the total time of flight are

a) $\vec{v}/2$ and $v/2$ b) 0 and $v/2$ c) 0 and 0 d) $\vec{v}/2$ and 0

461. Two cars A and B are travelling in the same direction with velocities v_A and $v_B (v_A > v_B)$. When the car A is at a distance s behind car B, the driver of the car A applies the brakes producing a uniform retardation a, there will be no collision when

a) $s < \frac{(v_A - v_B)^2}{2a}$ b) $s = \frac{(v_A - v_B)^2}{2a}$ c) $s \geq \frac{(v_A - v_B)^2}{2a}$ d) $s \leq \frac{(v_A - v_B)^2}{2a}$

462. A body falling from a high Minaret travels $40\ m$ in the last 2 seconds of its fall to ground. Height of Minaret in meters is (take $g = 10\ m/s^{-2}$)

a) 60 b) 45 c) 80 d) 50

463. A body is moving with uniform acceleration describes $40\ m$ in the first 5 sec and $65\ m$ in next 5 sec. Its initial velocity will be

a) $4\ m/s$ b) $2.5\ m/s$ c) $5.5\ m/s$ d) $11\ m/s$

464. A bullet moving with a velocity of $200\ cm/s$ penetrates a wooden block and comes to rest after traversing $4cm$ inside it. What velocity is needed for travelling distance of $9cm$ in same block

a) $100\ cm/s$ b) $136.2cm/s$ c) $300cm/s$ d) $250\ cm/s$

465. For a moving body at any instant of time

a) If the body is not moving, the acceleration is necessarily zero

b) If the body is slowing, the retardation is negative

c) If the body is slowing, the distance is negative

d) If displacement, velocity and acceleration at that instant are known, we can find the displacement at any given time in future

466. A ball is dropped from a bridge at a height of 176.4 m over a river. After 2 s, a second ball is thrown straight downwards. What should be the initial velocity of the second ball so that both hit the water simultaneously?

a) $2.45\ \text{ms}^{-1}$ b) $49\ \text{ms}^{-1}$ c) $14.5\ \text{ms}^{-1}$ d) $24.5\ \text{ms}^{-1}$

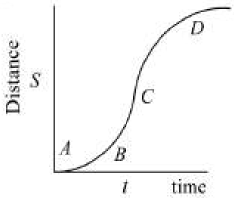
467. The acceleration a of a particle starting from rest varies with time according to relation $a = \alpha t + \beta$. The velocity of the particle after a time t will be

a) $\frac{\alpha t^2}{2} + \beta$ b) $\frac{\alpha t^2}{2} + \beta t$ c) $\alpha t^2 + \frac{1}{2}\beta t$ d) $\frac{(\alpha t^2 + \beta)}{2}$

468. The relation between time and distance is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is

a) $2\alpha v^3$ b) $2\beta v^3$ c) $2\alpha\beta v^3$ d) $2\beta^2 v^3$

469. A particle shows distance-time curve as given in this figure. The maximum instantaneous velocity of the particle is around the point

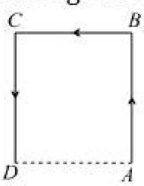


a) D b) A c) B d) C

470. A point particle starting from rest has a velocity that increase linearly with time such that $v = pt$, where $p = 4\text{ms}^{-2}$. The distance covered in the first 2 s will be

a) 6 m b) 4 m c) 8 m d) 10 m

471. A particle moves along the sides AB, BC, CD of a square of side 25 m wuth a velocity of 15 ms^{-1}. Its average velocity is

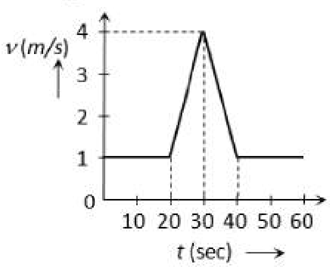


a) 15 ms^{-1} b) $10ms^{-1}$ c) $7.5ms^{-1}$ d) $5ms^{-1}$

472. If a body is thrown up with the velocity of 15 m/s then maximum height attained by the body is ($g = 10\ m/s^2$)

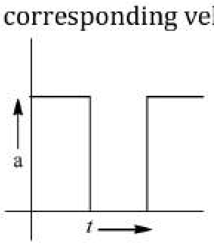
a) 11.25 m b) 16.2 m c) 24.5 m d) 7.62 m

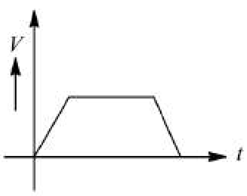
473. Velocity-time (v-t) graph for a moving object is shown in the figure. Total displacement of the object during the same interval when there is non-zero acceleration and retardation is

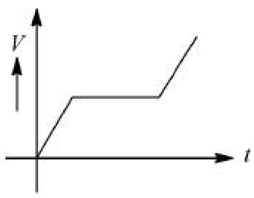


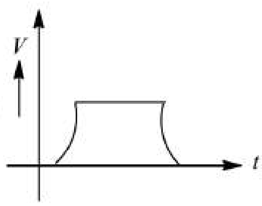
a) 60 m b) 50 m c) 30 m d) 40 m

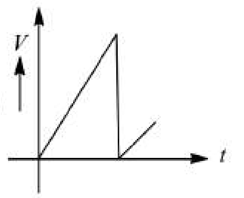
474. Figure shows the acceleration-time graphs of a particle. Which of the following represents the corresponding velocity-time graphs?



a) 

b) 

c) 

d) 

475. A boggy of uniformly moving train is suddenly detached from train and stops after covering some distance. The distance covered by the boggy and distance covered by the train in the same time has relation

a) Both will be equal
b) First will be half of second
c) First will be 1/4 of second
d) No definite ratio

476. An aeroplane is moving with horizontal velocity u at height h.The velocity of a packet dropped from it on the earth's surface will be (g is acceleration due to gravity)

a) $\sqrt{u^2+2gh}$
b) $\sqrt{2gh}$
c) $2gh$
d) $\sqrt{u^2-2gh}$

477. From the top of a tower of height 50m, a ball is thrown vertically upwards with a certain velocity. It hits the ground 10 s after it is thrown up. How much time does it take to cover a distance AB where A and B are two points 20m and 40m below the edge of the tower? ($g = 10\text{ms}^{-2}$)

a) 2.0 s
b) 1.0 s
c) 0.5 s
d) 0.4 s

478. A ball is thrown vertically upwards. It was observed at a height h twice with a time interval Δt. The initial velocity of the ball is

a) $\sqrt{8gh+g^2(\Delta t)^2}$
b) $\sqrt{8gh+\left(\frac{g\Delta t}{2}\right)^2}$
c) $\frac{1}{2}\sqrt{8gh+g^2(\Delta t)^2}$
d) $\sqrt{8gh+4g^2(\Delta t)^2}$

479. A particle moves along a semicircle of radius 10m in 5 seconds. The average velocity of the particle is

a) $2\pi\ ms^{-1}$
b) $4\pi\ ms^{-1}$
c) $2\ ms^{-1}$
d) $4\ ms^{-1}$

480. A boy released a ball from the top of a building. It will clear a window 2m high at a distance 10m below the top in nearly

a) 1 s
b) 1.3 s
c) 0.6 s
d) 0.13 s

481. A stone is dropped into water from a bridge 44.1m above the water. Another stone is thrown vertically downward 1s later. Both strike the water simultaneously. What was the initial speed of the second stone?

a) $12.25\ \text{ms}^{-1}$
b) $14.75\ \text{ms}^{-1}$
c) $16.23\ \text{ms}^{-1}$
d) $17.15\ \text{ms}^{-1}$

482. The ratios of the distances traversed, in successive intervals of time by a body, falling from rest are

a) 1 : 3 : 5 : 7 : 9 : ...
b) 2 : 4 : 6 : 8 : 10 : ...
c) 1 : 4 : 7 : 10 : 13 : ...
d) None of these

483. Equation of displacement for any particle is $s = 3t^3 + 7t^2 + 14t + 8m$. Its acceleration at time $t = 1$ sec is

a) $10\ m/s^2$
b) $16\ m/s^2$
c) $25\ m/s^2$
d) $32\ m/s^2$

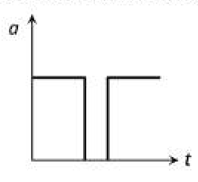
484. A balloon is rising vertically up with a velocity of 29 ms^{-1}. A stone is dropped from it and it reaches the ground in 10 seconds. The height of the balloon when the stone was dropped from it is ($g = 9.8\ ms^{-2}$)

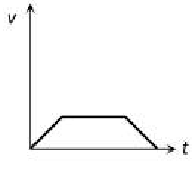
a) 100 m
b) 200 m
c) 400 m
d) 150 m

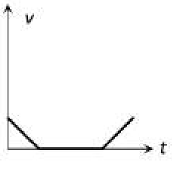
485. A particle moving with a uniform acceleration travels 24 m and 64 m in the first two consecutive intervals of 4 sec each.
Its initial velocity is

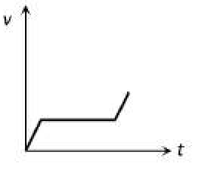
a) 1 m/sec
b) 10 m/sec
c) 5 m/sec
d) 2 m/sec

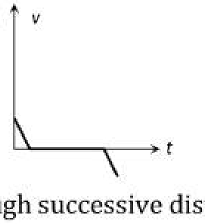
486. Acceleration-time graph of a body is shown. The corresponding velocity-time graph of the same body is



a) 

b) 

c) 

d) 

487. A particle is dropped vertically from rest a height. The time taken by it to fall through successive distances of 1 m each will then be

a) All equal, being equal to $\sqrt{2/g}$ second

b) In the ratio of the square roots of the integers 1, 2, 3.......

c) In the ratio of the difference in the square roots of the integers i.e. $\sqrt{1}, (\sqrt{2}-\sqrt{1}), (\sqrt{3}-\sqrt{2}), (\sqrt{4}-\sqrt{3})$......

d) In the ratio of the reciprocal of the square roots of the integers i.e.,. $\frac{1}{\sqrt{1}}, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{4}}$

488. A particle moves along x-axis as
$x = 4(t-2) + a(t-2)^2$
Which of the following is true
a) The initial velocity of the particle is 4
b) The acceleration of particle is $2a$
c) The particle is at origin at $t = 0$
d) None of these

489. The displacement-time graphs of two particles A and B are straight lines making angles of respectively 30° and 60° with the time axis. If the velocity of A is v_A and that of B is v_B, then the value of $\frac{v_A}{v_B}$ is
a) $\frac{1}{2}$
b) $\frac{1}{\sqrt{3}}$
c) $\sqrt{3}$
d) $\frac{1}{3}$

490. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that if faces constant resistance to motion
a) 1.5 cm
b) 1.0 cm
c) 3.0 cm
d) 2.0 cm

491. With what velocity a ball be projected vertically so that the distance covered by it in 5th second is twice the distance it covers in its 6th second ($g = 10\ m/s^2$)
a) 58.8 m/s
b) 49 m/s
c) 65 m/s
d) 19.6 m/s

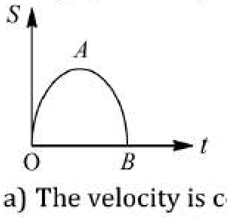
492. A body is moving along a straight line path with constant velocity. At an instant of time the distance travelled by it is S and its displacement is D, then
a) $D < S$
b) $D > S$
c) $D = S$
d) $D \leq S$

493. A body is released from a great height falls freely towards the earth. Another body is released from the same height exactly a second later. Then the separation between two bodies, 2 s after the release of the second body is, nearly
a) 15 m
b) 20 m
c) 25 m
d) 30 m

494. A particle moves along a straight line such that its displacement at any time t is given by $S = t^3 - 6t^2 + 3t + 4$ *metres*
The velocity when the acceleration is zero is
a) $3ms^{-1}$
b) $-12ms^{-1}$
c) $42ms^{-1}$
d) $-9ms^{-1}$

495. A balloon is rising vertically up with a velocity of 29 ms^{-1}. A stone is dropped from it and it reaches the ground in 10 s. The height of the balloon when the stone was dropped from it is ($g = 9.8\ ms^{-2}$)
a) 400 m
b) 150 m
c) 100 m
d) 200 m

496. The graph of displacement-time for a body travelling in a straight line is given. We can conclude that



a) The velocity is constant
b) The velocity increases uniformly.
c) The body is subjected to acceleration from O to A.
d) The velocity of the body at A is zero.

497. A balloon gong upward with a velocity of 12 ms^{-1} is at a height of 65 m from the earth's surface at any instant. Exactly at this instant a ball drops from it. How much time will the ball take in reaching the surface of earth?
($g = 10\ ms^{-2}$)
a) 5 s
b) 6 s
c) 10 s
d) None of these

498. A ball is dropped from a high rise platform at $t = 0$ starting from rest. After 6 seconds another ball is thrown downwards from the same platform with a speed v. The two balls meet at $t = 18s$. What is the value of v? (taking $g = 10\ m/s^2$)

a) $60\ m/s$ b) $75\ m/s$ c) $55\ m/s$ d) $40\ m/s$

499. Starting from rest, acceleration of a particle is $a = 2(t-1)$. The velocity of the particle at $t = 5s$ is

a) $15\ m/sec$ b) $25\ m/sec$ c) $5\ m/sec$ d) None of these

500. A body of mass m is thrown upwards at an angle θ with the horizontal with velocity v. While rising up the velocity of the mass after t second will be

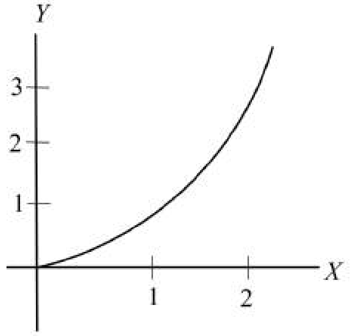
a) $\sqrt{(v\cos\theta)^2 + (v\sin\theta)^2}$ b) $\sqrt{(v\cos\theta - v\sin\theta)^2 - gt}$

c) $\sqrt{v^2 + g^2t^2 - (2\ v\sin\theta)gt}$ d) $\sqrt{v^2 + g^2 + g^2 - (2\ v\cos\theta)gt}$

501. The motion of a particle is described by the equation $x = a + bt^2$ where $a = 15\ cm$ and $b = 3\ cm/s^2$.Its instantaneous velocity at time 3 sec will be

a) $36\ cm/sec$ b) $18\ cm/sec$ c) $16\ cm/sec$ d) $32\ cm/sec$

502. If the figure below represents a parabola, identify the physical quantities representing Y and X for constant acceleration



a) X = time, Y = velovity b) X = velocity, Y = time

c) X = time, Y = displacement d) X = time, Y = acceleration

503. Two balls are dropped from height h and $2h$ respectively from the earth surface. The ratio of time of these balls to reach the earth is

a) $1 : \sqrt{2}$ b) $\sqrt{2} : 1$ c) $2 : 1$ d) $1 : 4$

504. A body starts from rest, with uniform acceleration. If its velocity after n seconds is v,then its displacement in the last two seconds is

a) $\frac{2v(n+1)}{n}$ b) $\frac{v(n+1)}{n}$ c) $\frac{v(n-1)}{n}$ d) $\frac{2v(n-1)}{n}$

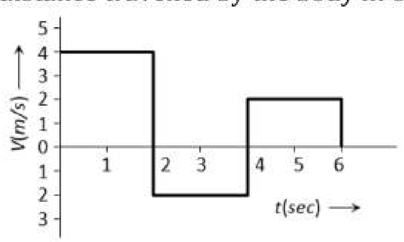
505. The distance x covered by a particle in one-dimensional motion varies with time t as $x^2 = at^2 + 2bt + c$. The accelerating of the particle varies as

a) x^{-3} b) $x^{3/2}$ c) x^2 d) $x^{-2/3}$

506. A particle moves for 20 *seconds* with velocity $3\ m/s$ and then velocity $4\ m/s$ for another 20 *seconds* and finally moves with velocity $5\ m/s$ for next 20 *seconds*. What is the average velocity of the particle

a) $3\ m/s$ b) $4\ m/s$ c) $5\ m/s$ d) Zero

507. The velocity-time graph of a body moving in a straight line is shown in the figure. The displacement and distance travelled by the body in 6 sec are respectively



a) $8\ m, 16\ m$ b) $16\ m, 8\ m$ c) $16\ m, 16\ m$ d) $8\ m, 8\ m$

508. A stone thrown upward with a speed u from the top of the tower reaches the ground with a velocity $3u$. The height of the tower is

a) $3u^2/g$ b) $4u^2/g$ c) $6u^2/g$ d) $9u^2/g$

509. Two trains each 50 m long are travelling in opposite direction with velocity 10 m/s and 15 m/s. The time of crossing is

a) $2s$ b) $4s$ c) $2\sqrt{3}s$ d) $4\sqrt{3}\,s$

510. A projectile is fired vertically upwards with an initial velocity u. After an interval of T seconds a second projectile is fired vertically upwards, also with initial velocity is

a) They meet at time $t=\frac{u}{g}$ and at a height $\frac{u^2}{2G}+\frac{gT^2}{8}$

b) They meet at time $t=\frac{u}{g}+\frac{T}{2}$ and at a height $\frac{u^2}{2g}+\frac{gT^2}{8}$

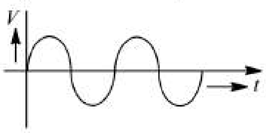
c) They meet at time $t=\frac{u}{g}+\frac{T}{2}$ and at a height $\frac{u^2}{2g}-\frac{gT^2}{8}$

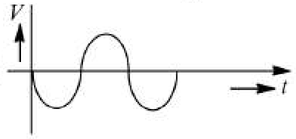
d) They never meet

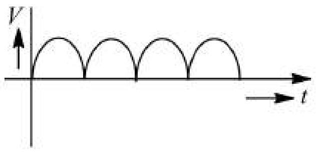
511. A body of *mass* 10 kg is moving with a constant velocity of 10 m/s.When a constant force acts for 4 *seconds* on it, it moves with a velocity 2 m/sec in the opposite direction. The acceleration produced in it is

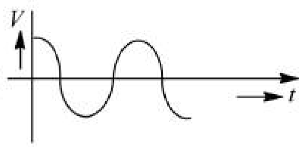
a) $3m/\sec^2$ b) $-3m/\sec^2$ c) $0.3m/\sec^2$ d) $-0.3m/\sec^2$

512. The position of a particle at any instant t is given by $x=a\cos\omega t$. The speed-time graph of the particle is

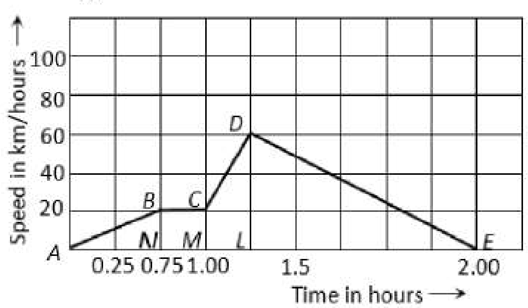
a) 

b) 

c) 

d) 

513. A train moves from one station to another 2 hours time. Its speed-time graph during this motion is shown in the figure. The maximum acceleration during the journey is



a) 140 $km\,h^{-2}$

b) 160 $km\,h^{-2}$

c) 100 $km\,h^{-2}$

d) 120 $km\,h^{-2}$

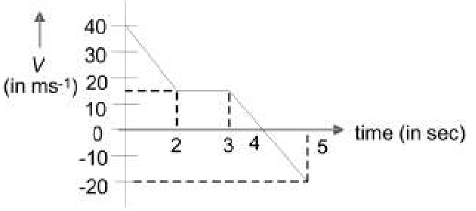
514. From the top of a tower, a particle is thrown vertically downwards with a velocity of 10ms^{-1}. The ratio of the distances covered by it in the 3rd and 2nd seconds of its motion is (Given, $g=10\text{ms}^{-2}$)

a) 7:5 b) 3:4 c) 4:3 d) 6:5

515. A body travels for 15 *sec* starting from rest with constant acceleration. If it travels distances S_1, S_2 and S_3 in the first five seconds, second five secods and next five seconds respectively the relation between S_1, S_2 and S_3 is

a) $S_1=S_2=S_3$ b) $5S_1=3S_2=S_3$ c) $S_1=\frac{1}{3}S_2=\frac{1}{5}S_3$ d) $S_1=\frac{1}{5}S^2=\frac{1}{3}S_3$

516. In the given $v-t$ graph, the distance travelled by the body in 5 will be

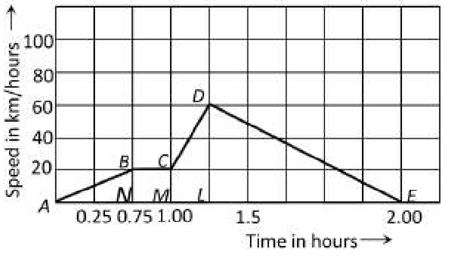


a) 20 m b) 40 m c) 80 m d) 100 m

517. A particle moves along a straight line such that its displacement at any time t is given by $s = t^3 - 6t^2 + 3t + 4$. The velocity when its acceleration is zero is

a) $2\ \text{ms}^{-1}$ b) $12\ \text{ms}^{-1}$ c) $-9\ \text{ms}^{-1}$ d) $2\ \text{ms}^{-1}$

518. A train moves from one station to another 2 hours time. Its speed-time graph during this motion is shown in the figure. The maximum acceleration during the journey is



a) $140\ km\ h^{-2}$ b) $160\ km\ h^{-2}$ c) $100\ km\ h^{-2}$ d) $120\ km\ h^{-2}$

519. A body A is thrown up vertically from the ground with a velocity V_0 and another body B is simultaneously dropped from a height H. They meet at a height $\frac{H}{2}$ if V_0 is equal to

a) $\sqrt{2gH}$ b) $\sqrt{gH}$ c) $\frac{1}{2}\sqrt{gH}$ d) $\sqrt{\frac{2g}{H}}$

520. Displacement (x) of a particle is related to time (t) as

$$x = at + bt^2 - ct^3$$

Where a, b and c are constants of the motion. The velocity of the particle when its acceleration is zero is given by

a) $a + \frac{b^2}{c}$ b) $a + \frac{b^2}{2c}$ c) $a + \frac{b^2}{3c}$ d) $a + \frac{b^2}{4c}$

521. A stone dropped from a building of height h and it reaches after t seconds on earth. From the same building if two stones are thrown (one upwards and other downwards) with the same velocity u and they reach the earth surface after t_1 and t_2 seconds respectively, then

a) $t = t_1 - t_2$ b) $t = \frac{t_1 + t_2}{2}$ c) $t = \sqrt{t_1 t_2}$ d) $t = t_1^2 t_2^2$

522. A goa can travel at a speed of 8 kmh^{-1} in still water on a lake. In the flowing water of a stream, it can move at 8kmh^{-1} relative to the water in the stream. If the stream speed is 3kmh^{-1}, how fast can the boat move past a tree on the shore in travelling (i) upstream (ii) downstream?

a) 5kmh^{-1} and 11 kmh^{-1} b) 11kmh^{-1} and 5 kmh^{-1}

c) 8kmh^{-1} and 8 kmh^{-1} d) 5kmh^{-1} and 5 kmh^{-1}.

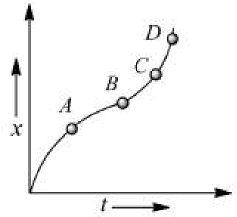
523. A car is moving along a straight road with uniform, acceleration. It passes through two points P and Q separated by a distance with velocities 30kmh^{-1} and 40kmh^{-1} respectively. The velocity of car midway between P and Q is

a) 33.3km^{-1} b) 1 km^{-1} c) $25\sqrt{2}\text{km}^{-1}$ d) 35.35 km^{-1}

524. If a train travelling at 72 $kmph$ is to be brought to rest in a distance of 200 metres, then its retardation should be

a) 20 ms^{-2} b) 10 ms^{-2} c) 2 ms^{-2} d) 1ms^{-2}

525. Figure shows the graphical variation of displacement with time for the case of a particle moving along a straight line. The accelerations of the particle during the intervals OA, AB, BC and CD are respectively

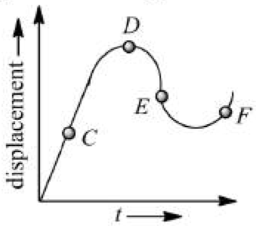


a) OA AB BC CD b) $-$ 0 + 0 c) + 0 + + d) $-$ 0 $-$ 0

526. A bee files a line from a point A to another point B in 4 s with a velocity of $|t-2|\text{ms}^{-1}$. The distance between A and B in metre is

a) 2 b) 4 c) 6 d) 8

527. The displacement-time graph of a moving particle is shown below. The instantaneous velocity of the particle is negative at the point



a) C b) D c) E d) F

528. The retardation experienced by a moving motor boat, after its engine is cut off, is given by $\frac{du}{dt}=-kv^3$, where k is a constant.
If v_0 is the magnitude of the velocity at cut-off, the magnitude of the velocity at time t after the cut-off is

a) v_0 b) $\frac{v_0}{2}$ c) v_0e^{-kt} d) $\frac{v_0}{\sqrt{2v_0^2kt+1}}$

529. A body moves 6m north, 8m east and 10m vertically upwards, what is its resultant displacement from initial position?

a) $10\sqrt{2}$m b) 10m c) $\frac{10}{\sqrt{2}}$m d) 10×2 m

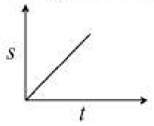
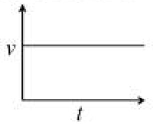
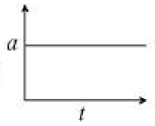
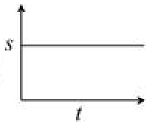
530. A particle moving along a straight line has a velocity v ms^{-1}, when it cleared a distance of y metre. These two are connected by the relation $v=\sqrt{49+y}$. When its velocity is 1 ms^{-1}, its acceleration (in ms^{-2})is

a) 1 b) 2 c) 7 d) 0.5

531. The distance between two particles moving towards each other is decreasing at the rate of $6m/sec$. If these particles travel with same speeds and in the same direction, then the separation increase at the rate of $4m/sec$. The particles have speeds as

a) $5m/sec$: $1m/sec$ b) 4 m/sec : $1m/sec$ c) 4 m/sec : $2m/sec$ d) 5 m/sec : $2m/sec$

532. Which graph represents a state of rest for an object

a)  b)  c)  d) 

533. When a ball is thrown up vertically with velocity V_0 , it reaches a maximum height of $'h'$. If one wishes to triple the maximum height then the ball should be thrown with velocity

a) $\sqrt{3}V_0$ b) $3V_0$ c) $9V_0$ d) $3/2V_0$

534. A body dropped from a height h with an initial speed zero, strikes the ground with a velocity 3 km/h . Another body of same mass is dropped from the same height h with an initial speed $-u' = 4km/h$. Find the final velocity of second body with which it strikes the ground

a) 3 km/h b) 4 km/h c) 5 km/h d) 12 km/h

535. A man is 45 m behind the bus when the bus start accelerating from rest with acceleration 2.5 m/s^2. With what minimum velocity should the man start running to catch the bus

a) $12\ m/s$ b) $14\ m/s$ c) $15\ m/s$ d) $16\ m/s$

536. A body is moving from rest under constant acceleration and let S_1 be the displacement in the first $(P-1)$ sec and S_2 be the displacement in the first P sec. The displacement in $(P^2-P+1)^{th}$ see will be

a) S_1+S_2 b) S_1S_2 c) S_1-S_2 d) $S_1\,/\,S_2$

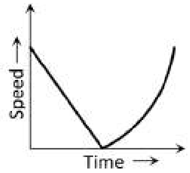
537. A body projected vertically upwards with velocity u returns to the starting point in 4 seconds. If $g = 10\ m/\sec^2$, the value of u is

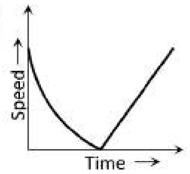
a) $5\ m/sec$ b) $10\ m/sec$ c) $15\ m/sec$ d) $20\ m/sec$

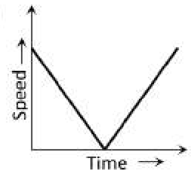
538. Two bodies of different masses m_a and m_b are dropped from two different heights a and b. The ratio of the time taken by the two to cover these distances are

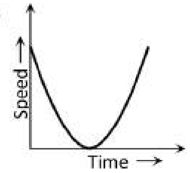
a) $a:b$ b) $b:a$ c) $\sqrt{a}:\sqrt{b}$ d) $a^2:b^2$

539. A ball is thrown vertically upwards. Which of the following plots represents the speed-time graph of the ball during its flight if the air resistance is not ignored

a) 

b) 

c) 

d) 

540. A cricket ball is thrown up with a speed of $19.6\ ms^{-1}$. The maximum height it can reach is

a) $9.8\ m$ b) $19.6\ m$ c) $29.4\ m$ d) $39.2\ m$

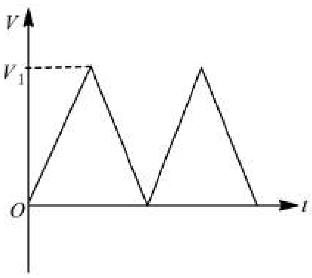
541. The displacement of the particle varies with time according to the relation $x=\frac{k}{b}[1-e^{-bt}]$. Then the velocity of the particle is

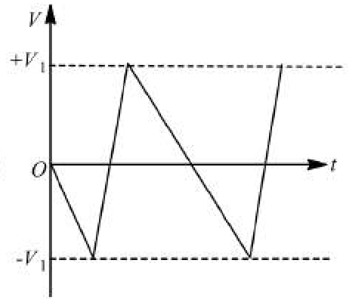
a) $k(e^{-bt})$ b) $\frac{k}{b^2e^{-bt}}$ c) $k\ b\ e^{-bt}$ d) None of these

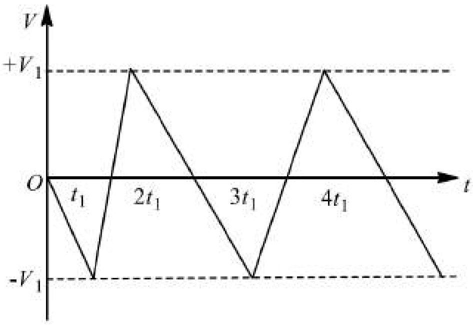
542. A body of 5 kg is moving with a velocity of $20m/s$. If a force of $100N$ is applied on it for $10s$ in the same direction as its velocity, what will now be the velocity of the body

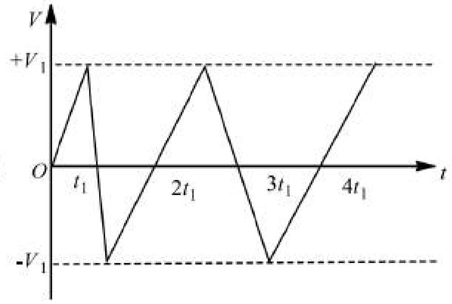
a) $200\ m/s$ b) $220\ m/s$ c) $240\ m/s$ d) $260\ m/s$

543. Consider a rubber ball freely falling from a height $h = 4.9$ m onto a horizontal elastic plate. Assume that the duration of collision is negligible and the collision with the plate is totally elastic. Then the velocity as a function of time will be

a) 

b) 

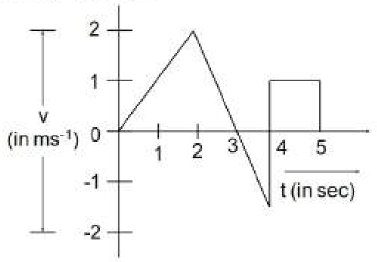
c) 

d) 

544. A ball is thrown up under gravity ($g = 10\ m/sec^2$). Find its velocity after 1.0 sec at a height of $10m$

a) $5\ m/\sec^2$ b) $5\ m/sec$ c) $10\ m/sec$ d) $15\ m/sec$

545. The velocity-time graph of a particle moving along a straight line is shown in figure. The displacement of the body in 5s is



a) 0.5m b) 1m c) 2m d) 3m

546. At $t = 0$, a stone of mass 10 gm is thrown straight up from the ground level with a speed 10 m/s. After 1 s, a second stone of the same mass is thrown from the same position with a speed 20 m/s. What is the position of the first stone from the ground level at that moment? (Take g = 10 m/s^2)

a) 10 m b) 1 m c) 2 m d) 5 m

547. A man is 45 m behind the bus, when the bus starts accelerating from rest with acceleration 2.5 ms^{-2}. With what minimum velocity should the man start running to catch the bus?

a) 12 ms^{-1} b) 14 ms^{-1} c) 15 ms^{-1} d) 16 ms^{-1}

548. The initial velocity of a body moving along a straight line is 7 m/s. It has a uniform acceleration of 4 m/s^2. The distance covered by the body in the 5^{th} second of its motion is

a) 25 m b) 35 m c) 50 m d) 85 m

549. A very large number of balls are thrown vertically upwards in quick succession in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height is 5m, the number of ball thrown per minute is (take $g = 10\ ms^{-2}$)

a) 120 b) 80 c) 60 d) 40

550. A ball dropped from the 9th story of a multi-storeyed building reaches the ground in 3s. In the first second of its free fall, it passes through n stories, where n is equal to (Take g = 10ms^{-2})

a) 1 b) 2 c) 3 d) 4

551. Two balls are dropped from height h and 2h respectively from the earth surface. The ratio of time of these balls to reach the earth is

a) $1 : \sqrt{2}$ b) $\sqrt{2} : 1$ c) $2 : 1$ d) $1 : 4$

552. A car travels half the distance with constant velocity of 40 $kmph$ and the remaining half with a constant velocity of 60 $kmph$. The average velocity of the car in $kmph$ is

a) 40 b) 45 c) 48 d) 50

553. The displacement x of a particle at the instant when its velocity v is given by $v = \sqrt{3x + 16}$. Its acceleration and initial velocity are

a) 1.5 units, 4 units b) 3 units, 4 units c) 16 units, 1.6 units d) 16 units, 3 units

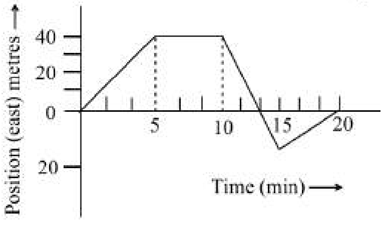
554. The velocity of a particle is $v = v_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time $(t = 1) is$

a) $v_0 = 2g + 3f$ b) $v_0 + g/2 + f/3$ c) $v_0 + g + f$ d) $v_0 + g/2 + f$

555. A body falls from rest, its velocity at the end of first second is ($g = 32ft/sec$)

a) 16 ft/sec b) 32 ft/sec c) 64 ft/sec d) 24 ft/sec

556. A body begins to walk eastward along a street in front of his house and the graph of his position from home is shown in the following figure. His average speed for the whole time interval is equal to



a) 8 m/min b) 6 m/min c) $\frac{8}{3}$ m/min d) 2 m/min

557. The ratios of the distances traversed, in successive intervals of time by a body, falling from rest are
a) 1 : 3 : 5 : 7 : 9 : ... b) 2 : 4 : 6 : 8 : 10 : ... c) 1 : 4 : 7 : 10 : 13 : ... d) None of these

558. If the velocity of a particle is given by $v = (180 - 16x)^{1/2}\text{ms}^{-1}$, then its acceleration will be
a) Zero b) 8 ms^{-2} c) -8 ms^{-2} d) 4 ms^{-2}

559. The initial velocity of a body moving along a straight line is 7 m/s. It has a uniform acceleration of 4 m/s^2. The distance covered by the body in the 5^{th} second of its motion is
a) 25 m b) 35 m c) 50 m d) 85 m

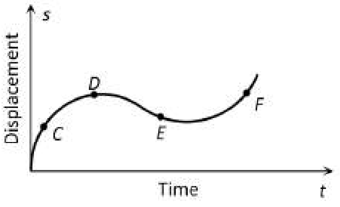
560. A car moving with a speed of 50 kmh^{-1}, can be stopped by brakes after at least 6 m. if the same car is moving at a speed of 100 kmh^{-1}, the minimum stopping distance is
a) 12 m b) 18 m c) 24 m d) 6 m

561. A small block sides without friction down an inclined plane starting from rest. Let S_n be the distance travelled from time $t = n - 1$ to $t = n$. Then $\frac{S_n}{S_{n+1}}$ is
a) $\frac{2n-1}{2n}$ b) $\frac{2n+1}{2n-1}$ c) $\frac{2n-1}{2n+1}$ d) $\frac{2n}{2n+1}$

562. A body has speed of V,2V and 3V in first 1/3 of distance S, seconds 1/3 of S and third 1/3 of S respectively. Its average speed will be
a) V b) $2V$ c) $\frac{18}{11}V$ d) $\frac{11}{18}V$

563. A particle projected vertically upwards attains a maximum height H. If the ratio of the times to attain a height $h(h < H)$ is $\frac{1}{3}$. Then
a) $4h = 3H$ b) $3h = 4H$ c) $3h = H$ d) $4h = H$

564. The displacement-time graph of moving particle is shown below



The instantaneous velocity of the particle is negative at the point
a) D b) F c) C d) E

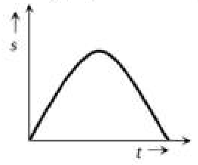
565. A bus begins to move with an acceleration of $1ms^{-2}$. A man who is $48m$ behind the bus starts running at $10\ ms^{-1}$ to catch the bus. The man will be able to catch the bus after
a) $6s$ b) $5s$ c) $3s$ d) $8s$

566. The driver of an express train moving with a velocity v_1 finds that a goods train is moving with a velocity v_2 in the same direction on the same track. He applies the brakes and produces a retardation a. The minimum time required to avoid collision is
a) $\frac{v_1 - v_2}{a}$ b) $\frac{v_1}{a}$ c) $\frac{v_2}{a}$ d) $\frac{v_1 + v_2}{a}$

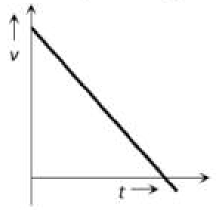
567. A ball is released from the top of a tower of height h metre. It takes$T$ sec to reach the ground. What is the position of the ball in$\frac{T}{3}$s?
a) $h/9$ m from the ground
b) $7h/9$ m from the ground
c) $8h/9$ m from the ground
d) $17h/18$ m from the ground

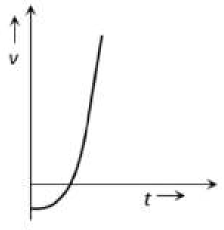
568. A particle is constrained to move on a straight line path. It returns to the starting point after 10 sec. The total distance covered by the particle during this time is 30 m. Which of the following statement about the motion of the particle is false
a) Displacement of the particle is $zero$
b) Average speed of the particle is 3 m/s
c) Displacement of the particle is 30 m
d) Both (a) and (b)

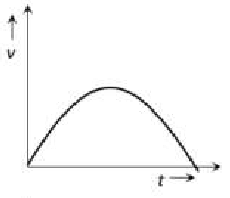
569. The graph of displacement v/s time is

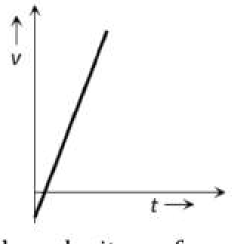


Its corresponding velocity-time graph will be

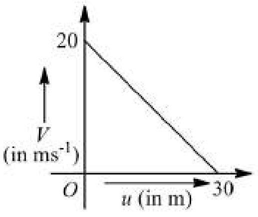
a) 

b) 

c) 

d) 

570. If the velocity v of a particle moving along a straight line decreases linearly with its displacement s from $20 ms^{-1}$ to a value approaching zero $s = 30$ m, then acceleration of the particle at s = 15m is



a) $\frac{2}{3} ms^{-2}$ b) $-\frac{2}{3} ms^{-2}$ c) $\frac{20}{3} ms^{-2}$ d) $-\frac{20}{3} ms^{-2}$

571. From the top of a tower, a stone is thrown up and reaches the ground in time $t_1 = 9$s. A second stone is thrown down with the same speed and reaches the ground in time $t_2 = 4$ s. A third stone is released from rest and reaches the ground in time t_3, which is equal to

a) 6.5 s b) 6.0 s c) $\frac{5}{36}$ s d) 65 s

572. A ball is projected upwards from a height h above the surface of the earth with velocity v. The time at which the ball strikes the ground is

a) $\frac{v}{g} + \frac{2hg}{\sqrt{2}}$ b) $\frac{v}{g}\left[1 - \sqrt{1 + \frac{2h}{g}}\right]$ c) $\frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$ d) $\frac{v}{g}\left[1 + \sqrt{v^2 + \frac{2h}{g}}\right]$

573. The displacement of a particle is given by $y = a + bt + ct^2 - dt^4$. The initial velocity and acceleration are respectively

a) $b, -4d$ b) $-b, 2c$ c) $b, 2c$ d) $2c, -4d$

574. A car starts from station and moves along the horizontal road by a machine delivering constant power. The distance covered by the car in time t is proportional to

a) t^2 b) $t^{3/2}$ c) $t^{2/3}$ d) t^3

575. A 210 m long train is moving due North at a speed of 25 m/s. A small bird is flying due South a little above the train with speed 5 m/s. The time taken by the bird to cross the train is

a) $6s$ b) $7s$ c) $9s$ d) $10s$

576. Two identical metal spheres are released from the top of a tower after t seconds of each other such that they fall along the same vertical line. If air resistance is neglected, then at any instant of time during their fall

a) The difference in their displacements remains the same

b) The difference between their speeds remains the same

c) The difference between their heights above ground is proportional to t^2

d) The difference between their displacements is proportional to t

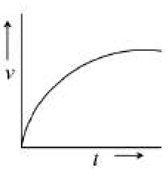
577. Time taken by an object falling from rest to cover the height of h_1 and h_2 is respectively t_1 and t_2 then the ratio of t_1 to t_2 is

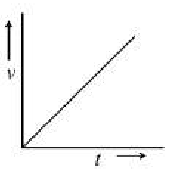
a) $h_1 : h_2$ b) $\sqrt{h_1} : \sqrt{h_2}$ c) $h_1 : 2h_2$ d) $2h_1 : h_2$

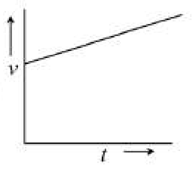
578. A body projected vertically upwards crosses a point twice in its journey at a height h just after t_1 and t_2 second. Maximum height reached by the body is

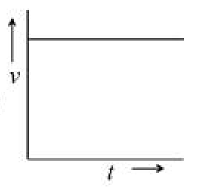
a) $\frac{g}{4}(t_1 + t_2)^2$ b) $g\left(\frac{t_1 + t_2}{4}\right)^2$ c) $2g\left(\frac{t_1 + t_2}{4}\right)^2$ d) $\frac{g}{4}(t_1 t_2)$

579. A body starts from rest and moves with uniform acceleration. Which of the following graphs represent its motion

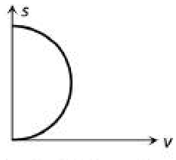
a) 

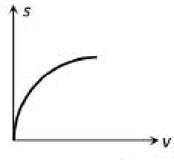
b) 

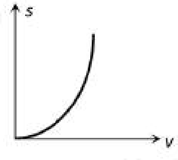
c) 

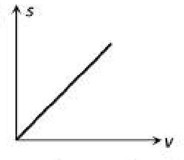
d) 

580. An object is moving with a uniform acceleration which is parallel to its instantaneous direction of motion. The displacement (s) –velocity (v)graph of this object is

a) 

b) 

c) 

d) 

581. A body falling from a high Minaret travels 40 m in the last 2 seconds of its fall to ground. Height of Minaret in meters is (take $g = 10\ m/s^{-2}$)

a) 60

b) 45

c) 80

d) 50

582. A train has a speed of 60 km/h. for the first one hour and 40 km/h for the next half hour. Its average speed in km/h is

a) 50 b) 53.33 c) 48 d) 70

583. A body falls from rest in the gravitational field of the earth. The distance travelled in the fifth second of its motion is $(g = 10\ m/s^2)$

a) $25m$ b) $45m$ c) $90m$ d) $125m$

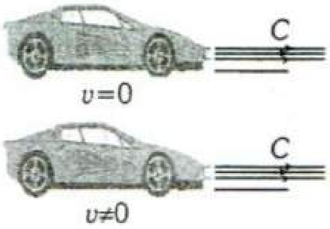
584. A bind person after walking 10 steps in one direction each of length 80cm, turns randomly to the left or to right by 90∘. After walking a total of 40 steps, the maximum displacement of the person from its starting point can be

a) Zero b) $8\sqrt{2}$m c) $16\sqrt{2}$m d) 32 m

585. Water drops fall at regular intervals from a tap which is 5 m above the ground. The third drop is leaving the tap at the instant the first drop touches the ground. How far above the ground is the second drop at that instant

a) 2.50 m b) 3.75 m c) 4.00 m d) 1.25 m

586.



In figure, one car at rest and velocity of the light from head light is c, tehn velocity of light from head light for the moving car at velocity v, would be

a) $c+v$ b) $c-v$ c) $c\times v$ d) c

587. If a car covers $2/5^{th}$ of the total distance with v_1 speed and $3/5^{th}$ distance with v_2 then average speed is

a) $\frac{1}{2}\sqrt{v_1 v_2}$ b) $\frac{v_1+v_2}{2}$ c) $\frac{2v_1 v_2}{v_1+v_2}$ d) $\frac{5v_1 v_2}{3v_1+2v_2}$

588. Two trains each 50 m long are travelling in opposite direction with velocity 10 m/s and 15 m/s. The time of crossing is

a) $2s$ b) $4s$ c) $2\sqrt{3}s$ d) $4\sqrt{3}\,s$

589. A car travels equal distances in the same direction with velocities 60kmh^{-1}, 20 km h^{-1} and 10 km h^{-1}respectively. The average velocity of the car over the whole journey of motion is

a) 8 ms^{-1} b) 7 ms^{-1} c) 6 ms^{-1} d) 5 ms^{-1}

590. A particle moving in a straight line covers half the distance with speed of 3m/s. The other half of the distance is covered in two equal time intervals with speed of 4.5 m/s and 7.5 m/s respectively. The average speed of particle during this motion is

a) 4m/s b) 5m/s c) 5.5m/s d) 4.8m/s

591. A man goes 10 m towards North, then 20 m towards east then displacement is

a) 22.5m b) 25m c) 25.5m d) 30m

592. Two spheres of same size, one of mass 2 kg and another of mass 4 kg, are dropped simultaneously from the top of Qutab Minar (height = 72 m). When they are 1 m above the ground, the two spheres have the same

a) Momentum b) Kinetic energy c) Potential energy d) Acceleration

593. A body of mass 3 kg falls from the multi-storeyed building 100m high and buries itself 2m deep in the sand. The time of penetration will be

a) 0.09 s b) 0.9 s c) 9 s d) 10 s

594. The distance travelled by a particle starting from rest and moving with an acceleration $\frac{4}{3}ms^{-2}$, in the third second is

a) $\frac{10}{3}m$ b) $\frac{19}{3}m$ c) 6 m d) 4 m

595. A train is moving towards east and a car is along north, both with same speed. The observed direction of car to the passenger in the train is

a) East- north direction

b) West-north direction

c) South-east direction

d) None of these

596. Velocity of a body on reaching the point from which it was projected upwards, is

a) $v = 0$ b) $v = 2u$ c) $v = 0.5u$ d) $v = u$

597. A particle moves 200 cm in the first 2s and 220 cm in the next 4s with uniform deceleration. The velocity of the particle at the end of 7s is

a) 12 cms^{-1} b) 11 cms^{-1} c) 10cms^{-1} d) 5 cms^{-1}

598. The motion of a body falling from rest in a resistive medium is described by the equation $\frac{dv}{dt} = a - bv$, where a and b are constants. The velocity at any time t is

a) $a(1 - b^{2t})$ b) $\frac{a}{b}(1 - e^{-bt})$ c) abe^{-t} d) $ab^2(1 - t)$

599. A stone is shot straight upward with a speed of 20 m/sec from a tower 200 m high. The speed with which it strikes the ground is approximately

a) 60 m/sec b) 65 m/sec c) 70 m/sec d) 75 m/sec

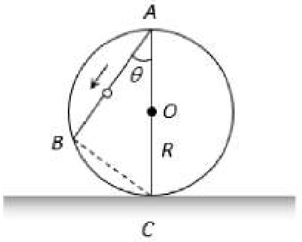
600. A stone falls from a balloon that is descending at a uniform rate of 12ms^{-1}. The displacement of the stone from the point of release after 10s is

a) 725 m b) 610 m c) 510 m d) 490 m

601. A particle covers half of its total distance with speed v_1 and the rest half distance with speed v_2. Its average speed during the complete journey is

a) $\frac{v_1^2 v_2^2}{v_1^2 + v_2^2}$ b) $\frac{v_1 + v_2}{2}$ c) $\frac{v_1 v_2}{v_1 + v_2}$ d) $\frac{2v_1 v_2}{v_1 + v_2}$

602. A frictionless wire AB is fixed on a sphere of radius R. A very small spherical ball slips on this wire. The time taken by this ball to slip from A to B is



a) $\frac{2\sqrt{gR}}{g\cos\theta}$ b) $2\sqrt{gR}.\frac{\cos\theta}{g}$ c) $2\sqrt{\frac{R}{g}}$ d) $\frac{gR}{\sqrt{g\cos\theta}}$

603. A river is flowing from W to E with a speed of 5 m/min. A man can swim in still water with a velocity 10 m/min. In which direction should the man swim so as to take the shortest possible path to go to the south

a) 30° with downstream b) 60° with downstream

c) 120° with downstream d) South

604. The acceleration experienced by a moving boat after is engine is cut-off, is given by $a = -kv^3$, where k is a constant. If v_0 is the magnitude of velocity at cut-off, then the magnitude of the velocity at time t after the cut off is

a) $\frac{v_0}{2ktv_0^2}$ b) $\frac{v_0}{1 + 2\,ktv_0^2}$ c) $\frac{v_0}{\sqrt{1 - 2\,k\,v_0^2}}$ d) $\frac{v_0}{\sqrt{1 + 2\,ktv_0^2}}$

605. A body has speed of V,2V and 3V in first 1/3 of distance S, seconds 1/3 of S and third 1/3 of S respectively. Its average speed will be

a) V b) $2V$ c) $\frac{18}{11}V$ d) $\frac{11}{18}V$

606. The ratio of the numerical values of the average velocity and average speed of a body is always

a) Unity b) Unity or less c) Unity or more d) Less than unity

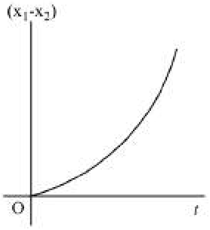
607. The velocity of a bullet is reduced from 200 m/s to 100 m/s while travelling through a wooden block of thickness 10 cm. The retardation, assuming it to be uniform, will be

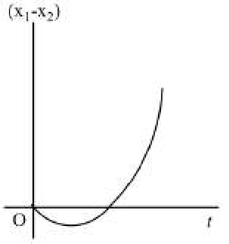
a) $10 \times 10^4\ m/s^2$ b) $12 \times 10^4\ m/s^2$ c) $13.5 \times 10^4\ m/s^2$ d) $15 \times 10^4\ m/s^2$

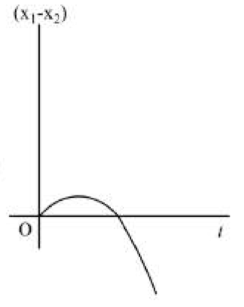
608. A ball is thrown vertically upwards from the top of a tower of height h with velocity v. The ball strikes the ground after

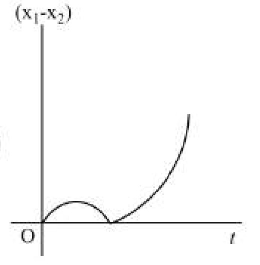
a) $\frac{v}{g}\left[1+\sqrt{1+\frac{2gh}{v^2}}\right]$ b) $\frac{v}{g}\left[1-\sqrt{1+\frac{2gh}{v^2}}\right]$ c) $\frac{v}{g}\left(1+\frac{2gh}{v^2}\right)^{1/2}$ d) $\frac{v}{g}\left(1-\frac{2gh}{v^2}\right)^{1/2}$

609. A body is at rest at $x=0$. At $t=0$, it starts moving in the positive x −direction with a constant acceleration. At the same instant another body passes through $x=0$ moving in the positive x −direction with a constant speed. The position of the first body is given by $x_1(t)$ after time t and that of the second body by $x_2(t)$ after the same time interval. Which of the following graphs correctly describes (x_1-x_2) as a function of time t?

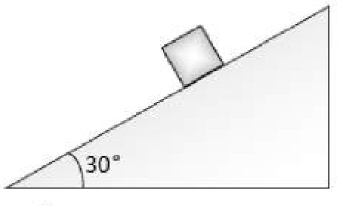
a) 

b) 

c) 

d) 

610. The time taken by a block of wood (initially at rest)to slide down a smooth inclined plane 9.8 m long (angle of inclination is 30°) is



a) $\frac{1}{2}sec$ b) $2sec$ c) $4sec$ d) $1sec$

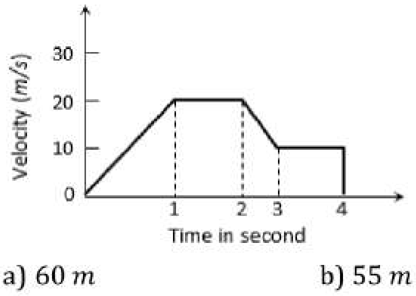
611. A ball of mass $m_1$and another ball of mass m_2 are dropped from equal height. If time taken by the balls are t_1 and t_2 respectively, then

a) $t_1=\frac{t_2}{2}$ b) $t_1=t_2$ c) $t_1=4t_2$ d) $t_1=\frac{t_2}{4}$

612. A person moves 30 m north and then 20 m towards east and finally $30\sqrt{2}$m in south-west direction. The displacement of the person from the origin will be

a) 10 m along north b) 10 m along south c) 10 m along west d) Zero

613. The variation of velocity of a particle with time moving along a straight line is illustrated in the following figure. The distance travelled by the particle in four seconds is



a) 60 m b) 55 m c) 25 m d) 30 m

614. A ball is thrown up under gravity ($g=10\ m/sec^2$). Find its velocity after 1.0 sec at a height of 10m

a) 5 $m/\sec^2$ b) 5 m/sec c) 10 m/sec d) 15 m/sec

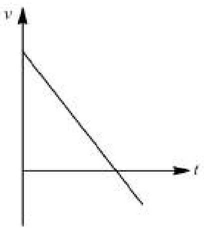
615. A bus moves over a straight level road with a constant acceleration a. A body in the bus drops a ball outside. The acceleration of the ball with respect to the bus and the earth are respectively

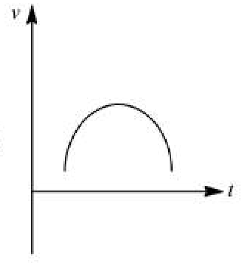
a) a and g b) $a+$ g and g $-a$ c) $\sqrt{a^2+g^2}$ and g d) $\sqrt{a^2+g^2}$ and a

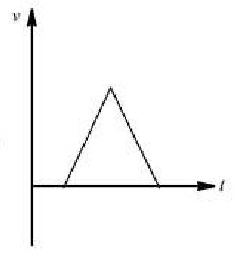
616. A ball is thrown vertically upwards with a velocity of $25\ ms^{-1}$ from the top of a tower of height 30 m. How long will it travel before it hits ground

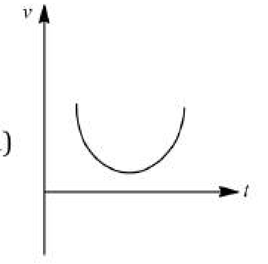
a) $6s$ b) $5s$ c) $4s$ d) $12s$

617. A particle is thrown upwards, then correct $v-t$ graph will be

a) 

b) 

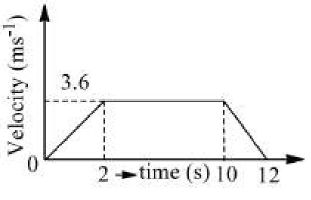
c) 

d) 

618. Two cars A and B are moving with same speed of 45 km/hr along same direction. If a third car C coming from the opposite direction with a speed of 36 km/hr meets two cars in an interval of 5 minutes, the distance of separation of two cars A and B should be (in km)

a) 6.75 b) 7.25 c) 5.55 d) 8.35

619. An elevator is going up. The variation in the velocity of the elevator is as given in the graph. What is the height to which the elevator takes the passengers?

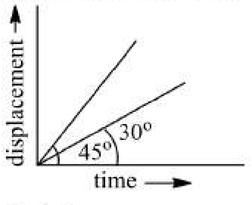


a) 3.6 m b) 28.8 m c) 36.0 m d) 72.0 m

620. A body is projected up with a speed 'u' and the time taken by it is T to reach the maximum height H. Pick out the correct statement

a) It reaches $H/2$ in $T/2\ sec$
b) It acquires velocity $u/2$ in $T/2sec$
c) Its velocity is $u/2$ at $H/2$
d) Same velocity at $2T$

621. The displacement-time graphs of two moving particles make angles of 30° and 45° with the x-axis. The ratio of the two velocities is



a) $\sqrt{3}:1$ b) $1:1$ c) $1:2$ d) $1:\sqrt{3}$

622. A parachutist after bailing out falls 50 m without friction. When parachute opens, it decelerates at 2 ms^{-2}. He reaches the ground with a speed of 3 ms^{-1}. At what height, did he bail out?

a) 91 m b) 182 m c) 293 m d) 111 m

623. A ball is thrown vertically upwards from the top of a tower at 4.9 ms^{-1}. It strikes the pond near the base of the tower after 3 $seconds$. The height of the tower is

a) 73.5 m b) 44.1 m c) 29.4 m d) None of these

624. Two cars are moving in the same direction with a speed of 30kmh^{-1}. They are separated from each other by 5 km. Third car moving in the opposite direction meets the two cars after an interval of 4 min. What is the speed of the third car?

a) 30 kmh^{-1} b) 35 kmh^{-1} c) 40 kmh^{-1} d) 45 kmh^{-1}

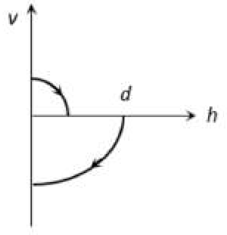
625. A body starts from rest with uniform acceleration. If its velocity after n second is v, then its displacement in the last 2 s is

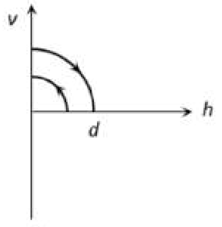
a) $\frac{2v(n+1)}{n}$ b) $\frac{v(n+1)}{n}$ c) $\frac{v(n-1)}{n}$ d) $\frac{2v(n-1)}{n}$

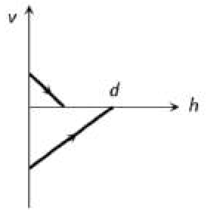
626. The motor of an electric train can give it an acceleration of $1\ ms^{-2}$ and brakes can give a negative acceleration of $3\ ms^{-2}$. The shortest time in which the train can make a trip between the two stations 1215 m apart is

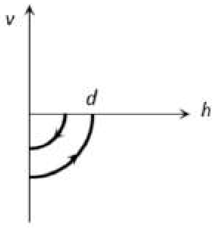
a) 113.6 s b) 56.9 s c) 60 s d) 55 s

627. A ball is dropped vertically from a height d above the ground. It hits the ground and bounces up vertically to a height $d/2$. Neglecting subsequent motion and air resistance, its velocity v varies with the height h above the ground as

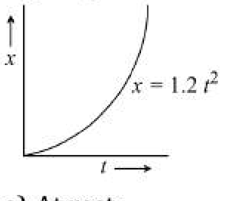
a) 

b) 

c) 

d) 

628. Figure given shows the distance –time graph of the motion of a car. It follows from the graph that the car is



a) At rest b) In uniform motion
c) In non-uniform acceleration d) Uniformly accelerated

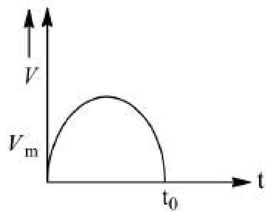
629. A body is moving along a straight line path with constant velocity. At an instant of time the distance travelled by it is s and its displacement is D, then

a) $D < s$ b) $D > s$ c) $D = s$ d) $D \leq s$

630. A man drops a ball downside from the roof of a tower of height 400 m. At the same time another ball is thrown upside with a velocity 50 m/s. From the surface of the tower, then they will meet at which height from the surface of the tower

a) 100 m b) 320 m c) 80 m d) 240 m

631. The velocity of a particle moving in a straight line varies with time in such a manner that v *versus* t graph is velocity is v_m and the total time of motion is t_0



(i) Average velocity of the particle is $\frac{\pi}{4}v_m$

(ii)such motion cannot be realized in practical terms

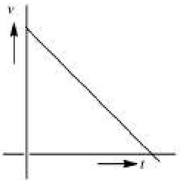
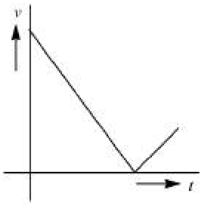
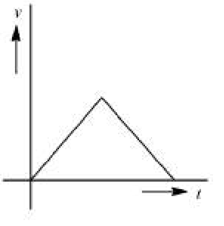
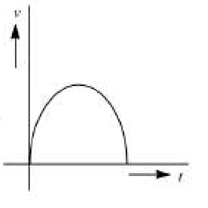
a) Only (i) is correct
b) Only (ii) is correct
c) Both (i)and (ii) are correct
d) Both (i)and (ii) are wrong

632. A body is thrown vertically upwards with a velocity u. Find the true statement from the following
a) Both velocity and acceleration are zero at its highest point
b) Velocity is maximum and acceleration is zero at the highest point
c) Velocity is maximum and acceleration is g downwards at its highest point
d) Velocity is zero at the highest point and maximum height reached is $u^2/2g$

633. The velocity of a body depends on time according to the equation $v = 20 + 0.1t^2$. The body is undergoing
a) Uniform acceleration
b) Uniform retardation
c) Non-uniform acceleration
d) Zero acceleration

634. The initial velocity of a particle is u (at $t = 0$) and the acceleration f is given by at. Which of the following relation is valid
a) $v = u + at^2$
b) $v = u + a\frac{t^2}{2}$
c) $v = u + at$
d) $v = u$

635. A ball is thrown vertically upward. Ignoring the air resistance, which one of the following plot represents the velocity-time plot for the period ball remains in air?

a) 
b) 
c) 
d) 

636. A body is moving according to the equation $x = at + bt^2 - ct^3$ where $x =$ displacement and a, b and c are constants. The acceleration of the body is
a) $a + 2bt$
b) $2b + 6ct$
c) $2b - 6ct$
d) $3b - 6ct^2$

637. A ball is projected upwards from a height h above the surface of the earth with velocity v. The time at which the ball strikes the ground is
a) $\frac{v}{g} + \frac{2hg}{\sqrt{2}}$
b) $\frac{v}{g}\left[1 - \sqrt{1 + \frac{2h}{g}}\right]$
c) $\frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$
d) $\frac{v}{g}\left[1 + \sqrt{v^2 + \frac{2h}{g}}\right]$

638. Time taken by an object falling from rest to cover the height of h_1 and h_2 is respectively t_1 and t_2 then the ratio of t_1 to t_2 is
a) $h_1 : h_2$
b) $\sqrt{h_1} : \sqrt{h_2}$
c) $h_1 : 2h_2$
d) $2h_1 : h_2$

639. Two cars A and B at rest at same point initially. If A starts with uniform velocity of 40 m/sec and B starts in the same direction with constant acceleration of $4m/s^2$, then B will catch A after how much time
a) 10 sec
b) 20 sec
c) 30 sec
d) 35 sec

640. A body dropped from a height h with an initial speed zero, strikes the ground with a velocity 3 km/h. Another body of same mass is dropped from the same height h with an initial speed $-u' = 4km/h$. Find the final velocity of second body with which it strikes the ground
a) 3 km/h
b) 4 km/h
c) 5 km/h
d) 12 km/h

641. The correct statement from the following is

a) A body having zero velocity will not necessarily have zero acceleration
b) A body having zero velocity will necessarily have zero acceleration
c) A body having uniform speed can have only uniform acceleration
d) A body having non-uniform velocity will have zero acceleration

642. An aeroplane flies 400m north and 300m south and then flies 1200m upwards, then net displacement is

a) 1500m b) 1400m c) 1300m d) 1200m

643. A very large number of balls are thrown vertically upwards in quick succession in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height is $5m$, the number of ball thrown per minute is (take $g = 10\ ms^{-2}$)

a) 120 b) 80 c) 60 d) 40

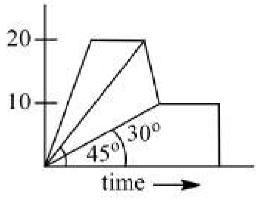
644. A constant force acts on a body of mass 0.9 kg at rest for $10s$. If the body moves a distance of 250 m, the magnitude of the force is

a) $3N$ b) $3.5N$ c) $4.0N$ d) $4.5N$

645. The speed of body moving with uniform acceleration is u.This speed is doubled while covering distance S, its speed would be become

a) $\sqrt{3}u$ b) $\sqrt{5}u$ c) $\sqrt{11}u$ d) $\sqrt{7}u$

646. The variation of velocity of a particle moving along a straight line is shown in the figure. The distance travelled by the particle in 4s is



a) 25 m b) 30 m c) 55 m d) 60 m

647. A body falling for 2 seconds covers a distance S is equal to that covered in next second. Taking $g = 10m/s^2, S =$

a) 30 m b) 10 m c) 60 m d) 20 m

648. A ball A is thrown up vertically with speed u and at the same instant another ball B is released from a height h. At time t, the speed of A relative to B is

a) u b) $2u$ c) $u - gt$ d) $\sqrt{(u^2 - gt)}$

649. A boat moves with a speed of 5 km/h relative to water in a river flowing with a speed of 3 km/h and having a width of 1 km. The minimum time taken around a round trip is

a) 5 min b) 60 min c) 20 min d) 30 min

650. A car A is travelling on a straight level road with a uniform speed of 60 km/h.
It is followed by another car B which is moving with a speed of $70km/h$. When the distance between them is 2.5 km, the car B is given a deceleration of 20 km/h^2.After how much time will B catch up with A.

a) 1 hr b) $1/2hr$ c) $1/4hr$ d) $1/8hr$

651. A body is released from a great height and falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies , two seconds after the release of the second body is

a) 4.9 m b) 9.8 m c) 19.6 m d) 24.5 m

652. A boat moves with a speed of 5 km/h relative to water in a river flowing with a speed of 3 km/h and having a width of 1 km. The minimum time taken around a round trip is

a) 5 min b) 60 min c) 20 min d) 30 min

653. The particles A, B and C are thrown from the top of a tower with the same speed. A is thrown up, B is thrown down and C is horizontally. They hit the ground with speeds V_A, V_B and V_C respectively

a) $V_A = V_B = V_C$ b) $V_A = V_B > V_C$ c) $V_B > V_C > V_A$ d) $V_A > V_B = V_C$

654. A body starts from rest and falls vertically from a height of 19.6m. If $g = 9.8ms^{-2}$, then the distance travelled by the body in the last 0.1s of its motion is

a) 1.9 m b) 0.049 m c) 17.7 m d) 19.6 m

655. The displacement of the body along x − axis depends on time as $\sqrt{x} = t + 1$. Then the velocity of body
a) Increases with time b) Decreases with time c) Independent of time d) None of these

656. A particle moves along X- axis in such a way that its coordinate X varies with time t according to the equation $x = (2 - 5t + 6t^2)m$. The initial velocity of the particle is
a) $-5\ m/s$ b) $6\ m/s$ c) $-3\ m/s$ d) $3\ m/s$

657. Three particles start from the origin at the same time, one with a velocity v_1 along x-axis, the second along the y-axis with a velocity v_2 and the third along $x = y$ line. The velocity of the third so that the three may always lie on the same line is
a) $\frac{v_1 v_2}{v_1 + v_2}$ b) $\frac{\sqrt{2} v_1 v_2}{v_1 + v_2}$ c) $\frac{\sqrt{3} v_1 v_2}{v_1 + v_2}$ d) Zero

658. A person going towards east in a car with a velocity of 25kmh^{-1}, a train appears to move towards north with a velocity of $25\sqrt{3}\ \text{kmh}^{-1}$. The actual velocity of the train will be
a) $25\ \text{kmh}^{-1}$ b) $50\ \text{kmh}^{-1}$ c) $5\ \text{kmh}^{-1}$ d) $35\ \text{kmh}^{-1}$

659. A car moving with speed of 40 km/h can be stopped by applying brakes after atleast 2 m. If the same car is moving with a speed of 80 km/h, what is the minimum stopping distance
a) 8 m b) 2 m c) 4 m d) 6 m

660. A 120 m long train is moving in a direction with speed 20 m/s. A train B moving with 30 m/s in the opposite direction and 130 m long crosses the first train in a time
a) 6 s b) 36 s c) 38 s d) None of these

661. From the top of tower a body A is projected vertically up, another body B is horizontally thrown and a third body C is thrown vertically down with same velocity. Then
a) B strikes the ground with more velocity
b) C strikes the ground with less velocity
c) A, B, C strike the ground with same velocity
d) A and Cstrike the ground with more velocity than$B$

662. Two particles A and B start moving simultaneously from point P with velocity 15 $\text{ms}^{-1}$and 20ms^{-1} respectively. They move with equal accelerations but opposite in direction. When A overtakes B at C then its velocity is 30ms^{-1}. The velocity of B at C will lbe
a) 5ms^{-1} b) 10ms^{-1} c) 15ms^{-1} d) 20ms^{-1}

663. A car moves a distance of 200 m. it covers first half of the distance at speed 60 kmh^{-1} and the second half at speed v. If the average speed is 40 kmh^{-1}, the value of v is
a) 30 kmh^{-1} b) 13 kmh^{-1} c) 60 kmh^{-1} d) 40 kmh^{-1}

664. A tiger chases a deer 30m ahead of it and gains 3m in 5s after the chase began. The distance gained by the tiger in 10 s is
a) 6m b) 12 m c) 18 m d) 20 m

665. A particle moves with constant acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive interval t_1, t_2 and t_3 of time. Which of the following relations is correct?
a) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 - t_2}{t_2 + t_3}$ b) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 - t_2}{t_1 - t_3}$ c) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 - t_2}{t_2 - t_3}$ d) $\frac{v_1 - v_2}{v_2 - v_3} = \frac{t_1 + t_2}{t_2 + t_3}$

666. A 210 m long train is moving due North at a speed of 25 m/s. A small bird is flying due South a little above the train with speed 5 m/s. The time taken by the bird to cross the train is
a) 6s b) 7s c) 9s d) 10s

667. A body starting from rest moves with constant acceleration. The ratio of distance covered by the body during the 5th sec to that covered in 5 sec is
a) 9/15 b) 3/5 c) 25/9 d) 1/25

668. A particle moves a distance x in time t according to equation $x = (t + 5)^{-1}$. The acceleration of particle is proportional to
a) $(\text{Velocity})^{2/3}$ b) $(\text{Velocity})^{3/2}$ c) $(\text{distance})^2$ d) $(\text{distance})^{-2}$

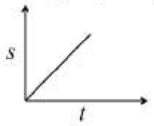
669. A ball is thrown straight upward with a speed v from a height h above the ground. The time taken for the ball to strike the ground is given by

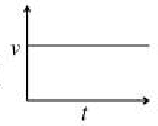
a) $-h = vt - \frac{1}{2}gt^2$ b) $h = vt - \frac{1}{2}gt^2$ c) $\frac{1}{2}gt^2$ d) $\sqrt{\frac{2g}{h}}$

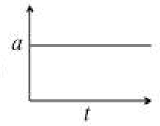
670. A car moves a distance of 200 m. It covers first half of the distance at speed 60 kmh^{-1} and the second half at speed v. If the average speed is 40 kmh^{-1}, the value of v is

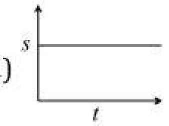
a) 30 kmh^{-1} b) 13 kmh^{-1} c) 60 kmh^{-1} d) 40 kmh^{-1}

671. Which graph represents a state of rest for an object

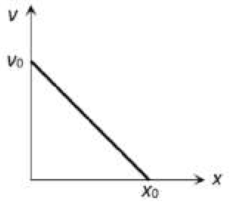
a) 

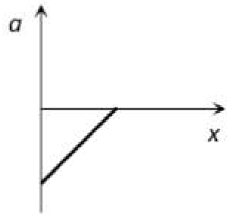
b) 

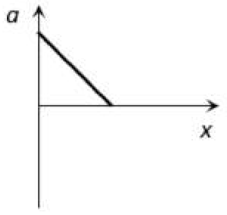
c) 

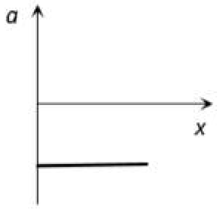
d) 

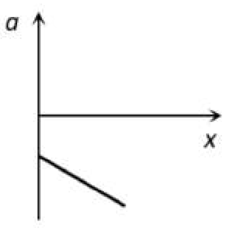
672. The given graph shows the variation of velocity with displacement. Which one of the graph given below correctly represents the variation of acceleration with displacement



a) 

b) 

c) 

d) 

673. With what velocity a ball be projected vertically so that the distance covered by it in 5th second is twice the distance it covers in its 6th second ($g = 10\ m/s^2$)

a) 58.8 m/s b) 49 m/s c) 65 m/s d) 19.6 m/s

674. A body, thrown upwards with some velocity reaches the maximum height of 50 m. Another body with the double the mass thrown up with double the initial velocity will reach a maximum height of

a) 100 m b) 200 m c) 300 m d) 400 m

675. Two particles held at different heights a and b above the ground are allowed to fall from rest. The ratio of their velocities on reaching the ground is

a) $a : b$ b) $\sqrt{a}:\sqrt{b}$ c) $a^2:b^2$ d) $a^3:b^3$

676. A body starts from rest and moves with a constant acceleration. The ratio of distance covered in the nth second to the distance covered in n second is

a) $\frac{2}{n}-\frac{1}{n^2}$ b) $\frac{1}{n^2}-\frac{1}{n}$ c) $\frac{2}{n^2}-\frac{1}{n}$ d) $\frac{2}{n}+\frac{1}{n^2}$

677. The initial and final position vectors for a particle are respectively $(-3.0\text{ m})\hat{\mathbf{i}}+(2.0\text{ m})\hat{\mathbf{j}}+(8.0\text{ m})\hat{\mathbf{k}}$ and $(9.0\text{ m})\hat{\mathbf{i}}+(2.0\text{ m})\hat{\mathbf{j}}+(-8.0\text{ m})\hat{\mathbf{k}}$.The displacement of the particle is

a) $(6.0\text{ m})\hat{\mathbf{i}}+(4.0\text{ m})\hat{\mathbf{j}}+(16.0\text{ m})\hat{\mathbf{k}}$ b) $(6.0\text{ m})\hat{\mathbf{i}}$

c) $(12.0\text{ m})\hat{\mathbf{i}}-(16.0\text{ m})\hat{\mathbf{j}}$ d) $(12.0\text{ m})\hat{\mathbf{i}}$

678. What is the relation between displacement, time and acceleration in case of a body having uniform acceleration

a) $S=ut+\frac{1}{2}ft^2$ b) $S=(u+f)\,t$ c) $S=v^2-2fs$ d) None of these

679. A body is thrown vertically up with a velocity u. It passes three points A, B and C in its upward journey with velocities $\frac{u}{2},\frac{u}{3}$ and $\frac{u}{4}$ respectively. The ratio of the separations between points A and B and between B and C $i.e.,\frac{AB}{BC}$ is

a) 1 b) 2 c) $\frac{10}{7}$ d) $\frac{20}{7}$

680. A ball is dropped from top of a tower of $100m$ height. Simultaneously another ball was thrown upward from bottom of the tower with a speed of 50 m/s $(g=10\,m/s^2)$. They will cross each other after

a) $1s$ b) $2s$ c) $3s$ d) $4s$

681. A body moves for a total of nine second starting from rest with uniform acceleration and then with uniform retardation, which is twice the value of acceleration and then stops. The duration of uniform acceleration

a) 3 s b) 4.5 s c) 5 s d) 6 s

682. A point initially at rest moves along x-axis. Its acceleration varies with time as $a=(6t+5)$ in ms^{-2}. It starts from origin, the distance covered in 1 s is

a) 3 m b) 3.5 m c) 4 m d) 4.5 m

683. A train is moving towards east and a car is along north, both with same speed. The observed direction of car to the passenger in the train is

a) East- north direction b) West-north direction c) South-east direction d) None of these

684. A student is standing at a distance of 50 metres from the bus. As soon as the bus begins its motion with an acceleration of 1 ms^{-2}, the student starts running towards the bus with a uniform velocity u. Assuming the motion to be along a straight road, the minimum value of u, so that the student is able to catch the bus is

a) 52 ms^{-1} b) 8 ms^{-1} c) 10 ms^{-1} d) 12 ms^{-1}

685. Two balls A and B of same masses are thrown from the top of the building. A, thrown upward with velocity V and B, thrown downward with velocity V, then

a) Velocity of A is more than B at the ground

b) Velocity of B is more than A at the ground

c) Both A & B strike the ground with same velocity

d) None of these

686. The position of a particle moving along x-axis at certain times is given below:

$t(s)$	0	1	2	3
$x(m)$	-2	0	6	16

Which of the following describes the motion correctly

a) Uniform accelerated b) Uniform decelerated

c) Non-uniform accelerated d) There is not enough data for generalization

687. The position of a particle x (in metres) at a time t seconds is given by the relation $\vec{r} = (3t\hat{\imath} - t^2\hat{\jmath} + 4\hat{k})$. Calculate the magnitude of velocity of the particle after 5 seconds

a) 3.55 b) 5.03 c) 8.75 d) 10.44

688. A stone falls freely from rest from a height h and it travels a distance $\frac{9h}{25}$ in the last second. The value of h is

a) 145 m b) 100 m c) 122.5 m d) 200 m

689. A bullet fired into a fixed target loses half of its velocity after penetrating 3 cm. How much further it will penetrate before coming to rest assuming that if faces constant resistance to motion

a) 1.5 cm b) 1.0 cm c) 3.0 cm d) 2.0 cm

690. From the top of a tower, a particle is thrown vertically downwards with a velocity of 10 m/sec. The ratio of the distances, covered by it in the 3rd and 2nd seconds of the motion is (Take $g = 10\ m/s^2$)

a) 5 : 7 b) 7 : 5 c) 3 : 6 d) 6 : 3

691. Two trains one of 100 m and another of length 125m, are moving in mutually opposite directions along parallel lines, meet each other, each with speed 10m/s.
If their acceleration are $0.3m/s^2$ and $0.2m/s^2$ respectively, then the time taken to pass each other will be

a) 5 s b) 10 s c) 15 s d) 20 s

692. A body of mass m thrown horizontally with velocity v from the top of tower of height h, touches the level ground a distance of 250 m from the foot of the tower. A body of mass, 2 m thrown horizontally with velocity $\frac{v}{2}$, from the top of tower of height 4 h will touch the level ground at a distance x from the foot of tower. The value of x is

a) 250 m b) 500 m c) 125 m d) $250\sqrt{2}$m

693. A balloon is at a height of 81m and is ascending upwards with a velocity of 12ms^{-1}. A body of 2 kg weight is dropped from it. If $g = 10\text{ms}^{-2}$, the body will reach the surface of the earth in

a) 1.5 s b) 4.025 s c) 5.4 s d) 6.75 s

694. A rocket is fired upward from the earth's surface such that it creates an acceleration of 19.6 $m/\sec^2$. If after 5 sec its engine is switched off, the maximum height of the rocket from earth's surface would be

a) 245 m b) 490 m c) 980 m d) 735 m

695. Two trains travelling on the same track are approaching each other with equal speeds of $40m/s$. The drivers of the trains begin to decelerate simultaneously when they are just $2.0km$ apart. Assuming the decelerations to be uniform and equal, the value of the deceleration to barely avoid collision should be

a) 11.8 m/s^2 b) 11.0 m/s^2 c) 2.1 m/s^2 d) 0.8 m/s^2

696. Two bodies of different masses m_a and m_b are dropped from two different heights a and b. The ratio of the time taken by the two to cover these distances are

a) $a : b$ b) $b : a$ c) $\sqrt{a} : \sqrt{b}$ d) $a^2 : b^2$

697. The speed of body moving with uniform acceleration is u.This speed is doubled while covering distance S, its speed would be become

a) $\sqrt{3}u$ b) $\sqrt{5}u$ c) $\sqrt{11}u$ d) $\sqrt{7}u$

698. A body starts to fall freely under gravity. The distance covered by it in first, second and third *second* are in ratio

a) 1: 3: 5 b) 1: 2: 3 c) 1: 4: 9 d) 1: 5: 6

699. The position x of a particle varies with time t as $x = at^2 - bt^3$. The acceleration of the particle will be zero at time t equal to

a) $\frac{a}{b}$ b) $\frac{2a}{3b}$ c) $\frac{a}{3b}$ d) Zero

700. A particle moves along X- axis in such a way that its coordinate X varies with time t according to the equation $x = (2 - 5t + 6t^2)m$. The initial velocity of the particle is

a) $-5\ m/s$ b) 6 m/s c) $-3\ m/s$ d) 3 m/s

701. An object is projected upwards with a velocity of $100m/s$. It will strike the ground after (approximately)

a) 10 sec b) 20 sec c) 15 sec d) 5 sec

702. A ball is dropped from top of a tower of 100m height. Simultaneously another ball was thrown upward from bottom of the tower with a speed of 50 m/s ($g = 10\ m/s^2$). They will cross each other after

a) 1s b) 2s c) 3s d) 4s

703. If a ball is thrown vertically upwards with speed u, the distance covered during the last t seconds of its ascent is

a) $\frac{1}{2}gt^2$ b) $ut - \frac{1}{2}gt^2$ c) $(u - gt)t$ d) ut

704. When a bullet is fired at a target, its velocity decreases by half after penetration 30 cm into it. The additional thickness it will penetrate before coming to rest is

a) 30 cm b) 40 cm c) 10 cm d) 50 cm

705. At $t = 0$, a stone of mass 10 gm is thrown straight up from the ground level with a speed 10 m/s. After 1 s, a second stone of the same mass is thrown from the same position with a speed 20 m/s. What is the position of the first stone from the ground level at that moment? (Take g = 10 m/s^2)

a) 10 m b) 1 m c) 2 m d) 5 m

706. A stone is dropped from a height h. Simultaneously, another stone is thrown up from the ground which reaches a height 4 h. The two stones cross other after time

a) $\sqrt{\frac{h}{8g}}$ b) $\sqrt{8gh}$ c) $\sqrt{2gh}$ d) $\sqrt{\frac{h}{2g}}$

707. The displacement of a particle is proportional to the cube of time elapsed. How does the acceleration of the particle depends on time obtained

a) $a \propto t^2$ b) $a \propto 2t$ c) $a \propto t^3$ d) $a \propto t$

708. If a freely falling body travels in the last second a distance equal to the distance travelled by it in the first three second, the time of the travel is

a) 6 sec b) 5 sec c) 4 sec d) 3 sec

709. A body moves with initial velocity 10 ms^{-1}. If it covers a distance of 20m in 2s, then acceleration of the body is

a) Zero b) $10ms^{-2}$ c) $5ms^{-2}$ d) $2ms^{-2}$

710. A body sliding on a smooth inclined plane required 4s to reach the bottom, starting from rest at the top. How much time does it takes to cover one-fourth the distance starting from rest at top?

a) 1 s b) 2 s c) 4 s d) 16 s

711. Select the incorrect statements from the following

S1 : Average velocity is path length divided by time interval

S2 : In general, speed is greater than the magnitude of the velocity

S3 : A particle moving in a given direction with a non-zero velocity can have zero speed

S4 : The magnitude of average velocity is the average speed

a) S2 and S3 b) S1 and S4 c) S1, S3 and S4 d) All four statements

712. A stone thrown vertically upwards attains a maximum height of 45m. In what time the velocity of stone become equal to one-half the velocity of throw? (Given g = $10ms^{-2}$)

a) 2 s b) 1.5 s c) 1 s d) 0.5 s

713. A bullet emerge from a barrel of length 1.2 m with a speed of 640 ms^{-1}. Assuming constant acceleration, the approximate time that is spends in the barrel after the gun is fired is

a) 4 ms b) 40 ms c) 400 μs d) 1 s

714. A body moving with a uniform acceleration crosses a distance of 65 m in the 5^{th} second and 105 m in 9^{th} second. How far will it go in 20 s?

a) 2040 m b) 240 m c) 2400 m d) 2004 m

715. A balloon starts rising from the ground with an acceleration of 1.25 m/s^2 after 8s, a stone is released from the balloon. The stone will ($g - 10\ m/s^2$)

a) Reach the ground in 4 second

b) Begin to move down after being released

c) Have a displacement of 50 m

d) Cover a distance of 40 m in reaching the ground

716. Which of the following are true?

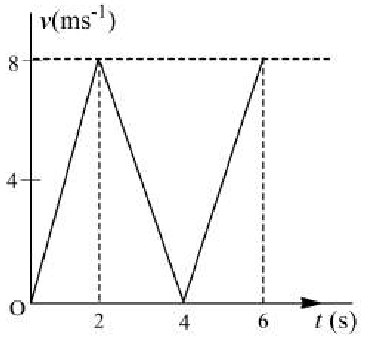
(i) A body having constant speed can have verying velocity.

(ii) Position-time graphs for two objects with zero relative velocity are parallel.

(iii) The numerical ration of velocity to speed of an object can never be more than one.

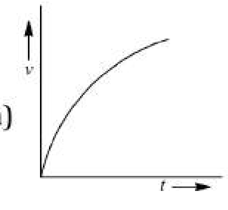
a) (i) b) (ii) and (iii) c) All d) None of these

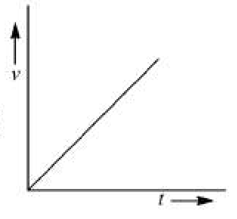
717. The $v - t$ graph for a particle is as shown. The distance travelled in the first four second is

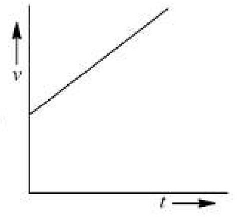


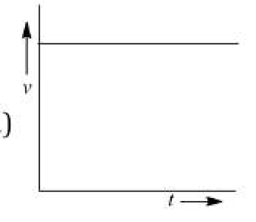
a) 12 m b) 16 m c) 20 m d) 24 m

718. A body starts from rest and moves with uniform acceleration. Which of the following graphs represents it motion?

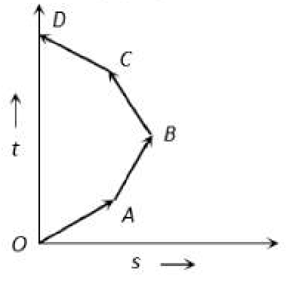
a) 

b) 

c) 

d) 

719. Which of the following options is correct for the object having a straight line motion represented by the following graph



a) The object moves with constantly increasing velocity from O to A and then it moves with constant velocity

b) Velocity of the object increases uniformly

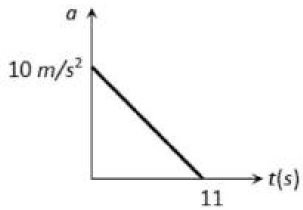
c) Average velocity is zero

d) The graph shown is impossible

720. A boy standing at the top of a tower of 20 m height drops a stone. Assuming $g = 10\ ms^{-2}$, the velocity with which it hits the ground is

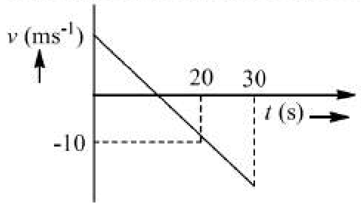
a) 5.0 m/s b) 10.0 m/s c) 20.0 m/s d) 40.0 m/s

721. A particle starts from rest. Its acceleration (a) versus time (t) is as shown in the figure. The maximum speed of the particle will be



a) $110\ m/s$ b) $55\ m/s$ c) $550\ m/s$ d) $660\ m/s$

722. The distance-time graph of a particle at time t makes angle $45°$ with time axis. After 1s, it makes angle $60°$ with time axis. What is the acceleration of the particle?



a) $\sqrt{3}-1$ unit b) $\sqrt{3}+1$ unit c) $\sqrt{3}$ unit d) 1 unit

723. A man throws balls with the same speed vertically upwards one after the other at an interval of two seconds. What should be the speed of the throw so that more than two balls are in the sky at any time (Given $g=9.8\ m/s^2$)

a) At least $0.8\ m/s$
b) Any speed less than $19.6\ m/s$
c) Only with speed $19.6\ m/s$
d) More than 19.6

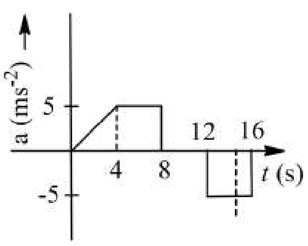
724. A 2 m wide truck is moving with a uniform speed $v_0=8\text{ms}^{-1}$ along a straight horizontal road. A pedestrian starts to cross the road with a uniform speed v when the truck is 4m away from him. The minimum value of v, so that he can cross the raod safely is

a) 2.62ms^{-1} b) 4.6ms^{-1} c) 3.57ms^{-1} d) 1.414ms^{-1}

725. A man is $45\ m$ behind the bus when the bus start accelerating from rest with acceleration $2.5\ m/s^2$. With what minimum velocity should the man start running to catch the bus

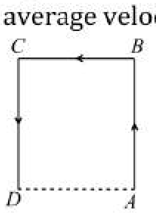
a) $12\ m/s$ b) $14\ m/s$ c) $15\ m/s$ d) $16\ m/s$

726. The acceleration of a train between two stations 2 km apart is shown in the figure. The maximum speed of the train is



a) 60ms^{-1} b) $30\ \text{ms}^{-1}$ c) $120\ \text{ms}^{-1}$ d) $90\ \text{ms}^{-1}$

727. A particle moves along the sides AB, BC, CD of a square of side $25\ m$ wuth a velocity of $15\ ms^{-1}$. Its average velocity is



a) $15\ ms^{-1}$ b) $10ms^{-1}$ c) $7.5ms^{-1}$ d) $5ms^{-1}$

728. A body is released from the top of a tower of height h. It takes t sec to reach the ground. Where will be the ball after time $t/2$ sec

a) At $h/2$ from the ground
b) At $h/4$ from the ground
c) Depends upon mass and volume of the body
d) At $3h/4$ from the ground

729. A steamer taken 12 days to reach from part x to part y. Every day only one steamer sets out from both the ports. How many steamers does each steamer meet in the open sea?

a) 23 b) 25 c) 27 d) 21.

730. A train accelerates from rest at a constant rate α for distance x_1 and time t_1. After that it retards to rest at constant rate β for distance x_2 and time t_2. Then it is found that

a) $\frac{x_1}{x_2}=\frac{\alpha}{\beta}=\frac{t_1}{t_2}$ b) $\frac{x_1}{x_2}=\frac{\beta}{\alpha}=\frac{t_1}{t_2}$ c) $\frac{x_1}{x_2}=\frac{\beta}{\alpha}=\frac{t_2}{t_1}$ d) $\frac{x_1}{x_2}=\frac{\beta}{\alpha}=\frac{t_2}{t_1}$

731. A stone is thrown with an initial speed of 4.9 m/s from a bridge in vertically upward direction. It falls down in water after 2 sec. The height of the bridge is

a) 4.9 m b) 9.8 m c) 19.8 m d) 24.7 m

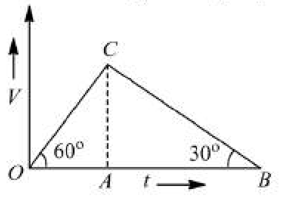
732. A body is released from a great height and falls freely towards the earth. Another body is released from the same height exactly one second later. The separation between the two bodies , two seconds after the release of the second body is

a) 4.9 m b) 9.8 m c) 19.6 m d) 24.5 m

733. Which of the following is a one dimensional motion

a) Landing of an aircraft b) Earth revolving around the sun
c) Motion of wheels of moving train d) Train running on a straight track

734. The velocity-time graph of a body is shown in figure. The ratio of the ... during the intervals OA and AB is....



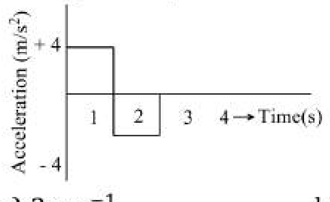
a) Average velocities :2

b) $\frac{OA}{AB}:\frac{1}{3}$

c) Average accelerations, same as distance covered

d) Distance covered : $\frac{1}{2}$

735. A particle starts from rest at $t=0$ and moves in a straight line with an acceleration as shown below. The velocity of the particle at $t=3s$ is



a) 2 ms^{-1} b) 4 ms^{-1} c) 6 ms^{-1} d) 8 ms^{-1}

736. The position coordinates of a particle moving in $X-Y$ as a function of time t are

$$x=2t^2+6t+25$$
$$y=t^2+2t+1$$

The speed of the object at $t=10$ s is approximately

a) 31 b) 51 c) 71 d) 81

737. A ball is thrown vertically upwards from the top of a tower at 4.9ms^{-1}. It strikes the pond near the base of the tower after 3s. The height of the tower is

a) 29.4m b) 44.1m c) 73.5m d) 490m

738. A body starting from rest, accelerates at a constant rate a m/s^2 for some time after which it decelerates at a constant rate b m/s^2 to come to rest finally. If the total time elapsed is t sec, the maximum velocity attained by the body is given by

a) $\frac{ab}{a+b}t\ m/s$ b) $\frac{ab}{a-b}t\ m/s$ c) $\frac{2ab}{a+b}t\ m/s$ d) $\frac{2ab}{a-b}t\ m/s$

739. A police jeep is chasing with velocity of 45 km/h a thief in another jeep moving with velocity 153 km/h. Police fires a bullet with muzzle velocity of 180 m/s. The velocity with which it will strike the car of the thief is

a) 150 m/s b) 27 m/s c) 450 m/s d) 250 m/s

740. The acceleration a of a particle starting from rest varies with time according to relation $a = \alpha t + \beta$. The velocity of the particle after a time t will be

a) $\frac{\alpha t^2}{2} + \beta$ b) $\frac{\alpha t^2}{2} + \beta t$ c) $\alpha t^2 + \frac{1}{2}\beta t$ d) $\frac{(\alpha t^2 + \beta t)}{2}$

741. The velocity of a bullet is reduced from 200 m/s to 100 m/s while travelling through a wooden block of thickness 10 cm. The retardation, assuming it to be uniform, will be

a) $10 \times 10^4\ m/s^2$ b) $12 \times 10^4\ m/s^2$ c) $13.5 \times 10^4\ m/s^2$ d) $15 \times 10^4\ m/s^2$

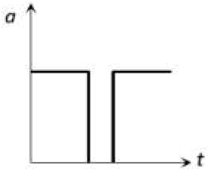
742. A car starts from rest and moves with uniform acceleration a on a straight road from time $t = 0$ to $t = T$. After that, a constant deceleration brings it to rest. In this process the average speed of the car is

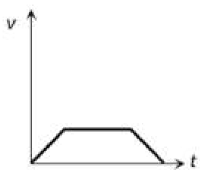
a) $\frac{aT}{4}$ b) $\frac{3aT}{2}$ c) $\frac{aT}{2}$ d) aT

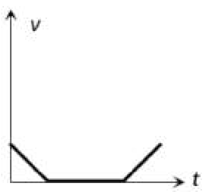
743. A particle located at $x = 0$ at time $t = 0$, starts moving along the positive x −direction with a velocity v that varies as $v = \alpha\sqrt{x}$. The displacement of the particle varies with time as

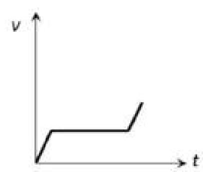
a) t^2 b) t c) $t^{1/2}$ d) t^3

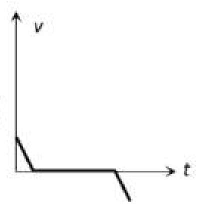
744. Acceleration-time graph of a body is shown. The corresponding velocity-time graph of the same body is



a) 

b) 

c) 

d) 

745. If the velocity of a car is increased by 20%, then the minimum distance in which it can be stopped increase by

a) 44% b) 55% c) 66% d) 88%

746. If the velocity of particle is given by $v = (180 - 16x)^{1/2}\ m/s$, then its acceleration will be

a) Zero b) 8 m/s^2 c) −8 m/s^2 d) 4 m/s^2

747. A graph is drawn between velocity and time for the motion of a particle. The area under the curve between the time intervals t_1 and t_2 gives

a) Momentum of the particle b) Displacement of the particle
c) Acceleration of the particle d) Change in velocity of the particle

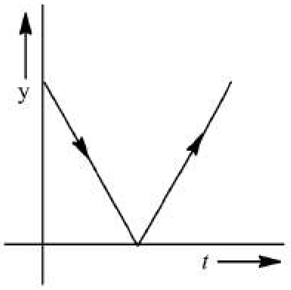
748. The relation between time and distance is $t = \alpha x^2 + \beta x$, where α and β are constants. The retardation is

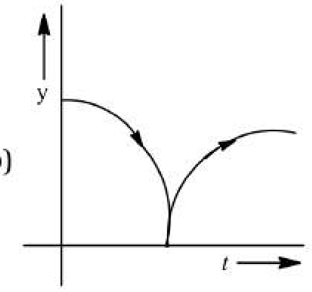
a) $2\alpha v^3$ b) $2\beta v^3$ c) $2\alpha\beta v^3$ d) $2\beta^2 v^3$

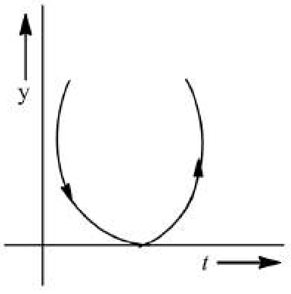
749. An aeroplane files around a square field ABCD of each side 1000 km. Its speed along AB is 250 $km\ h^{-1}$, along DA 100 $km\ h^{-1}$. Its average speed (in $km\ h^{-1}$) over the entire trip is

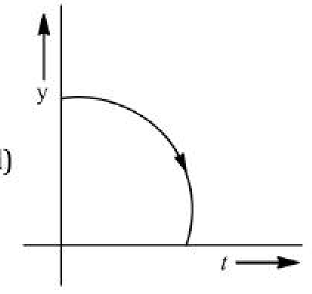
a) 225.5 b) 175.5 c) 125.5 d) 190.5

750. A ball is dropped on a floor and bounces back to a height somewhat less than the original height, which of the curves depicts its motion correctly?

a) 

b) 

c) 

d) 

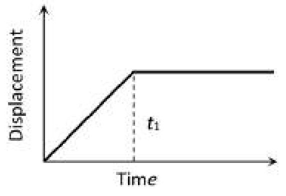
751. A body is thrown vertically upwards with velocity u. The distance travelled by it in the fifth and the sixth seconds are equal. The velocity u is given by ($g = 9.8\ ms^{-2}$)

a) $24.5\ ms^{-1}$ b) $49.0\ ms^{-1}$ c) $73.5\ ms^{-1}$ d) $98.0\ ms^{-1}$

752. A car accelerates from rest at a constant rate α for some time, after which it decelerates at a constant rate β and comes to rest. If the total time elapsed is t, then the maximum velocity acquired by the car is

a) $\left(\frac{\alpha t + \beta^2}{\alpha\beta}\right)t$ b) $\left(\frac{\alpha^2 - \beta^2}{\alpha\beta}\right)t$ c) $\frac{(\alpha + \beta)t}{\alpha\beta}$ d) $\frac{\alpha\beta t}{\alpha + \beta}$

753. The $x - t$ graph shown in the figure represents



a) Constant velocity
b) Velocity of the body is continuously changing
c) Instantaneous velocity
d) The body travels with constant speed upto time t_1 and then stops

754. The acceleration of a particle increasing linearly with time t is bt. The particle starts from the origin with an initial velocity v_0. The distance travelled by the particle in time t will be

a) $v_0 t + \frac{1}{6}bt^3$ b) $v_0 t + \frac{1}{3}bt^2$ c) $v_0 t + \frac{1}{3}bt^3$ d) $v_0 t + \frac{1}{3}bt^2$

755. A particle is moving with constant acceleration from A to B in a straight line AB. If u and v are the velocities at A and B respectively then its velocity at the midpoint C will be

a) $\left(\frac{u^2 + v^2}{2u}\right)^2$ b) $\frac{u + v}{2}$ c) $\frac{v - u}{2}$ d) $\sqrt{\frac{u^2 + v^2}{2}}$

756. A particle is constrained to move on a straight line path. It returns to the starting point after 10 *sec*. The total distance covered by the particle during this time is 30 m. Which of the following statement about the motion of the particle is false

a) Displacement of the particle is *zero*
b) Average speed of the particle is 3 m/s
c) Displacement of the particle is 30 m
d) Both (a) and (b)

757. Two bodies are thrown vertically upwards with their initial speed in the ratio 2 : 3. The ratio of the maximum heights reached by then and the ratio of their time taken by them to return back to the ground respectively are

a) 4 : 9 and 2 : 3 b) 2 : 3 and $\sqrt{2} : \sqrt{3}$ c) $\sqrt{2} : \sqrt{3}$ and 4 : 9 d) $\sqrt{2} : \sqrt{3}$ and 2 : 3

758. Two balls are dropped to the ground from different heights. One ball is dropped $2s$ after the other but they both strike the ground at the same time. If the first ball takes $5s$ to reach the ground, then the difference in initial heights is ($g = 10\ ms^{-2}$)

a) $20m$ b) $80m$ c) $170m$ d) $40m$

759. The displacement of particle is given by $x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$

What is its acceleration?

a) $\frac{2a_2}{3}$ b) $-\frac{2a_2}{3}$ c) a_2 d) Zero

760. A bullet emerges from a barrel of length 1.2 m with a speed of 640 ms^{-1}. Assuming constant acceleration, the approximate time that it spends in the barrel after the gun is fired is

a) 4 ms b) 40 ms c) 400 μs d) 1 s

761. An aeroplane is flying horizontally with a velocity of 600 kmh^{-1} and at a height of 1960 m. When it is vertically above a point A on the ground a bomb is released from it. The bomb strikes the ground at point B. The distance AB is

a) 1200 m b) 0.33 km c) 333.3 km d) 3.33 km

762. The area under acceleration-time graph gives

a) Distance in travelled b) Change in acceleration
c) Force acting d) Change in velocity

763. The area under acceleration-time graph gives

a) Distance travelled b) Change in acceleration
c) Force acting d) Change in velocity

764. A police car is travelling in a straight line with a constant speed v. A truck travelling in the same direction with constant velocity 3v/2 passes, the police car at $t = 0$. The police car starts acceleration 10 s after passing the truck, at a constant rate of 3 ms^{-2}, while truck continues to move at constant speed. If he police car takes 10 s further to catch the truck, find the value of v

a) 10 ms^{-1} b) 15 ms^{-1} c) 20 ms^{-1} d) 30 ms^{-1}

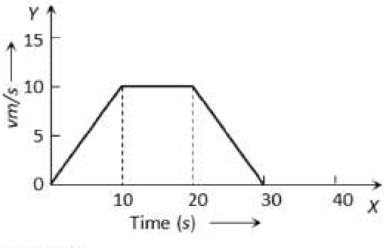
765. A boy walks to his school at a distance of $6km$ with constant speed of 2.5 $km/hour$ and walks back with a constant speed of 4 km/hr. His average speed for round trip expressed in $km/hour$, is

a) 24/13 b) 40/13 c) 3 d) 1/2

766. An aircraft is flying at a height of $34000m$ above the ground. If the angle subtended at a ground observation point by the aircraft positions $10s$ apart is 30°, then the speed of the aircraft is

a) $19.63 ms^{-1}$ b) 1963 ms^{-1} c) 108 ms^{-1} d) 196.3 ms^{-1}

767. In the following graph, distance travelled by the body in meters is



a) 200
b) 250
c) 300
d) 400

768. The engine of motorcycle can produce a maximum acceleration 5 m/s^2. Its brakes can produce a maximum retardation 10 m/s^2. What is the minimum time in which it can over a distance of 1.5 km

a) 30 sec b) 15 sec c) 10 sec d) 5 sec

769. A body A starts from rest with an acceleration a_1. After 2 seconds, another body B starts from rest with an acceleration a_2. If they travel equal distances in the 5th second, after the start of A, then the ration $a_1 : a_2$ is equal to

a) 5 : 9 b) 5 : 7 c) 9 : 5 d) 9 : 7

770. The velocity of particle is $v = v_0 + gt + ft^2$. If its position is $x = 0$ at $t = 0$, then its displacement after unit time $(t = 1)$ is

a) $v_0 + 2g + 3f$ b) $v_0 + g/2 + f/3$ c) $v_0 + g + f$ d) $v_0 + g/2 + f$

771. An aeroplane files around a square field ABCD of each side 1000 km. Its speed along AB is 250 $km\ h^{-1}$, along DA 100 $km\ h^{-1}$. Its average speed (in $km\ h^{-1}$) over the entire trip is

a) 225.5 b) 175.5 c) 125.5 d) 190.5

772. A balloon is rising vertically up with a velocity of 29 ms^{-1}. A stone is dropped from it and it reaches the ground in 10 seconds. The height of the balloon when the stone was dropped from it is ($g = 9.8\ ms^{-2}$)

a) 100 m b) 200 m c) 400 m d) 150 m

773. A car accelerates from rest at a constant rate of 2ms^{-2} for sometime. Then, it retards at a constant rate of 4ms^{-2}and comes to rest. If the total time for which it remains in motion is 3s, what is the total distance travelled?

a) 2m b) 3m c) 4m d) 6m

774. A particle is dropped vertically from rest a height. The time taken by it to fall through successive distances of 1 m each will then be

a) All equal, being equal to $\sqrt{2/g}$ second

b) In the ratio of the square roots of the integers 1, 2, 3…….

c) In the ratio of the difference in the square roots of the integers i.e. $\sqrt{1}, (\sqrt{2}-\sqrt{1}), (\sqrt{3}-\sqrt{2}), (\sqrt{4}-\sqrt{3})$……

d) In the ratio of the reciprocal of the square roots of the integers i.e.,. $\frac{1}{\sqrt{1}}, \frac{1}{\sqrt{2}}, \frac{1}{\sqrt{3}}, \frac{1}{\sqrt{4}}$

775. A particle moving in a straight line covers half the distance with a speed of 3ms^{-1}. The other half of the distance is covered in two equal time intervals with speeds of 4.5ms^{-1}and 7.5ms^{-1}. The average speed of the particle during this motion is

a) 4ms^{-1} b) 5ms^{-1} c) 5.5 ms^{-1} d) 4.8 ms^{-1}

776. A body starting from rest moves with uniform acceleration. The distance covered by the body in time t is proportional to

a) $\sqrt{t}$ b) $t^{3/2}$ c) t^2 d) t^3

777. Two boys are standing at the ends A and B of a ground where $AB = a$. The boy at B starts running in a direction perpendicular to AB with velocity v_1. The boy at A starts running simultaneously with velocity v and catches the other boy in a time t, when t is

a) $\frac{a}{\sqrt{(v^2 + v_1^2)}}$ b) $\sqrt{a^2 / (v^2 - v_1^2)}$ c) $a / (v - v_1)$ d) $a / (v + v_1)$

778. Three different objects of masses m_1, m_2 and m_3 are allowed to fall from rest and from the same point 'O' along three different frictionless paths. The speeds of the three objects, on reaching the ground, will be in the ratio of

a) $m_1 : m_2 : m_3$ b) $m_1 : 2m_2 : 3m_3$ c) $1 : 1 : 1$ d) $\frac{1}{m_1} : \frac{1}{m_2} : \frac{1}{m_3}$

779. A train is moving slowly on a straight track with a constant speed of 2 ms^{-1}. A passenger in that train starts walking at a steady aped of a 2 ms^{-1} to the back of the train in the opposite direction of the motion of the train. So to an observer standing on the platform directly in front of that passenger. The velocity of the passenger appears to be

a) 4 ms^{-1} b) 2 ms^{-1}

c) 2 ms^{-1} in the opposite direction of the train d) Zero

780. A bird files for 4s with a velocity of $|t-2|\text{ms}^{-1}$ in a straight line, where t =time in second. It covers a distance of

a) 8 m b) 6 m c) 4 m d) 2 m

781. A particle moving with a uniform acceleration along a straight line covers distance a and b in successive intervals of p and q second. The acceleration of the particle is

a) $\frac{pq(p+q)}{2(bp-aq)}$ b) $\frac{2(aq-bp)}{pq(p-q)}$ c) $\frac{bp-aq}{pq(p-q)}$ d) $\frac{2(bp-aq)}{pq(p-q)}$

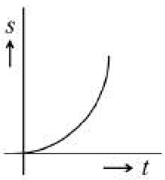
782. The motion of a particle is described by the equation $u=at$. The distance travelled by the particle in the first 4 seconds

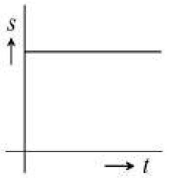
a) $4a$ b) $12a$ c) $6a$ d) $8a$

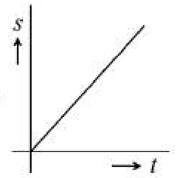
783. Equation of displacement for any particle is $s=3t^3+7t^2+14t+8m$. Its acceleration at time $t=1$ sec is

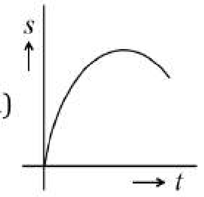
a) $10\ m/s^2$ b) $16\ m/s^2$ c) $25\ m/s^2$ d) $32\ m/s^2$

784. A body is travelling in a straight line with a uniformly increasing speed. Which one of the plot represents the changes in distance (s) travelled with time (t)

a) 

b) 

c) 

d) 

785. For a body moving with relativistic speed, if the velocity is doubled, then

a) Its linear momentum is doubled

b) Its linear momentum will be less than double

c) Its linear momentum will be more than double

d) Its linear momentum remains unchanged

786. A body moves with initial velocity $10\ ms^{-1}$. If it covers a distance of $20m$ in $2s$, then acceleration of the body is

a) Zero b) $10ms^{-2}$ c) $5ms^{-2}$ d) $2ms^{-2}$

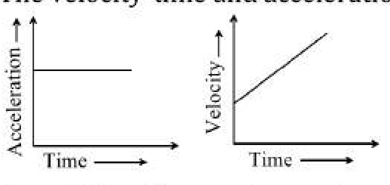
787. A car starts from rest and accelerates uniformly to a speed of 180 kmh^{-1} in 10 $seconds$. The distance covered by the car in this time interval is

a) $500\ m$ b) $250\ m$ c) $100\ m$ d) $200\ m$

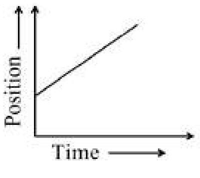
788. A body projected vertically upwards with velocity u returns to the starting point in 4 seconds. If $g=10\ m/\sec^2$, the value of u is

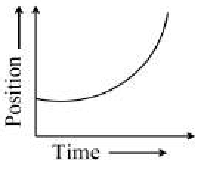
a) $5\ m/sec$ b) $10\ m/sec$ c) $15\ m/sec$ d) $20\ m/sec$

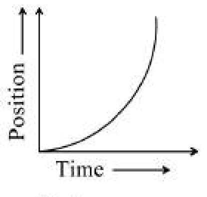
789. The velocity-time and acceleration-time graphs of a particle are given as

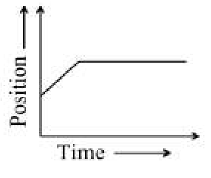


Its position-time graph may be given as

a) 

b) 

c) 

d) 

790. What determines the nature of the path followed by the particle

a) Speed b) Velocity c) Acceleration d) Both (b) and (c)

791. A particle covers 4m, 5m, 6m, and 7m, in 3rd, 4th, 5th and 6th second respectively. The particle starts

a) With an initial non-zero velocity and moves with uniform acceleration

b) From rest and moves with uniform velocity

c) With an initial velocity and moves with uniform velocity

d) From rest and moves with uniform acceleration

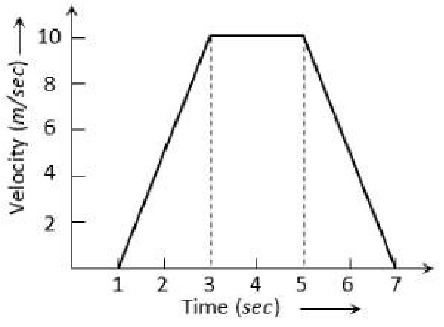
792. The acceleration 'a' in m/s^2 of a particle is given by $a = 3t^2 + 2t + 2$ where t is the time. If the particle starts out with a velocity $u = 2m/s$ at $t = 0$, then the velocity at the end of 2 *seconds* is

a) 12 m/s b) 18 m/s c) 27 m/s d) 36 m/s

793. A 150 m long train is moving with a uniform velocity of 45 km/h. The time taken by the train to cross a bridge of length 850 m is

a) 56 *sec* b) 68 *sec* c) 80 *sec* d) 92 *sec*

794. For the velocity-time graph shown in figure below the distance covered by the body in last two seconds of its motion is what fraction of the total distance covered by it in all the seven seconds



a) $\frac{1}{2}$ b) $\frac{1}{4}$ c) $\frac{1}{3}$ d) $\frac{2}{3}$

795. A body of *mass* 10 kg is moving with a constant velocity of 10 m/s.When a constant force acts for 4 *seconds* on it, it moves with a velocity 2 m/sec in the opposite direction. The acceleration produced in it is

a) $3m/\sec^2$ b) $-3m/\sec^2$ c) $0.3m/\sec^2$ d) $-0.3m/\sec^2$

796. A body starting from rest moves with constant acceleration. The ratio of distance covered by the body during the 5 th second to that covered in 5 s is

a) $\frac{9}{25}$ b) $\frac{3}{5}$ c) $\frac{25}{5}$ d) $\frac{1}{25}$

797. Which of the following is a one dimensional motion

a) Landing of an aircraft b) Earth revolving around the sun

c) Motion of wheels of moving train d) Train running on a straight track

798. Which of the following 4 statements is false

a) A body can have zero velocity and still be accelerated

b) A body can have a constant velocity and still have a varying speed

c) A body can have a constant speed and still have a varying velocity

d) The direction of the velocity of a body can change when its acceleration is constant

799. If a car covers $2/5^{th}$ of the total distance with v_1 speed and $3/5^{th}$ distance with v_2 then average speed is

a) $\frac{1}{2}\sqrt{v_1 v_2}$ b) $\frac{v_1 + v_2}{2}$ c) $\frac{2v_1 v_2}{v_1 + v_2}$ d) $\frac{5v_1 v_2}{3v_1 + 2v_2}$

800. A thief is running away on a straight road in a jeep moving with a speed of 9ms^{-1}. A police man chases him on a motor cycle moving at a speed of 10ms^{-1}. If the instantaneous. Separation of the jeep from the motor cycle is 100m, how long will it take for the police man to catch the theif.

a) 1 s b) 19 s c) 90 s d) 100 s

801. A graph is drawn between velocity and time for the motion of a particle. The area under the curve between the time intervals t_1 and t_2 gives

a) Momentum of the particle b) Displacement of the particle

c) Acceleration of the particle d) Change in velocity of the particle

802. Which of the following 4 statements is false

a) A body can have zero velocity and still be accelerated

b) A body can have a constant velocity and still have a varying speed

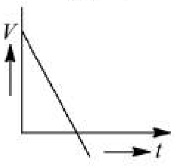
c) A body can have a constant speed and still have a varying velocity

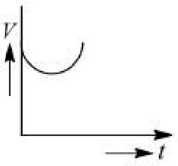
d) The direction of the velocity of a body can change when its acceleration is constant

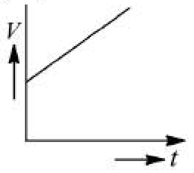
803. A car, starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate $\frac{f}{2}$ to come to rest. If the total distance traversed is 15 S, then

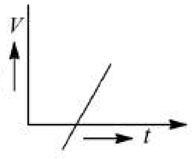
a) $S=\frac{1}{2}ft^2$ b) $S=\frac{1}{4}ft^2$ c) $S=\frac{1}{72}ft^2$ d) $S=\frac{1}{6}ft^2$

804. A stone is released from a balloon moving upwards with velocity v_0 a height h at $t=0$. Which of the following graphs is best representation of velocity-time graph for the motion of stone?

a) 

b) 

c) 

d) 

805. Two balls of same size but the density of one is greater than that of the other are dropped from the same height, then which ball will reach the earth first (air resistance is negligible)

a) Heavy ball b) Light ball c) Both simultaneously d) Will depend upon the density of the balls

806. The relation between time t and distance x is $t=ax^2+bx$, where a and $b$constants are. The acceleration is

a) $-2abv^2$ b) $2\,bv^3$ c) $-2av^3$ d) $2av^2$

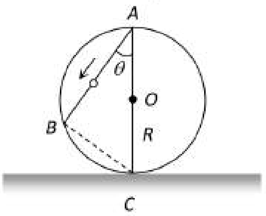
807. A body travelling with uniform acceleration crosses two points A and B with velocities $20ms^{-1}$ and d30 ms^{-1} respectively. The speed of the body at the mid-point of A and B is nearest to

a) 25.5 ms^{-1} b) 25 ms^{-1} c) $24ms^{-1}$ d) $10\sqrt{6}\,ms^{-1}$

808. The distance between two particles moving towards each other is decreasing at the rate of $6m/sec$. If these particles travel with same speeds and in the same direction, then the separation increase at the rate of $4m/sec$. The particles have speeds as

a) $5m/sec : 1m/sec$ b) $4\,m/sec : 1m/sec$ c) $4\,m/sec : 2m/sec$ d) $5\,m/sec : 2m/sec$

809. A frictionless wire AB is fixed on a sphere of radius R. A very small spherical ball slips on this wire. The time taken by this ball to slip from A to B is



a) $\frac{2\sqrt{gR}}{g\cos\theta}$ b) $2\sqrt{gR}.\frac{\cos\theta}{g}$ c) $2\sqrt{\frac{R}{g}}$ d) $\frac{gR}{\sqrt{g\cos\theta}}$

810. For a particle moving in a straight line, the displacement of the particle at time t is given by $S=t^3-6t^2+3t+7$. What is the velocity of the particle when its acceleration is zero?

a) -9ms^{-1} b) -12ms^{-1} c) 3 ms^{-1} d) 42 ms^{-1}

811. Two balls of same size but the density of one is greater than that of the other are dropped from the same height, then which ball will reach the earth first (air resistance is negligible)?

a) Heavy ball b) Light ball

c) Both simultaneously d) Will depend upon the density of the balls

812. A particle is projected upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2 respectively. The velocity of projection will be

a) gt_1 b) gt_2 c) $g(t_1+t_2)$ d) $\frac{g(t_1+t_2)}{2}$

813. A boggy of uniformly moving train is suddenly detached from train and stops after covering some distance. The distance covered by the boggy and distance covered by the train in the same time has relation

a) Both will be equal
b) First will be half of second
c) First will be 1/4 of second
d) No definite ratio

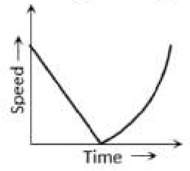
814. A particle moves along x-axis as

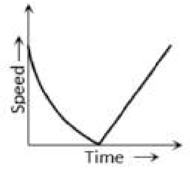
$x = 4(t-2) + a(t-2)^2$

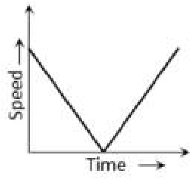
Which of the following is true

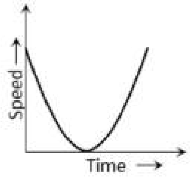
a) The initial velocity of the particle is 4
b) The acceleration of particle is $2a$
c) The particle is at origin at $t = 0$
d) None of these

815. A ball is thrown vertically upwards. Which of the following plots represents the speed-time graph of the ball during its flight if the air resistance is not ignored

a) 

b) 

c) 

d) 

816. A body starting from rest, accelerates at a constant rate a m/s^2 for some time after which it decelerates at a constant rate $b\ m/s^2$ to come to rest finally. If the total time elapsed is $t\ sec$, the maximum velocity attained by the body is given by

a) $\frac{ab}{a+b}t\ m/s$
b) $\frac{ab}{a-b}t\ m/s$
c) $\frac{2ab}{a+b}t\ m/s$
d) $\frac{2ab}{a-b}t\ m/s$

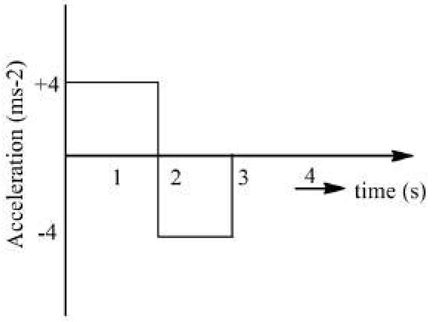
817. The numerical ratio of average velocity to average speed is

a) Always less than one
b) Always equal to one
c) Always more than one
d) Equal to or less than one

818. A bullet moving with a speed of 100 ms^{-1} can just penetrate two planks of equal thickness. Then, the number of such planks penetrated by the same bullet when the speed is doubled will be

a) 6
b) 10
c) 4
d) 8

819. A particle starts from rest at $t = 0$ and moves in a straight line with acceleration as shown in figure. The velocity of the particle at $t = 3$ s is

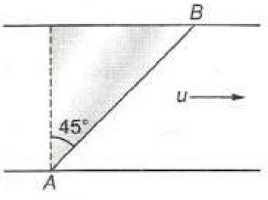


a) $2\ ms^{-1}$ b) $4\ ms^{-1}$ c) $6\ ms^{-1}$ d) $8\ ms^{-1}$

820. A car A is travelling on a straight level road with a uniform speed of 60 km/h. It is followed by another car B which is moving with a speed of $70 km/h$. When the distance between them is 2.5 km, the car B is given a deceleration of 20 km/h^2.After how much time will B catch up with A.

a) 1 hr b) 1/2hr c) 1/4hr d) 1/8hr

821. A man wants to reach point B on the opposite bank of a river flowing at a speed as shown in figure. What minimum speed relative to water should the man have so that he can reach point B? In which direction should be swim?



a) $u\sqrt{2}$ b) $u/\sqrt{2}$ c) 2u d) $u/2$

822. In the above question, the nearest distance between the two persons is

a) 10 m b) 9 m c) 8 m d) 7.2 m

823. A bullet emerges from a barrel of length 1.2 m with a speed of 640 ms^{-1}. Assuming constant acceleration, the approximate time that it spends in the barrel after the gun is fired is

a) 4 ms b) 40 ms c) 400 μs d) 1 s

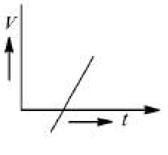
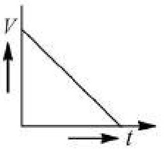
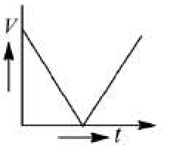
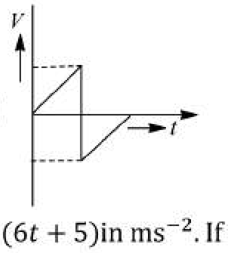
824. A body thrown vertically upwards with an initial velocity u reaches maximum height in 6 seconds. The ratio of the distances travelled by the body in the first second and the seventh second is

a) 1 : 1 b) 11 : 1 c) 1 : 2 d) 1 : 11

825. A car starting from rest, accelerates at the rate f through a distance S, then continues at constant speed for time t and then decelerates at the rate $f/2$ to come to rest. If the total distance travelled is 15 S, then

a) $S = ft$ b) $S = \frac{1}{6}ft^2$ c) $S = \frac{1}{2}ft^2$ d) None of these

826. Which of the following curves represent the $v - t$ graph of an object falling on a metallic surface and bouncing back?

a)  b)  c)  d) 

827. A point initially at rest moves along x-axis. Its acceleration varies with time as $a - (6t + 5)$in ms^{-2}. If it starts from origin, the distance covered in 2s is

a) 20 m b) 18 m c) 16 m d) 25 m

828. A ball kicked vertically up attains a height of 19.6m and returns to the point of throw. If the ball is in air for four second, then the value of acceleration due to gravity is

a) 4.9 ms^{-2} b) 9.8ms^{-2} c) 10 ms^{-2} d) $2 \times 9.8ms^{-2}$.

829. A man walks on a straight road from his home to a market 2.5 km away with a speed of 5 km/h. Finding the market closed, he instantly turns and walks back home with a speed of 7.5 km/h. The average speed of the man over the interval of time 0 to 40 min. Is equal to

a) 5 km/h b) $\frac{25}{4}$ km/h c) $\frac{30}{4}$ km/h d) $\frac{45}{8}$ km/h

830. The correct statement from the following is

a) A body having zero velocity will not necessarily have zero acceleration
b) A body having zero velocity will necessarily have zero acceleration
c) A body having uniform speed can have only uniform acceleration
d) A body having non-uniform velocity will have zero acceleration

831. Water drops fall from a tap on the floor 5m below at regular intervals of time, the first drop striking the floor when the fifth drop begins to fall. The height at which the third drop will be, from ground, at the instant when first drop strikes the ground, will be (g =10ms^{-2})

a) 1.25 m b) 2.15 m c) 2.73 m d) 3.75 m

832. Two cars leave one after the other and travel with and acceleration of 0.4ms^{-2}. Two minutes after the departure of the first car, the distance between them becomes 1.90 km. The time interval between their departures is

a) 50 s b) 60 s c) 70 s d) 80 s

833. A stone falls freely from rest and the total distance covered by it in the last second of its motion equals the distance covered by it in the first three seconds of its motion. The stone remains in the air for

a) 6 s b) 5 s c) 7 s d) 4 s

834. Water drops fall at regular intervals from a tap which is 5 m above the ground. The third drop is leaving the tap at the instant the first drop touches the ground. How far above the ground is the second drop at that instant

a) 2.50 m b) 3.75 m c) 4.00 m d) 1.25 m

835. A boy standing at the top of a tower of 20 m height drops a stone. Assuming $g = 10\ ms^{-2}$, the velocity with which it hits the ground is

a) 5.0 m/s b) 10.0 m/s c) 20.0 m/s d) 40.0 m/s

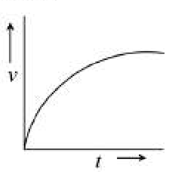
836. A body starting from rest moves with uniform acceleration. The distance covered by the body in time t is proportional to

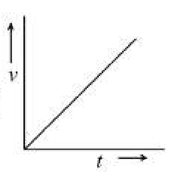
a) $\sqrt{t}$ b) $t^{3/2}$ c) t^2 d) t^3

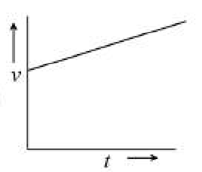
837. A man runs at a speed of 4$ms^{-1}$to overtake a standing bus. When he is 6 m behind the door at $t = 0$, the bus moves forward and continues with a constant acceleration of 1.2ms^{-2}. The man reaches the door in time t. Then,

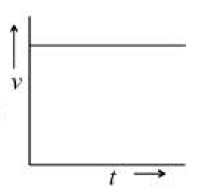
a) $4t = 6 + 0.6t^2$ b) $1.2t^2 = 4t$ c) $4t^2 = 1.2t$ d) $6 + 4t = 0.2t^2$

838. A body starts from rest and moves with uniform acceleration. Which of the following graphs represent its motion

a) 

b) 

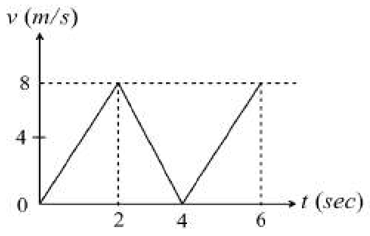
c) 

d) 

839. An object accelerates from rest to a velocity 27.5 ms^{-1} in 10 s, then the distance covered after next 10 s is

a) 550 m b) 137.5 m c) 412.5 m d) 175 m

840. $v - t$ graph for a particle is as shown. The distance travelled in the first 4 s is



a) $12m$ b) $16m$ c) $20m$ d) $24m$

MOTION IN A STRAIGHT LINE

: ANSWER KEY :

1)	c	2)	a	3)	b	4)	b	161)	a	162)	a	163)	c	164)	b
5)	d	6)	b	7)	a	8)	b	165)	c	166)	c	167)	c	168)	c
9)	a	10)	a	11)	a	12)	d	169)	c	170)	c	171)	a	172)	d
13)	b	14)	d	15)	d	16)	d	173)	b	174)	d	175)	d	176)	a
17)	c	18)	b	19)	c	20)	c	177)	a	178)	a	179)	b	180)	c
21)	c	22)	b	23)	c	24)	b	181)	a	182)	c	183)	c	184)	b
25)	b	26)	b	27)	b	28)	b	185)	a	186)	d	187)	a	188)	b
29)	a	30)	b	31)	a	32)	d	189)	d	190)	a	191)	c	192)	a
33)	c	34)	b	35)	d	36)	b	193)	c	194)	a	195)	d	196)	a
37)	d	38)	d	39)	a	40)	a	197)	d	198)	b	199)	b	200)	b
41)	a	42)	b	43)	a	44)	a	201)	a	202)	c	203)	b	204)	a
45)	b	46)	b	47)	a	48)	d	205)	a	206)	d	207)	d	208)	c
49)	c	50)	c	51)	b	52)	d	209)	d	210)	a	211)	b	212)	d
53)	a	54)	c	55)	a	56)	b	213)	b	214)	b	215)	b	216)	d
57)	b	58)	d	59)	b	60)	b	217)	a	218)	a	219)	b	220)	a
61)	c	62)	b	63)	d	64)	c	221)	a	222)	c	223)	d	224)	b
65)	d	66)	a	67)	a	68)	c	225)	b	226)	a	227)	b	228)	a
69)	b	70)	b	71)	b	72)	b	229)	b	230)	b	231)	c	232)	d
73)	b	74)	a	75)	d	76)	b	233)	c	234)	d	235)	a	236)	b
77)	b	78)	d	79)	c	80)	d	237)	a	238)	d	239)	d	240)	d
81)	d	82)	a	83)	a	84)	a	241)	d	242)	d	243)	d	244)	b
85)	c	86)	c	87)	c	88)	c	245)	c	246)	b	247)	c	248)	c
89)	b	90)	a	91)	c	92)	c	249)	d	250)	a	251)	c	252)	d
93)	c	94)	a	95)	a	96)	a	253)	a	254)	a	255)	b	256)	d
97)	c	98)	a	99)	c	100)	a	257)	a	258)	c	259)	d	260)	b
101)	a	102)	b	103)	a	104)	c	261)	c	262)	a	263)	c	264)	c
105)	b	106)	d	107)	d	108)	a	265)	c	266)	b	267)	b	268)	c
109)	a	110)	a	111)	b	112)	b	269)	c	270)	a	271)	a	272)	d
113)	a	114)	a	115)	b	116)	c	273)	d	274)	d	275)	a	276)	b
117)	d	118)	b	119)	c	120)	d	277)	d	278)	a	279)	d	280)	d
121)	c	122)	b	123)	d	124)	b	281)	a	282)	a	283)	b	284)	d
125)	a	126)	d	127)	c	128)	b	285)	b	286)	b	287)	b	288)	a
129)	a	130)	d	131)	b	132)	c	289)	a	290)	c	291)	d	292)	b
133)	c	134)	b	135)	b	136)	d	293)	d	294)	b	295)	d	296)	c
137)	c	138)	d	139)	b	140)	a	297)	d	298)	d	299)	b	300)	c
141)	d	142)	d	143)	c	144)	d	301)	d	302)	c	303)	b	304)	a
145)	a	146)	a	147)	a	148)	b	305)	c	306)	d	307)	b	308)	d
149)	b	150)	d	151)	a	152)	d	309)	b	310)	d	311)	c	312)	a
153)	d	154)	b	155)	a	156)	a	313)	d	314)	d	315)	a	316)	c
157)	b	158)	a	159)	c	160)	a	317)	c	318)	b	319)	d	320)	c

321)	b	322)	c	323)	d	324)	a	521)	c	522)	a	523)	d	524)	d
325)	d	326)	b	327)	b	328)	b	525)	a	526)	b	527)	c	528)	d
329)	a	330)	c	331)	d	332)	c	529)	a	530)	d	531)	a	532)	d
333)	b	334)	c	335)	b	336)	c	533)	a	534)	c	535)	c	536)	a
337)	a	338)	b	339)	a	340)	b	537)	d	538)	c	539)	c	540)	b
341)	c	342)	c	343)	b	344)	c	541)	a	542)	b	543)	c	544)	b
345)	b	346)	d	347)	a	348)	d	545)	d	546)	d	547)	c	548)	a
349)	d	350)	c	351)	b	352)	c	549)	c	550)	a	551)	a	552)	c
353)	c	354)	b	355)	c	356)	c	553)	a	554)	b	555)	b	556)	b
357)	d	358)	d	359)	b	360)	b	557)	a	558)	c	559)	a	560)	c
361)	a	362)	b	363)	d	364)	a	561)	c	562)	c	563)	a	564)	d
365)	a	366)	b	367)	c	368)	a	565)	d	566)	a	567)	c	568)	c
369)	c	370)	d	371)	a	372)	a	569)	a	570)	d	571)	b	572)	c
373)	b	374)	a	375)	a	376)	a	573)	c	574)	b	575)	b	576)	b
377)	b	378)	a	379)	c	380)	b	577)	b	578)	c	579)	b	580)	c
381)	a	382)	b	383)	a	384)	d	581)	b	582)	b	583)	b	584)	c
385)	b	386)	b	387)	b	388)	a	585)	b	586)	d	587)	d	588)	b
389)	b	390)	b	391)	b	392)	d	589)	d	590)	a	591)	a	592)	d
393)	a	394)	d	395)	c	396)	c	593)	a	594)	a	595)	b	596)	d
397)	d	398)	d	399)	c	400)	b	597)	c	598)	b	599)	b	600)	b
401)	a	402)	b	403)	d	404)	c	601)	d	602)	c	603)	c	604)	d
405)	c	406)	a	407)	b	408)	d	605)	c	606)	b	607)	d	608)	a
409)	d	410)	d	411)	c	412)	d	609)	b	610)	b	611)	b	612)	c
413)	a	414)	b	415)	c	416)	d	613)	b	614)	b	615)	c	616)	a
417)	c	418)	c	419)	c	420)	a	617)	a	618)	a	619)	c	620)	b
421)	c	422)	a	423)	d	424)	b	621)	d	622)	c	623)	c	624)	d
425)	c	426)	d	427)	a	428)	b	625)	d	626)	b	627)	a	628)	d
429)	c	430)	b	431)	b	432)	b	629)	c	630)	c	631)	c	632)	d
433)	b	434)	b	435)	b	436)	c	633)	c	634)	b	635)	a	636)	c
437)	b	438)	b	439)	d	440)	b	637)	c	638)	b	639)	b	640)	c
441)	d	442)	b	443)	a	444)	b	641)	a	642)	d	643)	c	644)	d
445)	a	446)	c	447)	c	448)	d	645)	d	646)	c	647)	a	648)	a
449)	b	450)	a	451)	b	452)	a	649)	d	650)	b	651)	d	652)	d
453)	b	454)	c	455)	d	456)	a	653)	a	654)	a	655)	a	656)	a
457)	a	458)	d	459)	a	460)	b	657)	b	658)	b	659)	a	660)	d
461)	c	462)	b	463)	c	464)	c	661)	d	662)	a	663)	a	664)	b
465)	d	466)	d	467)	b	468)	a	665)	d	666)	b	667)	a	668)	b
469)	d	470)	c	471)	d	472)	a	669)	a	670)	a	671)	d	672)	a
473)	b	474)	b	475)	b	476)	a	673)	c	674)	b	675)	b	676)	a
477)	d	478)	c	479)	d	480)	d	677)	c	678)	a	679)	d	680)	b
481)	a	482)	a	483)	d	484)	b	681)	d	682)	b	683)	b	684)	c
485)	a	486)	c	487)	c	488)	b	685)	c	686)	c	687)	d	688)	c
489)	d	490)	b	491)	c	492)	c	689)	b	690)	b	691)	b	692)	a
493)	c	494)	d	495)	d	496)	d	693)	c	694)	d	695)	d	696)	c
497)	a	498)	b	499)	a	500)	c	697)	d	698)	a	699)	c	700)	a
501)	b	502)	c	503)	a	504)	d	701)	b	702)	b	703)	a	704)	c
505)	a	506)	b	507)	a	508)	b	705)	d	706)	a	707)	d	708)	b
509)	b	510)	c	511)	b	512)	c	709)	a	710)	b	711)	c	712)	b
513)	b	514)	a	515)	c	516)	d	713)	a	714)	c	715)	a	716)	c
517)	c	518)	b	519)	b	520)	c	717)	d	718)	b	719)	c	720)	c

721)	b	722)	a	723)	d	724)	c	785)	c	786)	a	787)	b	788)	d
725)	c	726)	b	727)	d	728)	d	789)	b	790)	d	791)	a	792)	b
729)	a	730)	b	731)	b	732)	d	793)	c	794)	b	795)	b	796)	a
733)	d	734)	b	735)	b	736)	b	797)	d	798)	b	799)	d	800)	d
737)	a	738)	a	739)	a	740)	b	801)	b	802)	b	803)	c	804)	a
741)	d	742)	c	743)	a	744)	c	805)	c	806)	c	807)	a	808)	a
745)	a	746)	c	747)	b	748)	a	809)	c	810)	a	811)	c	812)	d
749)	d	750)	b	751)	b	752)	d	813)	b	814)	b	815)	c	816)	a
753)	d	754)	a	755)	d	756)	c	817)	d	818)	d	819)	b	820)	b
757)	a	758)	b	759)	b	760)	a	821)	b	822)	c	823)	a	824)	b
761)	d	762)	d	763)	d	764)	b	825)	d	826)	d	827)	b	828)	b
765)	b	766)	d	767)	a	768)	a	829)	d	830)	a	831)	d	832)	a
769)	a	770)	b	771)	d	772)	b	833)	b	834)	b	835)	c	836)	c
773)	d	774)	c	775)	a	776)	c	837)	a	838)	b	839)	c	840)	b
777)	b	778)	c	779)	d	780)	c								
781)	b	782)	d	783)	d	784)	a								

MOTION IN A STRAIGHT LINE

: HINTS AND SOLUTIONS :

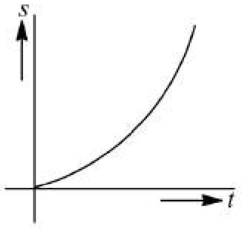
2 **(a)**

The equation of motion

$$s = ut + \frac{1}{2}\,at^2$$

$$= 0 + \frac{1}{2}\,at^2 = \frac{1}{2}\,at^2$$

The graph plot is as shown.



3 **(b)**

Let the initial velocity of ball be u

Time of rise $t_1 = \frac{u}{g+a}$ and height reached $= \frac{u^2}{2(g+a)}$

Time of fall t_2 is given by

$$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)}$$

$$\Rightarrow t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)}\sqrt{\frac{g+a}{g-a}}$$

$\therefore t_2 > t_1$ because $\frac{1}{g+a} < \frac{1}{g-a}$

4 **(b)**

$$v = u + at = u + \left(\frac{F}{m}\right)t = 20 + \left(\frac{100}{5}\right) \times 10$$

$$= 220\,m/s$$

5 **(d)**

If t_1 and t_2 are the time, when body is at the same height then,

$$h = \frac{1}{2}gt_1t_2 = \frac{1}{2} \times g \times 2 \times 10 = 10\,g$$

6 **(b)**

Relative velocity of one train $w.r.t.$ other

$= 10 + 10 = 20m/s$

Relative acceleration$= 0.3 + 0.2 = 0.5m/s^2$

If train crosses each other then from $s = ut + \frac{1}{2}at^2$

$As, s = s_1 + s_2 = 100 + 125 = 225$

$$\Rightarrow 225 = 20t + \frac{1}{2} \times 0.5 \times 0.5 \times t^2$$

$$\Rightarrow 0.5t^2 + 40t - 450 = 0$$

$$\Rightarrow t = \frac{-40 \pm \sqrt{1600 + 4.(005) \times 450}}{1}$$

$$= -40 \pm 50$$

$\therefore t = 10sec$ (Taking +ve value)

7 **(a)**

Distance between the balls = Distance travelled by first ball in 3 seconds – Distance travelled by second ball in 2 seconds $= \frac{1}{2}g(3)^2 - \frac{1}{2}g(2)^2 = 45 - 20 = 25\,m$

8 **(b)**

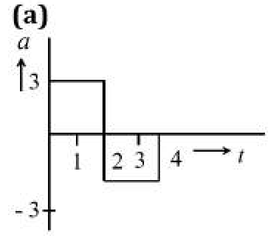
The velocity of balloon at height h, $v = \sqrt{2\left(\frac{g}{8}\right)h}$

When the stone released from this balloon, it will go upward with velocity, $= \frac{\sqrt{gh}}{2}$ (Same as that of balloon). In this condition time taken by stone to reach the ground

$$t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right] = \frac{\sqrt{gh}/2}{g}\left[1 + \frac{2gh}{gh/4}\right]$$

$$= \frac{2\sqrt{gh}}{g} = 2\sqrt{\frac{h}{g}}$$

9 **(a)**



Taking the motion from 0 to 2 s

$u = 0, a = 3ms^{-2}, t = 2s, v = ?$

$v = u + at = 0 + 3 \times 2 = 6ms^{-1}$

Taking the motion from 2 s to 4 s

$v = 6 + (-3)(2) = 0ms^{-1}$

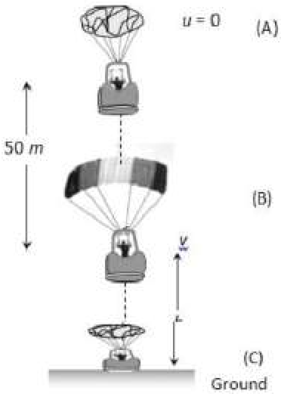
10 **(a)**

$H_{\max} = \frac{u^2}{2g} \Rightarrow H_{\max} \propto \frac{1}{g}$

On planet B value of g is 1/9 times to that of A. So value of $H_{\max}$ will become 9 times $i.e.$ $2 \times 9 = 18$ $metre$

11 **(a)**

After balling out from point A parachutist falls freely under gravity. The velocity acquired by it will 'v'



From $v^2 = u^2 + 2as = 0 + 2 \times 9.8 \times 50 = 980$

[As $u = 0, a = 9.8m/s^2, s = 50\ m$]

At point B, parachute opens and it moves with retardation of 2 m/s^2 and reach at ground (point C) with velocity of 3 m/s

For the part 'BC' by applying the equation $v^2 = u^2 + 2as$

$v = 3m/s, u = \sqrt{980}\ m/s, a = -2m/s^2, s = h$

$\Rightarrow (3)^2 = (\sqrt{980})^2 + 2 \times (-2) \times h \Rightarrow 9$

$= 980 - 4h$

$\Rightarrow h = \frac{980 - 9}{4} = \frac{971}{4} = 242.7 \cong 243\ m$

So, the total height by which parachutist bail out $= 50 + 243 = 293\ m$

12 **(d)**

Acceleration due to gravity is independent of mass of body

13 **(b)**

Distance average speed $= \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 2.5 \times 4}{2.5 + 4}$

$= \frac{200}{65} = \frac{40}{13} km/hr$

14 **(d)**

$S \propto u^2$. If u becomes 3 times then S will become 9 times

$i.e.$ $9 \times 20 = 180m$

15 **(d)**

Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{x}{t_1 + t_2}$

$= \frac{x}{\frac{x/3}{v_1} + \frac{2x/3}{v_2}} = \frac{1}{\frac{1}{3 \times 20} + \frac{2}{3 \times 60}} = 36\ km/hr$

16 **(d)**

$\because v = 0 + na \Rightarrow a = v/n$

Now, distance travelled in n $sec. \Rightarrow S_n = \frac{1}{2}an^2$ and distance travelled in $(n-2)sec \Rightarrow S_{n-2} = \frac{1}{2}a(n-2)^2$

$\therefore$ Distance travelled in last 2 seconds,

$= S_n - S_{n-2} = \frac{1}{2}an^2 - \frac{1}{2}a(n-2)^2$

$\frac{a}{2}[n^2 - (n-2)^2] = \frac{a}{2}[n + (n-2)][n - (n-2)]$

$= a(2n-2) = \frac{v}{n}(2n-2) = \frac{2v(n-1)}{n}$

17 **(c)**

When packet is released from the balloon, it acquires the velocity of balloon of value 12 m/s. Hence velocity of packet after 2 sec, will be

$v = u + gt = 12 - 9.8 \times 2 = -76\ m/s$

18 **(b)**

Distance covered =Area enclosed by $v - t$ graph

= Area of triangle $= \frac{1}{2} \times 4 \times 8 = 16\ m$

19 **(c)**

Mass does not affect maximum height

$H = \frac{u^2}{2g} \Rightarrow H \propto u^2$, So if velocity is doubled then height will become four times.i.e.$H = 20 \times 4 = 80m$

20 **(c)**

Distance covered in a particular time is

$s_n = u + \frac{1}{2}g(2n-1)$

$s_1 = 0 + \frac{1}{g}(2 \times 1 - 1) = \frac{g}{2}$

$s_2 = 0 + \frac{1}{2}g(2 \times 2 - 1) = \frac{3}{2}g$

And $s_3 = 0 + \frac{1}{2}g(2 \times 3 - 1) = \frac{5}{2}g$

Hence, the required ration is

$s_1 : s_2 : s_3 = \frac{g}{2} : \frac{3}{2}g : \frac{5}{2}g$

$= 1 : 3 : 5$

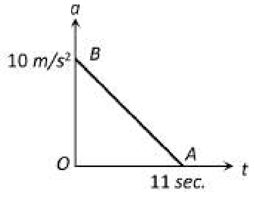
21 **(c)**

$$S_n = u + \frac{a}{2}(2n-1) \Rightarrow 1.2 = 0 + \frac{a}{2}(2\times 6 - 1)$$

$$\Rightarrow a = \frac{1.2\times 2}{11} = 0.218\ m/s^2$$

22 **(b)**

The area under acceleration time graph gives change in velocity. As acceleration is zero at the end of 11 sec



i.e. $v_{\max}$ =Area of ΔOAB

$$= \frac{1}{2}\times 11\times 10 = 55\ m/s$$

23 **(c)**

$$h = 0 + \frac{1}{2}gt^2 \ \Rightarrow t^2 \propto h$$

$$\therefore \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{16}{25}} = \frac{4}{5}$$

24 **(b)**

$x = \alpha t^3, y = \beta t^3$

$$v_x = \frac{dx}{dt} = 3\alpha t^2$$

$$v_y = \frac{dy}{dt} = 3\ \beta t^2$$

Resultant velocity, $v = \sqrt{v_x^2 + v_y^2}$

$$= \sqrt{9\alpha^2 t^4 + 9\beta^2 t^4}$$
$$= 3t^2\sqrt{\alpha^2 + \beta^2}$$

25 **(b)**

Velocity at the time of striking the floor,

$u = \sqrt{2gh_1} = \sqrt{2\times 9.8\times 10} = 14 m/s$

Velocity with which it rebounds

$v = \sqrt{2gh_2} = \sqrt{2\times 9.8\times 2.5} = 7\ m/s$

$\therefore$ Change in velocity $\Delta v = 7 - (-14) = 21 m/s$

$$\therefore \text{Acceleration} = \frac{\Delta v}{\Delta t} = \frac{21}{0.01}$$
$$= 2100 m/s^2 (\text{upwards})$$

26 **(b)**

For one dimensional motion along a plane

$$S = ut + \frac{1}{2}at^2 \Rightarrow 9.8 = 0 + \frac{1}{2}g\sin 30° t^2 \Rightarrow t$$
$$= 2\text{sec}$$

27 **(b)**

$$S_{3\text{rd}} = 10 + \frac{10}{2}(2\times 3 - 1) = 35\ m$$

$$S_{2\text{nd}} = 10 + \frac{10}{2}(2\times 2 - 1) = 25\ m \Rightarrow \frac{S_{3\text{rd}}}{S_{2\text{nd}}} = \frac{7}{5}$$

28 **(b)**

Average velocity is that uniform velocity with which the object will cover the same displacement in same interval of time as it does with its actual variable velocity during that time interval.

Here, total distance covered

$$= (3\ \text{ms}^{-1}\times 20\ \text{s}) + (4\ \text{ms}^{-1}\times 20\ \text{s}) + (5\ ms^{-1}\times 20\ \text{s})$$

$$= (60 + 80 + 100) = 240\ \text{m}$$

Total time taken $= 20 + 20 + 20 = 60$ s

$$\therefore \text{Average velocity} = \frac{240}{60} = 4\ \text{ms}^{-1}$$

29 **(a)**

As the train are moving in the same direction. So the initial relative speed $(v_1 - v_2)$ and by applying retardation final relative speed becomes zero

From $v = u - at \Rightarrow 0 = (v_1 - v_2) - at \Rightarrow t = \frac{v_1 - v_2}{a}$

30 **(b)**

If acceleration is variable (depends on time) then

$$v = u + \int (f)dt = u + \int (a\ t)dt = u + \frac{a\ t^2}{2}$$

31 **(a)**

Let initial $(t = 0)$ velocity of particle= u

For first 5 sec of motion $s_5 = 10$ $metre$

$$s = ut + \frac{1}{2}at^2 \Rightarrow 10 = 5u + \frac{1}{2}a(5)^2$$

$2u + 5a = 4$

For first 8 sec of motion $s_8 = 20$ $metre$

$$20 = 8u + \frac{1}{2}a(8)^2 \Rightarrow 2u + 8a = 5$$

By solving $u = \frac{7}{6} m/s$ and $a = \frac{1}{3} m/s^2$

Now distance travelled by particle in Total 10 sec

$$s_{10} = u\times 10 + \frac{1}{2}a(10)^2$$

By substituting the value of u and a we will get

$s_{10} = 28.3\ m$

so the distance in last 2 sec $= s_{10} - s_8$

$= 28.3 - 20 = 8.3m$

32 **(d)**

Given, $a = 1\text{ m/s}, s = 48\text{ m}$

By equation of motion

$$48 = 10t + \frac{1}{2}at^2$$

$$t = 8\ s$$

33 **(c)**

$\frac{dv}{dt} = bt \Rightarrow dv = bt\,dt \Rightarrow v = \frac{bt^3}{2} + K_1$

At $t = 0, v = v_0 \Rightarrow K_1 = v_0$

We get $v = \frac{1}{2}bt^2 + v_0$

Again $\frac{dx}{dt} = \frac{1}{2}bt^2 + v_0$

$\Rightarrow x = \frac{1}{2}\frac{bt^3}{3} + v_0t + K_2$

At $t = 0, x = 0 \Rightarrow K_2 = 0$

$\therefore x = \frac{1}{6}bt^3 + v_0t$

34 **(b)**

Let initial velocity of body a point A is v, AB is 40 cm.

From $\quad v^2 = u^2 - 2as$

$$\Rightarrow \quad \left(\frac{v}{2}\right)^2 = v^2 - 2a \times 40$$

Or $$a = \frac{3v^2}{320}$$

Let on penetrating 40 cm in a wooden block, the body moves x distance from B to C.

So, for B to C

$$u = \frac{v}{2}, v = 0$$

$$s = x, a = \frac{3v^2}{320}\text{(deceleration)}$$

$$\therefore \quad (0)^2 = \left(\frac{v}{2}\right)^2 - 2 \times \frac{3v^2}{320} \times x$$

Or $$x = \frac{40}{3}\text{cm}$$

35 **(d)**

Since, acceleration is in the direction of instantaneous velocity, so particle always moves in forward direction.

Hence, (d) is correct.

36 **(b)**

$H_{max} \propto u^2$, It body projected with double velocity then maximum height will become four times *i.e.* 200 m

37 **(d)**

The equation of motion

$$\left(\frac{u}{2}\right)^2 = u^2 - 2g\,(AO)$$

$$2g \times AO = u^2 - \frac{u^2}{4} = \frac{3u^2}{4}$$

$$AO = \frac{3u^2}{8g}$$

When particle will reach at point B

$$\left(\frac{u}{3}\right)^2 = u^2 - 2g(OB)$$

$$OB = \frac{8u^2}{18g}$$

When particle will reach at point C

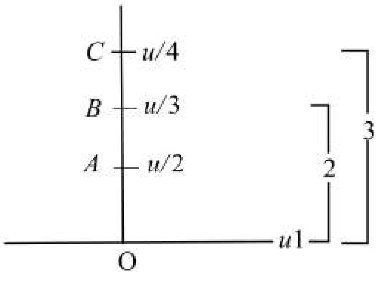
$$\left(\frac{u}{4}\right)^2 = u^2 - 2g\,(OC)$$

$$OC = \frac{15u^2}{32g}$$

$$AB = OB - OA = \frac{u^2}{g}\left[\frac{8}{18} - \frac{3}{8}\right] = \frac{5u^2}{72g}$$

$$BC = OC - OB = \frac{u^2}{g}\left[\frac{15}{32} - \frac{8}{18}\right]$$

The ratio, $\frac{AB}{BC} = \frac{20}{7}$



38 **(d)**

From first equation of motion, we have

$$v = u + at$$

Given, $u = 0, a_1 = 2\ ms^{-2}$

$$t = 10\ s,$$

$$\therefore \quad v_1 = 2 \times 10 = 20\ ms^{-1}$$

In the next 30 s, the constant velocity becomes

$$v_2 = v_1 + a_2 t_2$$

Given, $v_1 = 20\ ms^{-1}, a_2 = 2\ ms^{-2}, t_2 = 30\ s$

$$\therefore \quad v_2 = 20 + 2 \times 30 = 80\ ms^{-1}.$$

When it decelerates, then

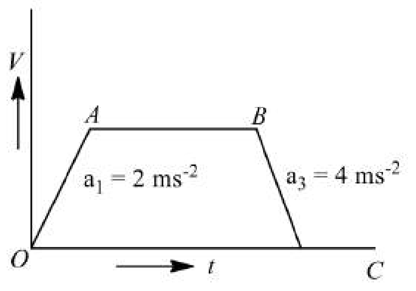
$$v_3^2 = u^2 - 2a_3 s$$

Here, $v_3 = 0$ (train stops), $v_2 = 80\ ms^{-1}$,

$$a_3 = 4\ ms^{-2}$$

$$0 = (80)^2 - 2 \times 4 \times s$$

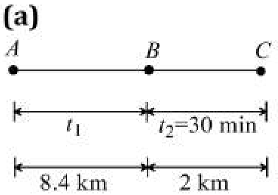
Or $\quad s = \frac{80 \times 80}{8} = 800\ m.$



39 **(a)**

Distance between the balls = Distance travelled by first ball in 3 seconds – Distance travelled by second ball in 2 seconds $= \frac{1}{2}g(3)^2 - \frac{1}{2}g(2)^2 = 45 - 20 = 25\ m$

40 **(a)**



Average speed $\bar{v} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$

$$= \frac{8.4km + 2km}{t_1 + t_2} = \frac{10.4\ km}{\left(\frac{8.4\ km}{70\ km/h}\right) + \frac{1}{2}h}$$

$$= \frac{10.4\ km}{0.12h + 0.5h} = 16.8\ km/h$$

41 **(a)**

Using

$$V = u + at$$

$$V = gt \qquad \text{...(i)}$$

Comparing with $y = mx + c$

Equation (i) represents a straight line passing through origin inclined x-axis (slope -g)

42 **(b)**

Let particle thrown with velocity u and its maximum height is H then $H = \frac{u^2}{2g}$

When particle is at height $H/2$, then its speed is $10\ m/s$

From equation $v^2 = u^2 - 2gh$

$$(10)^2 = u^2 - 2g\left(\frac{H}{2}\right) = u^2 - 2g\frac{u^2}{4g} \Rightarrow u^2 = 200$$

Maximum height $\Rightarrow H = \frac{u^2}{2g} = \frac{200}{2 \times 10} = 10\ m$

43 **(a)**

Since slope of graph remains constant for velocity-time graph

45 **(b)**

$$v = u + \int a dt = u + \int (3t^2 + 2t + 2)dt$$

$$= u + \frac{3t^3}{3} + \frac{2t^2}{2} + 2t = u + t^3 + t^2 + 2t$$

$$= 2 + 8 + 4 + 4 = 18\ m/s \quad (\text{As } t = 2\ sec)$$

46 **(b)**

For vertically upward motion, $h_1 = v_0 t - \frac{1}{2}gt^2$

and for vertically downward motion, $h_2 = v_0 t + \frac{1}{2}g\,t^2$

$\therefore$ Total distance covered in t sec $h = h_1 + h_2$

$$= 2v_0 t$$

47 **(a)**

An aeroplane files 400 m north and 300 m south so the net displacement is 100 m towards north

Then it files 1200 m upwards so $r = \sqrt{(100)^2 + (1200)^2}$

$= 1204\ m \simeq 1200\ m$

The option should be 1204 m, because this value mislead one into thinking that net displacement is in upward direction only

48 **(d)**

$$x = 2t^3 + 21t^2 + 60t + 6$$

$$\therefore v = \frac{dx}{dt} = 6t^2 + 42t + 60$$

But, $v = 0$ (given)

$$t^2 + 7t + 10 = 0$$

$\Rightarrow \ t = -5s$

or $\ t = -2s$

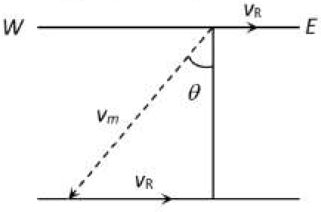
$$a = \frac{dv}{dt} = 12t + 42$$

$a\,|_{t=5s} = -60 + 42 = -18\text{ms}^{-2}$

$a\,|_{t=-2s} = -24 + 42 = 18\text{ms}^{-2}$

49 **(c)**

For shortest possible path man should swim with an angle $(90 + \theta)$ with downstream



From the fig,

$\sin\theta = \frac{v_r}{v_m} = \frac{5}{10} = \frac{1}{2}$

$\Rightarrow \therefore\ \theta = 30°$

So angle with downstream $= 90° + 30° = 120°$

50 **(c)**

Since displacement is always less than or equal to distance, but never greater than distance. Hence numerical ratio of displacement to the distance covered is always equal to or less than one

52 **(d)**

Average speed $= -\frac{\text{Total distance}}{\text{Total time}} = \frac{x}{t_1+t_2}$

$= \frac{x}{\frac{x/3}{v_1} + \frac{2x/3}{v_2}} = \frac{1}{\frac{1}{3\times 20} + \frac{2}{3\times 60}} = 36\ km/hr$

53 **(a)**

Velocity required by body in 10 *sec*

$v = 0 + 2 \times 10 = 20\ m/s$

And distance travelled by it in 10 *sec*

$S_1 = \frac{1}{2} \times 2 \times (10)^2 = 100\ m$

Then it moves with constant velocity $(20\ m/s)$ for 30 *sec*

$S_2 = 20 \times 30 = 600\ m$

After that due to retardation $(4\ m/s^2)$ it stops

$S_3 = \frac{v^2}{2a} = \frac{(20)^2}{2\times 4} = 50m$

Total distance travelled $S_1 + S_2 + S_3 = 750m$

54 **(c)**

Because acceleration is a vector quantity

55 **(a)**

Average speed $= \frac{2v_d v_u}{v_d + v_u}$

56 **(b)**

Boat covers distance of 16 km in a still water in hours

ie $v_B = \frac{16}{2} = 8\text{kmh}^{-1}$

Now, velocity of water

$v_W = 4\text{kmh}^{-1}$

Time taken for going upstream

$t_1 = \frac{8}{v_B - v_w} = \frac{8}{8-4} = 2\text{h}$

(As water current oppose the motion of boat)

Time taken for going downstream

$t_2 = \frac{8}{v_B + v_w} = \frac{8}{8+4} = \frac{8}{12}\text{h}$

(As water current helps the motion of boat)

$\therefore$ Total time $= t_1 + t_2$

$= \left(2 + \frac{8}{12}\right)\text{h} = 2\text{ h }40\text{ min}$

58 **(d)**

$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} = -\alpha x^2$ [Given]

$\Rightarrow \int_{v_0}^{0} v\,dv = \alpha \int_0^S x^2\,dx \Rightarrow \left[\frac{v^2}{2}\right]_{v_0}^{0} = -\alpha\left[\frac{x^3}{3}\right]_0^S$

$\Rightarrow \frac{v_0^2}{2} = \frac{\alpha S^3}{3} \Rightarrow S = \left(\frac{3v^2}{2\alpha}\right)^{\frac{1}{3}}$

59 **(b)**

$h_1 = \frac{1}{2}gt_1^2 = \frac{10}{2} \times (5)^2 = 125\text{ m}$

$h_2 = \frac{1}{2}\,gt_2^2 = \frac{10}{2} \times (3)^2 = 45\text{ m}$

$\therefore \qquad h_1 - h_2 = 125 - 45 = 80\text{ m}$

60 **(b)**

$v_t = 4t^3 - 2t$

$\Rightarrow \frac{dx_t}{dt} = 4t^3 - 2t$

$\Rightarrow \int dx_t = \int 4t^3 dt - \int 2t dt$

$\Rightarrow x_t = t^4 - t^2$

Since, $x_t = 2\text{m}$

$t = \sqrt{2}\text{s}$ (rejecting negative time)

Now acceleration,

$a_t = \frac{dv_t}{dt} = 12t^2 - 2 = 12(2) - 2 = 22\text{ms}^{-2}$

61 **(c)**

Stopping distance$= \frac{\text{Kinetic energy}}{\text{Retarding force}} = \frac{\frac{1}{2}mu^2}{F}$

$= \frac{u^2}{2\mu g}[F = \mu mg]$

So both will cover equal distance

62 **(b)**

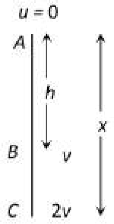
Let at point A initial velocity of body is equal to zero

for path AB: $v^2 = 0 + 2gh$ ... (i)

for path AC: $(2v)^2 = 0 + 2gx$

$4v^2 = 2gx$ ...(ii)

Solving (i) and (ii), $x = 4h$



63 **(d)**

Both trains will travel a distance of 1 km before to come in rest. In this case by using $v^2 = u^2 + 2as$

$\Rightarrow 0 = (40)^2 + 2a \times 1000 \Rightarrow a = -0.8\, m/s^2$

64 **(c)**

Since displacement is always less than or equal to distance, but never greater than distance. Hence numerical ratio of displacement to the distance covered is always equal to or less than one

65 **(d)**

The student is able to catch the bus if in time t the distance travelled by him is equal to the distance travelled by bus in time t

ie, $s_1 = s_2$ ... (i)

From Eq. (i)

$$0 + \frac{1}{2}at^2 = ut - d$$

Or $at^2 - 2ut + 2d = 0$

It is quadratic equation

So, $t = \frac{+2u \pm \sqrt{4u^2 - 8ad}}{2} = \frac{+2u \pm 2\sqrt{u^2 - 2ad}}{2}$

For t to be real

$$u \geq \sqrt{2ad} \geq \sqrt{2 \times 1 \times 50} = 10\ \text{ms}^{-1}$$

66 **(a)**

Average speed $= \frac{2v_d v_u}{v_d + v_u}$

67 **(a)**

We know that the velocity of body is given by the slope of displacement – time graph so it is clear that initially slope of the graph is positive and after some time it becomes zero (corresponding to the peak of graph) and it will become negative

69 **(b)**

Only directions of displacement and velocity gets changed, acceleration is always directed vertically downward

70 **(b)**

We will solve the problem is terms of relative initial velocity, relative acceleration and relative displacement of the coin with respect to the floor of the lift.

$u = 10 - 10 = 0\text{ms}^{-1}, a = 9.8\text{ms}^{-2}, s = 4.9\text{m}$, t=?

$$4.9 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$$

or $4.9t^2 = 4.9$ or $t = 1\text{s}$

71 **(b)**

$$S_2 = \frac{1}{2}gt_2^2 = \frac{10}{2} \times (3)^2 = 45\, m$$

$$S_1 = \frac{1}{2}gt_1^2 = \frac{10}{2} \times (5)^2 = 125\, m$$

$\therefore S_1 - S_2 = 125 - 45 = 80\, m$

72 **(b)**

$$v = \frac{ds}{dt} = 12t - 3t^2$$

Velocity is zero for $t = 0$ and $t = 4$ sec

73 **(b)**

$$h_n = \frac{g}{2}(2n-1) \Rightarrow h_{5^{\text{th}}} = \frac{10}{2}(2 \times 5 - 1) = 45\, m$$

74 **(a)**

Le the initial velocity $= u$

And acceleration $= a$

In Ist case $s_1 = ut_1 + \frac{1}{2}at_1^2$

$200 = 2u + 2a$ $(\because t_1 = 2\text{ s})$

Or $u + a = 100$ ... (i)

In IInd case

$$s_2 = ut_2 + \frac{1}{2}at_2^2$$

$420 = 6u + 18a$ $(\because t_2 = 2 + 4 = 6\text{ s})$

Or $3a + u = 70$ ... (ii)

Solving Eqs. (i) and (ii), we get

$$a = -15\ \text{ms}^{-2}$$

And $u = 115\ \text{ms}^{-1}$

$$v = u + at$$

$$= 115 - 15 \times 7 = 10\ \text{ms}^{-1}$$

75 **(d)**

Average acceleration $= \frac{\Delta v}{\Delta t}$

$= \frac{\sqrt{2gh'} - (-\sqrt{2gh})}{\Delta t} = \frac{\sqrt{2gh'} + \sqrt{2gh}}{\Delta t}$

$= \frac{\sqrt{2 \times 10 \times 2.5} + \sqrt{2 \times 10 \times 10}}{0.01} \text{ms}^{-2}$

$= \frac{\sqrt{15} + \sqrt{200}}{0.01} \text{ms}^{-2} = \frac{5\sqrt{2} + 10\sqrt{2}}{0.01} \text{ms}^{-2}$

$= \frac{15\sqrt{2}}{0.01} \text{ms}^{-2} = 1500\sqrt{2} \text{ms}^{-2}$

The upward velocity has been taken as positive. Since average acceleration is positive therefore its direction is vertically upward.

77 **(b)**

Velocity of graph = Area of a-t graph

$= (4 \times 1.5) - (2 \times 1) = 4 m/s$

78 **(d)**

Let the man will be able to catch the bus after t s

Then

$10t = 48 + \frac{1}{2} \times 1 \times t^2$

$t^2 - 20t + 96 = 0$

$(t - 12)(t - 8) = 0$

$t = 8s$ and $t = 12s$

Thus the man will be able to catch the bus after $8s$

79 **(c)**

Stopping distance $= \frac{\text{Kinetic energy}}{\text{Retarding force}} = \frac{\frac{1}{2}mu^2}{F}$

$= \frac{u^2}{2\mu g} [F = \mu mg]$

So both will cover equal distance

80 **(d)**

Body reaches the point of projection with same velocity

82 **(a)**

Distance covered in 5^{th} second

$S_{5^{th}} = u + \frac{a}{2}(2n - 1) = 0 + \frac{a}{2}(2 \times 5 - 1) = \frac{9a}{2}$

and distance covered in 5 second,

$S_5 = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times a \times 25 = \frac{25a}{2}$

$\therefore \frac{S_{5^{th}}}{S_5} = \frac{9}{25}$

84 **(a)**

$S \propto u^2 \therefore \frac{S_1}{S_2} = \left(\frac{u_1}{u_2}\right)^2 \Rightarrow \frac{2}{S_2} = \frac{1}{4} \Rightarrow S_2 = 8\ m$

85 **(c)**

$\frac{dx}{dt} = 2at - 3bt^2 \Rightarrow \frac{d^2x}{dt^2} = 2a - 6bt = 0 \Rightarrow t = \frac{a}{3b}$

86 **(c)**

Distance travelled by the particle is

$x = 40 + 12t - t^3$

We know that, speed is rate of change of distance i.e.

$v = \frac{dx}{dt}$

$\therefore v = \frac{d}{dt}(40 + 12t - t^3) = 0 + 12 - 3t^2$

But final velocity $v = 0$

$\therefore 12 - 3t^2 = 0$

$\Rightarrow t^2 = \frac{12}{3} = 4 \Rightarrow t = 2s$

Hence, distance travelled by the particle before coming to rest is given by

$x = 40 + 12(2) - (2)^3 = 40 + 24 - 8 = 64 - 8$

$= 56m$

87 **(c)**

From equation of motion, we have

$$s = ut + \frac{1}{2}gt^2$$

Where, u is initial velocity, g the acceleration due to gravity and t the time.

For upward motion

$$h = -ut_1 - \frac{1}{2}gt_1^2 \quad \text{... (i)}$$

for downward motion

$$h = -ut_2 + \frac{1}{2}gt_2^2 \quad \text{... (ii)}$$

multiplying Eq. (i) by t_2 and Eq. (ii) by t_1 and subtracting Eq. (ii) by Eq. (i), we get

$$h(t_2 - t_1) = \frac{1}{2}gt_1t_2(t_2 - t_1)$$

$$h = \frac{1}{2}gt_1t_2 \quad \text{... (iii)}$$

When stone is dropped from rest $u = 0$, reaches the ground in t second.

$$\therefore \quad h = \frac{1}{2}gt^2 \quad \text{... (iv)}$$

Equating Eqs. (iii) and (iv), we get

$$\frac{1}{2}gt^2 = \frac{1}{2}g\,t_1t_2$$

$\Rightarrow \quad t^2 = t_1 t_2 \Rightarrow t = \sqrt{t_1 t_2}$

88 **(c)**

$\frac{dv}{dt} = 6t$ or $dv = 6t, mv = \frac{6t^2}{2} = 3t^2,$

$dx = 3t^2 dt \Rightarrow x = 3\frac{t^3}{2} = t^3$

89 **(b)**

Region OA shows that graph bending toward time axis $i.e.$ acceleration is negative.

Region AB shows that graph is parallel to time axis $i.e.$ velocity is zero. Hence acceleration is zero.

Region BC shows that graph is bending towards displacement axis $i.e.$ acceleration is positive.

Region CD shows that graph having constant slope $i.e.$ velocity is constant. Hence acceleration is zero

90 **(a)**

$s \propto t^2$[Given] $\therefore s = Kt^2$

Acceleration $a = \frac{d^2s}{dt^2} = 2k$ [constant]

It means the particle travels with uniform acceleration

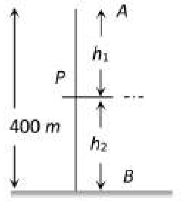
91 **(c)**

$v^2 = u^2 + 2gh \Rightarrow v = \sqrt{u^2 + 2gh}$

So for both the cases velocity will be equal

92 **(c)**

Let both balls meet at point P after time t



The distance travelled by ball $A, h_1 = \frac{1}{2}gt^2$

The distance travelled by ball $B, h_2 = ut - \frac{1}{2}gt^2$

$h_1 + h_2 = 400\ m \Rightarrow ut = 400, t = 400/50$

$= 8\ sec$

$\therefore h_1 = 320m$ and $h_2 = 80\ m$

93 **(c)**

$v = (180 - 16x)^{1/2}$

As $a = \frac{dv}{dt} = \frac{dv}{dx}.\frac{dx}{dt}$

$\therefore a = \frac{1}{2}(180 - 16x)^{-1/2} \times (-16)\left(\frac{dx}{dt}\right)$

$= -8(180 - 16x)^{-1/2} \times v$

$= -8(180 - 16x)^{-1/2} \times (180 - 16x)^{1/2}$

$= -8\ m/s^2$

94 **(a)**

Slope of displacement time-graph is velocity

$$\frac{v_1}{v_2} = \frac{\tan\theta_1}{\tan\theta_2} = \frac{\tan 30^\circ}{\tan 45^\circ} = \frac{1}{\sqrt{3}}$$

$$v_1 : v_2 = 1 : \sqrt{3}$$

95 **(a)**

The $v - x$ equation from the given graph can be written as,

$$v = \left(-\frac{v_0}{x_0}\right) x + v_0 \qquad \text{... (i)}$$

$$\therefore \quad a = \frac{dv}{dt} = \left(-\frac{v_0}{x_0}\right)\frac{dx}{dt} = \left(-\frac{v_0}{x_0}\right) v$$

Substituting v from Eq. (i), we get

$$a = \left(-\frac{v_0}{x_0}\right)\left[\left(-\frac{v_0}{x_0}\right) x + v_0\right]$$

$$a = \left(\frac{v_0}{x_0}\right)^2 x - \frac{v_0^2}{x_0}$$

Thus, $a - x$ graph is a straight line with positive slope and negative intercept.

96 **(a)**

When the stone is released from the balloon. Its height

$h = \frac{1}{2}at^2 = \frac{1}{2} \times 1.25 \times (8)^2 = 40\ m$ and velocity

$v = at = 1.25 \times 8 = 10\ m/s$

Time taken by the stone to reach the ground

$$t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$$

$$= \frac{10}{10}\left[1 + \sqrt{1 + \frac{2 \times 10 \times 40}{(10)^2}}\right]$$

$$= 4sec$$

97 **(c)**

Let v_1, v_2 be the initial speeds of first and second runners. Let t be time by them when the first runner has completed 50m. During this time, the second runner has covered a distance $= 50 - 1 =$ 49m.

So, $t = \frac{50}{v_1} = \frac{49}{v_2}$ ...(i)

Suppose, the second runner increases his speed to v_3 so that he covers the remaining distance (= 51m) in times t. So

$t=\frac{51}{v_3}=\frac{49}{v_2}$

or $v_3=\frac{51}{49}v_2$

or $v_3=\left(1+\frac{2}{49}\right)v_2$ or $\frac{v_3}{v_2}-1=\frac{2}{49}$

or $\frac{v_3-v_2}{v_2}=\frac{2}{49}$

or % increase $=\frac{2}{49}\times 100=4.1\%$

98 **(a)**

If t_0 is the reaction time, then the distance covered during decelerated motion is $10-10t_0$.

Now, in the first case,

$10^2=2a(10-10t_0)$ ...(i)

Similarly, in the second case,

$20^2=2a(30-20t_0)$ ...(ii)

Again, in the third case,

$15^2=2a(x-5t_0)$ ...(iii)

Dividing Eq.(ii) by Eq. (i), $\frac{20^2}{10^2}=\frac{30-20t_0}{10-10t_0}$

or $40-40t_0=30-20t_0$

or $20t_0=10$ or $t_0=\frac{1}{2}s$

Dividing Eq. (iii) by Eq. (i), we get

$\frac{225}{100}=\frac{x-15t_0}{10-10t_0}$ or $\frac{9}{4}=\frac{x-15\times\frac{1}{2}}{10-10\times\frac{1}{2}}$

$45=4x-30$ or $4x=75$

or $x=\frac{75}{4}\text{m}=18.75\text{m}$

99 **(c)**

$\mathbf{u}=3\hat{\mathbf{i}}+4\hat{\mathbf{j}}, \mathbf{a}=0.4\hat{\mathbf{i}}+0.3\hat{\mathbf{j}}$

Speed $\mathbf{v}=\mathbf{u}+\mathbf{a}t$

$=3\hat{\mathbf{i}}+4\hat{\mathbf{j}}+(0.4\hat{\mathbf{i}}+0.3\hat{\mathbf{j}})10$

$=3\hat{\mathbf{i}}+4\hat{\mathbf{j}}+4\hat{\mathbf{i}}+3\hat{\mathbf{j}}=7\hat{\mathbf{i}}+7\hat{\mathbf{j}}$

$v=\sqrt{7^2+7^2}=7\sqrt{2}$ unit

100 **(a)**

If t_1 and $2t_2$ are the time taken by particle to cover first and second half distance respectively

$t_1=\frac{x/2}{3}=\frac{x}{6}$ ...(i)

$x_1=4.5\,t_2$ and $x_2=7.5\,t_2$

So, $x_1+x_2=\frac{x}{2}\Rightarrow 4.5\,t_2+7.5\,t_2=\frac{x}{2}$

$t_2=\frac{x}{24}$ ...(ii)

Total time $t=t_1+2t_2=\frac{x}{6}+\frac{x}{12}=\frac{x}{4}$

So, average speed $=4\,m/sec$

101 **(a)**

$s=ut+\frac{1}{2}at^2$

$s=\frac{1}{2}at^2$ $[\because u=0]$

It is an equation of parabola

102 **(b)**

Speed of stone in a vertically upward direction is $20m/s$. So for vertical downward motion we will consider $u=-20\,m/s$

$v^2=u^2+2gh=(-20)^2+2\times 9.8\times 200$

$=4320\,m/s$

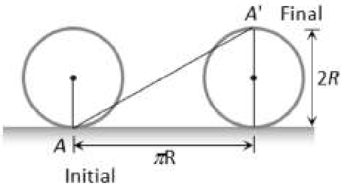
$\therefore v\simeq 65m/s$

103 **(a)**

$h=\frac{1}{2}gt^2=\frac{1}{2}\times 10\times(4)^2=80\,m$

104 **(c)**

Horizontal distance covered by the wheel in half revolution $=\pi R$



So the displacement of the point which was initially in contact with ground

$=AA'=\sqrt{(\pi R)^2+(2R)^2}$

$=R\sqrt{\pi^2+4}=\sqrt{\pi^2+4}$ [As $R=1m$]

105 **(b)**

$h=\frac{1}{2}gt^2$

$h'=\frac{1}{2}g(t-t_0)^2$

$h-h'=\frac{1}{2}g[t^2-(t-t_0)^2]$

$=\frac{1}{2}g[t^2-t^2-t_0^2+2tt_0]$

$\Delta h=\frac{1}{2}gt_0(2t-t_0)$

Δh is increasing with time

106 **(d)**

Average acceleration $=\frac{\text{Change in velocity}}{\text{Time taken}}=\frac{v_2-v_1}{t_2-t_1}$

$=\frac{[10+2(5)^2]-[10+2(2)^2]}{3}=\frac{60-18}{3}14m/s^2$

107 **(d)**

Relative velocity

$=10+5=15\,m/sec$

$\therefore t=\frac{150}{15}=10\,sec$

108 **(a)**

If a body starts from rest with acceleration α and then retards with retardation β and comes to rest. The total time taken for this journey is t and distance covered is S

Then $S = \frac{1}{2}\frac{\alpha\beta t^2}{(\alpha+\beta)} = \frac{1}{2}\frac{5\times 10}{(5+10)} \times t^2$

$\Rightarrow 1500 = \frac{1}{2}\frac{5\times 10}{(5+10)} \times t^2 \Rightarrow t = 30\ sec$

109 **(a)**

$h = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times (4)^2 = 80\ m$

110 **(a)**

Effective speed of bullet

= speed of bullet + speed of police jeep

$= 180\ m/s + 45\ km/h = (180 + 12.5)\ m/s$

$= 192.5\ m/s$

Speed of thief's jeep $= 153\ km/h = 42.5\ m/s$

Velocity of bullet $w.r.t.$ thief's car $= 192.5 - 42.5 = 150\ m/s$

111 **(b)**

$v = u + a\,t$

$2\times 100 = 100 + 10t$ or $t = 10$ s

112 **(b)**

Bullet will take $\frac{100}{1000} = 0.1\ sec$ to reach target.

During this period vertical distance (downward) travelled by the bullet $= \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times (0.1)^2 m = 5cm$

So the gun should be aimed 5 cm above the target

113 **(a)**

Average velocity $= \frac{2\times 8\times 12}{8+12}\text{ms}^{-1} = 9.6\text{ms}^{-1}$

114 **(a)**

$s = \frac{1}{2}\text{g}t^2, v = \frac{1}{2}\text{g} \times 2t = \text{g}t$

115 **(b)**

Average speed is the ratio of distance to time taken

Distance travelled from 0 to $5s = 40\ m$

Distance travelled from 5 to $10s = 0\ m$

Distance travelled from 10 to $15s = 60\ m$

Distance travelled from 15to $20s = 20$

So, total distance $= 40 + 0 + 60 + 20 = 120\ m$

Total time taken $= 20\ minutes$

Hence, average speed

$= \frac{\text{distance travelled } (m)}{\text{time (min)}} = \frac{120}{20} = 6\ m/min$

116 **(c)**

From given figure, it is clear that the net displacement is zero. So average velocity will be zero

117 **(d)**

$v = \sqrt{2\ gh}$ ... (i)

After rebounce, $v^2 = u^2 - 2gh$

Or $u^2 = v^2 + 2\ gh'$

$\therefore$ $u^2 = 2\ gh'$ ... (ii)

$\therefore$ $\frac{v^2}{u^2} = \frac{2gh}{2gh'}$

Or $h' = h \times \frac{u^2}{v^2}$

$= h \times \left(\frac{80}{100}\right)^2 = 0.64\ h$

118 **(b)**

In this problem point starts moving with uniform acceleration a and after time t (Position B) the direction of acceleration get reversed i.e. the retardation of same value works on the point. Due to this velocity of points goes on decreasing and at position C its velocity becomes zero. Now the direction of motion of point reversed and it moves from C to A under the effect of acceleration a.

We have to calculate the total time in this motion.

Starting velocity at position A is equal to zero.

Velocity at position $B \Rightarrow v = at$ [As $u = 0$]

Distance between A and B, $S_{AB} = \frac{1}{2}at^2$

As same amount of retardation works on a point and it comes to rest therefore

$S_{BC} = S_{AB} = \frac{1}{2}a\,t^2$

$\therefore S_{AC} = S_{AB} + S_{BC} = a\,t^2$ and time required to cover this distance is also equal to t.

$\therefore$ Total time taken for motion between A and C $= 2t$

Now for the return journey from C to A ($S_{AC} = at^2$)

$S_{AC} = u\,t + \frac{1}{2}at^2 \Rightarrow at^2 = 0 + \frac{1}{2}at_1^2 \Rightarrow t_1 = \sqrt{2}t$

Hence total time in which point returns to initial point

$T = 2t + \sqrt{2}\,t = (2 + \sqrt{2})t$

119 **(c)**

$t = \sqrt{\frac{2h}{(g+a)}} = \sqrt{\frac{2\times 2.7}{(9.8+1.2)}} = \sqrt{\frac{5.4}{11}} = \sqrt{0.49}$

$= 0.7$ sec

As $u = 0$ and lift is moving upward with acceleration

120 **(d)**

Man walks from his home to market with a speed of 5 km/h. Distance= 2.5 km and time $= \frac{d}{v} = \frac{2.5}{5} = \frac{1}{2}$ hr and he returns back with speed of 7.5 km/h in rest of time of 10 $minutes$

Distance $= 7.5 \times \frac{10}{60} = 1.25\ km$

So, Average speed $= \frac{\text{Total distance}}{\text{TOtal time}}$

$= \frac{(2.5+1.25)km}{(40/60)hr} = \frac{45}{8} km/hr$

121 **(c)**

As $v^2 = v^2 - 2as \Rightarrow u^2 = 2as$ $(\therefore v = 0)$

$\Rightarrow u^2 \propto s \Rightarrow \frac{u_2}{u_1} = \left(\frac{s_2}{s_1}\right)^{1/2}$

$\Rightarrow u_2 = \left(\frac{9}{4}\right)^{\frac{1}{2}} u_1 = \frac{3}{2} u_1 = 300 m/s$

122 **(b)**

$\int_0^x dx = \int_0^1 (v_0 + gt + ft^2) dt$

$x = v_0 + g\left(\frac{1}{2}\right) + f\left(\frac{1}{3}\right)$

123 **(d)**

Let the car accelerate at rate α for time t_1 then maximum velocity attained,

$v = 0 + \alpha t_1 = \alpha t_1$

Now, the car decelerates at a rate β for time $(t - t_1)$ and finally comes to rest. Then,

$0 = v - \beta(t - t_1) \Rightarrow 0 = \alpha t_1 - \beta t + \beta t_1$

$\Rightarrow t_1 = \frac{\beta}{\alpha + \beta} t$

$\therefore v = \frac{\alpha \beta}{\alpha + \beta} t$

124 **(b)**

$a = \sqrt{a_x^2 + a_y^2}$

$= \left[\left(\frac{d^2x}{dy}\right)^2 + \left(\frac{d^2y}{dt^2}\right)^2\right]^{\frac{1}{2}}$

Here, $\frac{d^2y}{dx^2} = 0$

Hence, $a = \frac{d^2x}{dt^2} = 8 \text{ms}^{-2}$

125 **(a)**

Let t_1 and t_2 be times taken by the car to go from X to Y and then from Y to X respectively.

Then, $t_1 + t_2 = \frac{XY}{v_u} + \frac{XY}{v_d} = XY \left(\frac{v_u + u_d}{v_u v_d}\right)$

Total distance travelled

$= XY + XY = 2\ XY$

Therefore, average speed of the car for this round trip is

Average speed $= \frac{\text{distance travelled}}{\text{time taken}}$

$v_{\text{av}} = \frac{2\ XY}{XY\left(\frac{v_u + v_d}{v_u v_d}\right)}$ or $v_{\text{av}} = \frac{2 v_u v_d}{v_u + v_d}$

126 **(d)**

Stopping distance $s \propto u^2$

$\Rightarrow \quad \frac{s_2}{40} = \left(\frac{90 \times \frac{5}{18}}{50 \times \frac{5}{18}}\right)^2$

$\Rightarrow \quad s_2 = 129.6$ m

127 **(c)**

$S \propto t^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{10}{20}\right)^2 \Rightarrow S_2 = 4S_1$

128 **(b)**

$\int_{6.25}^{0} \frac{dv}{\sqrt{v}} = -2.5 \int_0^t dt$

$\left|2\sqrt{v}\right|_{6.25}^{0} = -2.5t$

$2\sqrt{6.25} = 2.5t$

$t = 2sec$

129 **(a)**

$\frac{1}{2} at^2 = vt \Rightarrow t = \frac{2v}{a}$

130 **(d)**

Acceleration due to gravity is independent of mass of body

131 **(b)**

$v = u + at$

$\Rightarrow -2 = 10 + a \times 4$

$\therefore \quad a = -3 \text{ ms}^{-2}$

132 **(c)**

Acceleration $= a = \frac{dv}{dt} = 0.1 \times 2t = 0.2t$

Which is time dependent $i.e.$ non-uniform acceleration

133 **(c)**

Since acceleration due to gravity is independent of mass, hence time is also independent of mass (or density) of object

134 **(b)**

Time of ascent $=\frac{u}{g}=6$ sec $\Rightarrow u=60m/s$

Distance in first second $h_{\text{first}}=60-\frac{g}{2}(2\times1-1)=55m$

Distance in seventh second will be equal to the distance in first second of vertical downward motion

$h_{\text{seventh}}=\frac{g}{2}(2\times1-1)=5\ m\ \Rightarrow h_{\text{first}}/h_{\text{seventh}}=11:1$

135 **(b)**

$x=a+bt^2, v=\frac{dx}{dt}=2bt$

Instantaneous velocity $v=2\times3\times3=18\ cm/sec$

136 **(d)**

$u=\sqrt{2gh}=\sqrt{2\times10\times20}=20m/s$

and $T=\frac{2u}{g}=\frac{2\times20}{10}=4\ sec$

137 **(c)**

If a stone is dropped from height h then

$h=\frac{1}{2}gt^2$ ...(i)

if a stone is thrown upward with velocity u then

$h=-u\,t_1+\frac{1}{2}gt_1^2$ ...(ii)

If a stone is thrown downward with velocity u then

$h=ut_2+\frac{1}{2}gt_2^2$ ...(iii)

From (i) (ii) and (iii) we get

$-ut_1+\frac{1}{2}gt_1^2=\frac{1}{2}gt^2$ ...(iv)

$ut_2+\frac{1}{2}gt_2^2=\frac{1}{2}gt^2$ ...(v)

Dividing (iv) and (v) we get

$\therefore \frac{-ut_1}{ut_2}=\frac{\frac{1}{2}g(t^2-t_1^2)}{\frac{1}{2}g(t^2-t_2^2)}$

Or $-\frac{t_1}{t_2}=\frac{t^2-t_1^2}{t^2-t_2^2}$

By solving $t=\sqrt{t_1t_2}$

138 **(d)**

$3t=\sqrt{3x}+6\Rightarrow 3x=(3t-6)^2$

$\Rightarrow x=3t^2-12t+12$

$v=\frac{dx}{dt}=6t-12$, for $v=0, t=2$ sec

$x=3(2)^2-12\times2+12=0$

139 **(b)**

Let the total distance travelled by the body is $2S$. If t_1 is the time taken by the body to travel first half of the distance, then

$$t_1=\frac{S}{2}$$

Let t_2 be the time taken by the body for each time interval for the remaining half journey.

$$\therefore \quad S=3t_2+5t_2=8t_2$$

So, average speed $=\frac{\text{Total distance travelled}}{\text{Total time taken}}$

$$=\frac{2S}{t_1+2t_2}=\frac{2S}{\frac{S}{2}+\frac{S}{4}}=\frac{8}{3}\text{ms}^{-1}$$

140 **(a)**

Displacement = Area of upper trapezium- Area of lower trapezium

$=\frac{1}{2}(2+4)\times4-\frac{1}{2}(2+4)2=12-6=6\text{m}$

141 **(d)**

$S=3-4t+5t^2$

Velocity $\frac{ds}{dt}=-4+10\,t$

Hence, initial velocity will be

$$\left|u=\frac{ds}{dt}\right|_{t=0}=-4\text{ unit}$$

142 **(d)**

Slope of displacement time graph is negative only at point time E

143 **(c)**

Assume that the motion is along the positive direction of x-axis. For simplicity, let us take the beginning of the braking to be a t time $t=0$, at position x_0

Therefore, $x-x_0=v_0\left(\frac{v-v_0}{a}\right)+\frac{1}{2}a\left(\frac{v-v_0}{a}\right)^2$

Solving for a and substituting known data then yield

$a=\frac{v^2-v_0}{2(x-x_0)}$

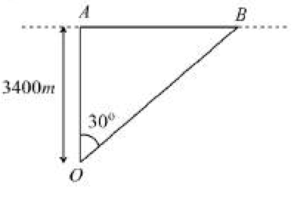
Here, $v_0=100\text{kmh}^{-1}=27.78\text{ms}^{-1}, x-x_0=88.0$

And $v=80\text{kmh}^{-1}=22.22\text{m}^{-1}$

$\therefore\ a=\frac{(22.22)^2-(27.78)^2}{2(88.0)}$

$=-1.58\text{ms}^{-2}$

144 **(d)**



O is the observation point at the ground. A and B are the positions of aircraft for which $\angle AOB = 30°$. Time taken by aircraft from A to B is $10s$

ΔAOB

$$\tan 30° = \frac{AB}{3400}$$

$$AB = 3400 \tan 30° = \frac{3400}{\sqrt{3}} m$$

$\therefore$ Speed of aircraft,

$$v = \frac{AB}{10} = \frac{3400}{10\sqrt{3}} = 196.3\ ms^{-1}$$

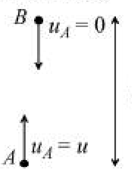
145 **(a)**

$$h = ut - \frac{1}{2}gt^2 \Rightarrow 96 = 80t - \frac{32}{2}t^2$$

$$\Rightarrow t^2 - 5t + 6 = 0 \Rightarrow t = 2sec \text{ or } 3\ sec$$

146 **(a)**

At time t



Velocity of A, $v_A = u - gt$ upward

Velocity of B, $v_B = gt$ downward

It we assume that height h is smaller than or equal to the maximum height reached by A, then at every instant v_A and v_B are in opposite directions

$\therefore V_{AB} = v_A + V_B$

$= u - gt + gt$ [Speeds in opposite directions get added]

$= u$

147 **(a)**

Displacement $= (2 \times 4 - 2 \times 2 + 2 \times 4) =$12m

$= 2 \times 4 + 2 \times 2 + 2 \times 4$=20m

149 **(b)**

$$v^2 = u^2 + 2gh \Rightarrow (3u)^2 = (-u)^2 + 2gh \Rightarrow h = \frac{4u^2}{g}$$

150 **(d)**

$$a = \frac{dv}{dt} = \frac{dv}{dx}\frac{dx}{dt} = v\frac{dv}{dx} = -\alpha x^2 \text{ [Given]}$$

$$\Rightarrow \int_{v_0}^{0} v dv = \alpha \int_{0}^{S} x^2\, dx \Rightarrow \left[\frac{v^2}{2}\right]_{v_0}^{0} = -\alpha\left[\frac{x^3}{3}\right]_0^S$$

$$\Rightarrow \frac{v_0^2}{2} = \frac{\alpha S^3}{3} \Rightarrow S = \left(\frac{3v^2}{2\alpha}\right)^{\frac{1}{3}}$$

151 **(a)**

$$h = ut + \frac{1}{2}gt^2$$

$$\therefore \quad 30 = -25t + \frac{10}{2}t^2$$

Or $\quad t^2 - 5t - 6 = 0$

Or $\quad (t-6)(t+1) = 0$

$\therefore \quad t = 6$ s

152 **(d)**

$x = 8 + 12t + t^3$

$v = 0 + 12 - 3t^2 = 0$

$3t^2 = 12$

$t = 2\ sec$

$$a = \frac{dv}{dt} = 0 - 6t$$

$a[t = 2] = -12\ m/s^2$

Retardation $= 12\ m/s^2$

153 **(d)**

$(S' \propto t^2$. Now, $S_1' : S_2' : S_3' :: \frac{1}{4} : 1 : \frac{9}{4}$ or 1:4:9

For successive intervals,

$S_1 : S_2 : S_3 :: 1 : (4-1) : (9-4)$

or $S_1 : S_2 : S_3 :: 1 : 3 : 5$

154 **(b)**

For vertically upward motion, $h_1 = v_0 t - \frac{1}{2}gt^2$

and for vertically downward motion, $h_2 = v_0 t + \frac{1}{2}g\, t^2$

$\therefore$ Total distance covered in t sec $h = h_1 + h_2$

$= 2v_0 t$

155 **(a)**

An aeroplane files 400 m north and 300 m south so the net displacement is 100 m towards north

Then it files 1200 m upwards so $r = \sqrt{(100)^2 + (1200)^2}$

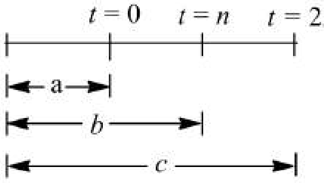
$= 1204\ m \simeq 1200\ m$

The option should be 1204 m, because this value mislead one into thinking that net displacement is in upward direction only

156 **(a)**

$$b - a = un + \frac{1}{2}An^2$$

$$2b - 2a = 2un + An^2$$

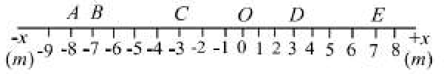


Again, $c - a = u(2n) + \frac{1}{2}A(2n)^2$

Subtracting, $c - a - 2b + 2a = An^2$

$A = \dfrac{c - 2b + a}{n^2}$

157 **(b)**



(i) The displacement of the main from A to E is $\Delta x = x_2 - x_1 = 7m - (-8m) = +15m$ directed in the positive x-direction

(ii) The displacement of the man from E to C is $\Delta x = -3m - (7m) = -10m$ directed in the negative x-direction

(iii) The displacement of the man from B to D is $\Delta x = 3m - (-7m) = +10m$ directed in the positive x-axis

158 **(a)**

For the given condition initial height $h = d$ and velocity of the ball is zero. When the ball moves downward its velocity increases and it will be maximum when the ball hits the ground & just after the collision it becomes half and in opposite direction. As the ball moves upward its velocity again decreases and becomes zero at height $d/2$. This explanation match with graph (A)

159 **(c)**

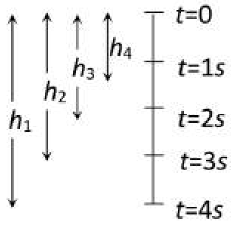
$y = a + bt + ct^2 - dt^4$

$\therefore v = \frac{dy}{dt} = b + 2ct - 4dt^3$ and $a = \frac{dv}{dt} = 2c - 12dt^2$

Hence, at $t = 0$, $v_{\text{initial}} = b$ and $a_{\text{initial}} = 2c$

160 **(a)**

For first marble, $h_1 = \frac{1}{2}g \times 16 = 8g$



For second marble, $h_2 = \frac{1}{2}g \times 9 = 4.5g$

For third marble, $h_3 = \frac{1}{2}g \times 4 = 2g$

For fourth marble, $h_4 = \frac{1}{2}g \times 1 = 0.5g$

$\therefore h_1 - h_2 = 8g - 4.5g = 3.5g = 35m.$

$h_2 - h_3 = 4.5g - 2g = 2.5g = 25m$ and

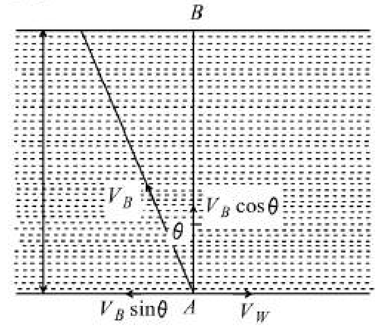
$h_3 - h_4 = 2g - 0.5g = 1.5g = 15m$

161 **(a)**

$S_n = u + \frac{a}{2}(2n - 1) = \frac{a}{2}(2n - 1)$ because $u = 0$

Hence $\frac{S_4}{S_3} = \frac{7}{5}$

162 **(a)**



From figure, $V_B \sin\theta = V_W$

$\sin\theta = \dfrac{V_W}{V_B} = \dfrac{1}{2} \Rightarrow \theta = 30°$ $\quad [\because V_B = 2V_W]$

Time taken to cross the river,

$t = \dfrac{D}{V_B \cos\theta} = \dfrac{D}{V_B \cos 30°} = \dfrac{2D}{V_B\sqrt{3}}$

163 **(c)**

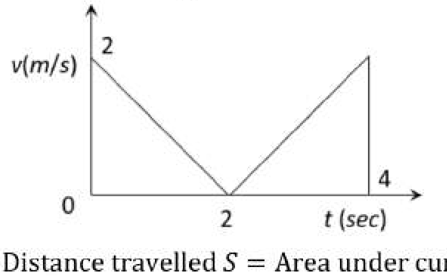
For same direction relative velocity $= |v_1 - v_2|$

Distance covered, $d = \frac{(v_1 - v_2)^2}{2a}$

For no collision, $d > \frac{(v_1 - v_2)^2}{2a}$

164 **(b)**

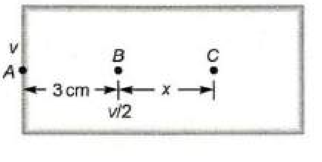
The velocity time graph for given problem is shown in the figure.



Distance travelled $S =$ Area under curve $= 2 + 2 = 4m$

165 **(c)**

Let initial velocity of body at point A is v, AB is 3 cm.



From $v^2 = u^2 - 2as$

$\left(\frac{v}{2}\right)^2 = v^2 - 2a \times 3$

$a = \frac{v^2}{8}$

Let on penetrating 3 cm in a wooden block, the body moves x distance form B to C.

So, for B to C

$u = \frac{v}{2}, v = 0,$

$s = x, a = \frac{v^2}{8}$ (deceleration)

$\therefore (0)^2 = \left(\frac{v}{2}\right)^2 - 2 . \frac{v^2}{8} . x$

$x = 1$

166 **(c)**

Mass does not affect maximum height

$H = \frac{u^2}{2g} \Rightarrow H \propto u^2$, So if velocity is doubled then height will become four times.i.e.$H = 20 \times 4 = 80m$

167 **(c)**

Given, $s = 2$ m, $u = 80$ ms^{-1}, $v = 0$

From $v^2 = u^2 - 2as$

$\therefore (0)^2 = (80)^2 - 2 \times a \times 2$

Or $a = \frac{80 \times 80}{4} = 1600$ ms^{-2}

168 **(c)**

Instantaeneous velocity $= v = \frac{\Delta x}{\Delta t}$

By using the data from the table

$v_1 = \frac{0-(-2)}{1} = 2m/s, \quad v_2 = \frac{6-0}{1} = 6m/s$

$v_3 = \frac{16-6}{1} = 10m/s$

So, motion is non-uniform but accelerated

169 **(c)**

Average velocity is defined as the displacement divided by time.

In the given graph, displacement is zero.

Hence, Average velocity $= \frac{\text{total displacement}}{\text{total time}} = \frac{0}{t} = 0$

170 **(c)**

Let body reaches the ground in t sec.

$\therefore$ Velocity of body after $(t-2)$ sec from equation of motion.

$v = u + gt'$

And $t' = t - 2$

$\therefore v = g(t-2)$

Distance covered in last two sec

$h' = g(t-2) \times 2 + \frac{1}{2}g(2)^2$

$60 = 20(t-2) + 20$

Or $t = 4$ s

Hence, height of tower is given buy

$h = ut + \frac{1}{2}gt^2$

$h = \frac{1}{2}gt^2 [\because u = 0]$

$= \frac{1}{2} \times 10 \times (4)^2 = 80$ m.

171 **(a)**

$x = \frac{1}{2}gt^2, 100 - x = 25x - \frac{1}{2}gt^2;$

Adding $25t = 100$ or $t = 4$ s

172 **(d)**

$S \propto u^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$

173 **(b)**

Speed can never be negative. Hence (b) is correct.

174 **(d)**

$x = 8 + 12t + t^3$

$v = 0 + 12 - 3t^2 = 0$

$3t^2 = 12$

$t = 2\ sec$

$a = \frac{dv}{dt} = 0 - 6t$

$a[t = 2] = -12\ m/s^2$

Retardation $= 12\ m/s^2$

175 **(d)**

$u = 72\ kmph = 20\ m/s, v = 0$

By using $v^2 = u^2 - 2as \Rightarrow a = \frac{u^2}{2s} = \frac{(20)^2}{2 \times 200} = 1\ m/s^2$

176 **(a)**

$S_1 = \frac{1}{2}ft^2, S_2 = -v_0 t - \frac{1}{2}gt^2$, Clearly, $(S_1 - S_2) \propto t$

177 **(a)**

$\tan(90° - \theta) = \frac{20}{15}$

$\therefore \cot\theta = \frac{20}{15} = \frac{4}{3}$

$\Rightarrow \theta = 37°$

$\therefore \theta = 37° + 23°$

$= 60°$

178 **(a)**

Let us calculate relative deceleration by considering relative velocity

Using, $v^2 - u^2 = 2aS, 0^2 - 80^2 = 2 \times a \times 2000$

or $a = -\frac{80 \times 80}{4000} = -\frac{64}{40} \text{ms}^{-2} = -1.6\text{ms}^{-2}$

Deceleration of each train is $\frac{1.6}{2} \text{ms}^{-2} ie, 0.8 \text{ ms}^{-2}$

179 **(b)**

The time of fall is independent of the mass

180 **(c)**

Distance travelled by the particle is

$x = 40 + 12t - t^3$

We know that, speed is rate of change of distance i.e.

$v = \frac{dx}{dt}$

$\therefore v = \frac{d}{dt}(40 + 12t - t^3) = 0 + 12 - 3t^2$

But final velocity $v = 0$

$\therefore 12 - 3t^2 = 0$

$\Rightarrow t^2 = \frac{12}{3} = 4 \Rightarrow t = 2s$

Hence, distance travelled by the particle before coming to rest is given by

$x = 40 + 12(2) - (2)^3 = 40 + 24 - 8 = 64 - 8$

$= 56m$

181 **(a)**

Slope of velocity-time graph measures acceleration. For graph (a) slope is zero. Hence $a = 0$ *i.e.* motion is uniform

182 **(c)**

Initial velocity $u = \tan 45° = 1$

Velocity after 2s, $v = \tan 60° = \sqrt{3}$

$\therefore$ Average acceleration, $a_{\text{av}} = \frac{v-u}{t} = \frac{\sqrt{3}-1}{2}$.

183 **(c)**

Distance covered by bus in 100 s

$$= 100 \times 10 = 1000 \text{ m}$$

Distance to be covered by scooterist

$$= 1000 + 1000 = 2000 \text{ m}$$

$\therefore$ Speed of scooterist $= \frac{2000}{100} = 20 \text{ ms}^{-1}$

184 **(b)**

$\vec{v} = \vec{u} + \vec{a}t$

$v = (2\hat{\imath} + 3\hat{\jmath}) + (0.3\hat{\imath} + 0.2\hat{\jmath}) \times 10$

$= 5\hat{\imath} + 5\hat{\jmath}$

$|\vec{v}| = 5\sqrt{2}$

185 **(a)**

Height reached $= \frac{1}{2} \times 132 \times 1200\text{m} = 66 \times 1200\text{m}$

186 **(d)**

Since $x = 1.2t^2$ which is in form $x = \frac{1}{2}at^2$

Thus the motion is uniformly accelerated

189 **(d)**

Let the body after time $t/2$ be at x from the top, then

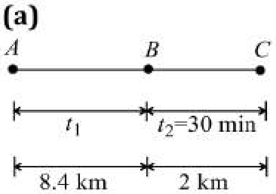
$x = \frac{1}{2}g\frac{t^2}{4} = \frac{gt^2}{8}$ ... (i)

$h = \frac{1}{2}gt^2$ ... (ii)

Eliminate t from (i) and (ii), we get $x = \frac{h}{4}$

$\therefore$ Height of the body from the ground $= h - \frac{h}{4} = \frac{3h}{4}$

190 **(a)**



Average speed $\bar{v} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$

$= \frac{8.4km + 2km}{t_1 + t_2} = \frac{10.4\ km}{\left(\frac{8.4\ km}{70\ km/h}\right) + \frac{1}{2}h}$

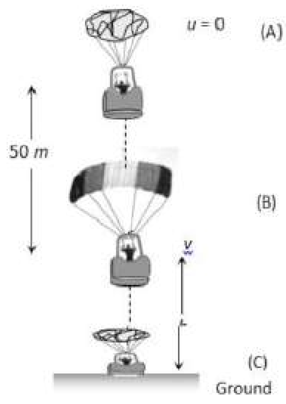
$= \frac{10.4\ km}{0.12h + 0.5h} = 16.8\ km/h$

191 **(c)**

Vertical component of velocities of both the balls are same and equal to zero. So $t = \sqrt{\frac{2h}{g}}$

192 **(a)**

After balling out from point A parachutist falls freely under gravity. The velocity acquired by it will 'v'



From $v^2 = u^2 + 2as = 0 + 2 \times 9.8 \times 50 = 980$

[As $u = 0, a = 9.8 m/s^2, s = 50\ m$]

At point B, parachute opens and it moves with retardation of $2\ m/s^2$ and reach at ground (point C) with velocity of $3\ m/s$

For the part 'BC' by applying the equation $v^2 = u^2 + 2as$

$v = 3m/s, u = \sqrt{980}\ m/s, a = -2m/s^2, s = h$

$\Rightarrow (3)^2 = (\sqrt{980})^2 + 2 \times (-2) \times h \Rightarrow 9$

$= 980 - 4h$

$\Rightarrow h = \frac{980 - 9}{4} = \frac{971}{4} = 242.7 \cong 243\ m$

So, the total height by which parachutist bail out $= 50 + 243 = 293\ m$

193 **(c)**

$v = \frac{dx}{dt} = 0 + 12t - 3t^2 = 0$

$\Rightarrow \quad t = 2$ s

Hence, distance travelled by the particle before coming to rest is given by

$x = 40 + 12(2) - (2)^3$

$= 40 + 24 - 8 = 64 - 8$

$= 56$ m

194 **(a)**

$\vec{r} = 20\hat{\imath} + 10\hat{\jmath}\ \therefore r = \sqrt{20^2 + 10^2} = 22.5\ m$

195 **(d)**

Because acceleration due to gravity is constant so the slope of line will be constant *i.e.*, velocity time curve for a body projected vertically upwards is straight line

196 **(a)**

$\sqrt{x} = t + 1$

Squaring both sides, we get

$x = (t + 1)^2 = t^2 + 2t + 1$

Differentiating it w.r.t time t, we get

$\frac{dx}{dt} = 2t + 2$

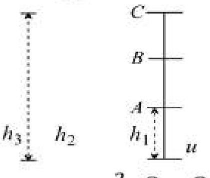
Velocity, $v = \frac{dx}{dt} = 2t + 2$

197 **(d)**

$A \Rightarrow \frac{u^2}{4} - u^2 = -2gh_1$

$B \Rightarrow \frac{u^2}{9} - u^2 = -2gh_2$

$C \Rightarrow \frac{u^2}{16} - u^2 = -2gh_3$



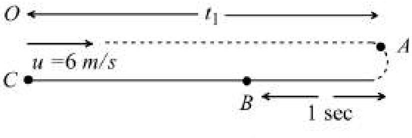
$\therefore AB = \frac{u^2}{2g}\left\{\frac{8}{9} - \frac{3}{4}\right\} = \frac{u^2}{2g} \cdot \frac{5}{36}$

$BC = \frac{u^2}{2g}\left\{\frac{15}{16} - \frac{8}{9}\right\} = \frac{u^2}{2g} \cdot \frac{7}{144}$

$\therefore \frac{AB}{BC} = \frac{5}{36} \times \frac{144}{7} = \frac{20}{7}$

198 **(b)**

Let the particle moves toward right with velocity $6\ m/s$. Due to retardation after time t_1 its velocity becomes zero



From $v = u - at \Rightarrow 0 = 6 - 2t_1 \Rightarrow t_1 = 3sec$

But retardation work on it for 4 *sec*.It means after reaching point A direction of motion get reversed and acceleration works on the particle for next one second.

$S_{OA} = ut_1 - \frac{1}{2}at_1^2 = 6 \times 3 - \frac{1}{2}(2)(3)^2 = 18 - 9 = 9m$

$S_{AB} = \frac{1}{2} \times 2 \times (1)^2 = 1m$

$\therefore S_{BC} = s_{oa} - s_{aB} = 9 - 1 = 8m$

Now velocity of the particle at pint B in return journey $v = 0 + 2 \times 1 = 2m/s$

In return journey from B to C, particle moves with constant velocity $2m/s$ to cover the distance $8m$.

Time taken $= \frac{\text{Distance}}{\text{Velocity}} = \frac{8}{2} = 4\ sec$

Total time taken by particle to return at point O *is*

$\Rightarrow T = t_{OA} + t_{AB} + t_{BC} = 3 + 1 + 4 = 8\ sec$

199 **(b)**

$v^2 = u^2 + 2as$

$a=\frac{v^2-u^2}{2s}=\frac{(20)^2-(10)^2}{2\times 135}=\frac{300}{270}=\frac{10}{9}m/s^2$

From first equation of motion

$v=u+at \Rightarrow t=\frac{v-u}{a}=\frac{20-10}{10/9}=\frac{10}{10/9}$

$=9\,sec$

200 **(b)**

$u=0, v=180\,km\,h^{-1}=50\,ms^{-1}$

Time taken $t=10s$

$a=\frac{v-u}{t}=\frac{50}{10}=5\,ms^{-2}$

$\therefore$ Distance covered $S=ut+\frac{1}{2}at^2$

$=0+\frac{1}{2}\times 5\times(10)^2=\frac{500}{2}=250\,m$

201 **(a)**

$v=18\times\frac{5}{18}\text{ms}^{-1}=5\text{ms}^{-1}$,

$h_{\max}=\frac{5\times 5}{2\times 10}\text{m}=\frac{25}{20}\text{m}=1.25\text{m}$

202 **(c)**

Let the stone falls through a height h in t s

Here, $u=0, a=g$

Using $D_n=u+\frac{a}{2}(2n-1)$

Distance travelled by the stone in the last second is

$\frac{9h}{25}=\frac{g}{2}(2t-1)$ $[\because u=0]$ ...(i)

Distance travelled by the stone in t s is

$h=\frac{1}{2}gt^2$ $[\because u=0]$ ...(ii)

Divide (i) by (ii), we get

$\frac{9}{25}=\frac{(2t-1)}{t^2}$

$9t^2=50t-25$

$9t^2-50t+25=0$

On solving, we get

$t=5s$ or $t=\frac{5}{9}s$

Substituting $t=5s$ in (ii), we get

$h=\frac{1}{2}\times 9.8\times(5)^2=122.5\,m$

204 **(a)**

Let the speed of trains be x

$\therefore \frac{x-u}{x+u}=\frac{1}{2}\Rightarrow 2x-2u=x+u\Rightarrow x=3u$

205 **(a)**

Given that $u=0$ (the electron starts from rest),

At any time $v=kt=2t$

$a=\frac{du}{dt}=2\text{ms}^{-1}$(Constant acceleration)

Now $s=ut+\frac{1}{2}at^2$

$=0\times 3+\frac{1}{2}\times 2\times(3)^2$

$=9\text{m}$

206 **(d)**

$\frac{v_A}{v_B}=\frac{\tan\theta_A}{\tan\theta_B}=\frac{\tan 30°}{\tan 60°}=\frac{1/\sqrt{3}}{\sqrt{3}}=\frac{1}{3}$

207 **(d)**

Interval of ball throw $=2sec$

If we want that minimum three (more than two) ball remain in air then time of flight of first ball must be greater than 4 sec

$T>4\,sec$

$\frac{2u}{g}>4\,\text{sec}\Rightarrow u>19.6\,m/s$

For $u=19.6$, first ball will just about to strike the ground (in air)

Second ball will be at highest point (in air)

Third ball will be at point of projection or at ground (not in air)

208 **(c)**

$S_n\propto(2n-1)$. In equal time interval of 2 $seconds$

Ratio of distance $=1:3:5$

209 **(d)**

$\vec{v}_{\text{man}}=\frac{v}{\sqrt{2}}\hat{\imath}+\frac{v}{\sqrt{2}}\hat{\jmath}$

Let $\vec{v}_{\text{wind}}=a\hat{\imath}+b\hat{\jmath}$

$\Rightarrow \vec{v}_{\text{wind/man}}=\left(a-\frac{v}{\sqrt{2}}\right)\hat{\imath}+\left(b-\frac{v}{\sqrt{2}}\right)\hat{\jmath}$

$\Rightarrow \tan\theta=\frac{b-\frac{v}{\sqrt{2}}}{a-\frac{v}{\sqrt{2}}}=\tan 270°$

$\Rightarrow a-\frac{v}{\sqrt{2}}=0$

$\Rightarrow a=\frac{v}{\sqrt{2}}\Rightarrow \vec{v}_{\text{wind}}=\frac{v}{\sqrt{2}}\hat{\imath}+b\hat{\jmath}$

when the man doubles his speed

$\vec{v}'_{\text{man}}=2\left(\frac{v}{\sqrt{2}}\hat{\imath}+\frac{v}{\sqrt{2}}\hat{\jmath}\right)=\sqrt{2}(v\hat{\imath}+v\hat{\jmath})$

$\Rightarrow \vec{v}'_{\text{wind/man}}=\left(\frac{v}{\sqrt{2}}-\sqrt{2}\,v\right)\hat{\imath}+(b-\sqrt{2}\,v)\hat{\jmath}$

$\Rightarrow \tan\theta'=\frac{b-\sqrt{2}}{\frac{v}{\sqrt{2}-\sqrt{2}\,v}}=\frac{2v-\sqrt{2}\,b}{v}$

But $\theta'=270°-\cot^{-1}(2)$

$\Rightarrow \tan[270°-\cot^{-1}(2)]=\frac{2v-\sqrt{2}b}{v}$

$\Rightarrow \cot[\cot^{-1}(2)]=\frac{2v-\sqrt{2}b}{v}$

$\Rightarrow 2v=2v-\sqrt{2}\,b=b=0$

$\therefore \vec{v}_{\text{wind}}=\frac{v}{\sqrt{2}}\hat{\imath}$

210 **(a)**

$v_{\text{rel}}=45+36=81\,\text{kmh}^{-1}=81\times\frac{5}{18}\text{ms}^{-1}$

$$s_{\text{rel}} = v_{\text{rel}} \times t = 81 \times \frac{5}{18} \times (5 \times 60)$$

$$= \frac{81 \times 5 \times 5 \times 60}{18} - 6750 \text{ m}$$

$$= 6.75 \text{ km}$$

211 **(b)**

The velocity of balloon at height h, $v = \sqrt{2\left(\frac{g}{8}\right)h}$

When the stone released from this balloon, it will go upward with velocity, $= \frac{\sqrt{gh}}{2}$ (Same as that of balloon). In this condition time taken by stone to reach the ground

$$t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right] = \frac{\sqrt{gh}/2}{g}\left[1 + \frac{2gh}{gh/4}\right]$$

$$= \frac{2\sqrt{gh}}{g} = 2\sqrt{\frac{h}{g}}$$

212 **(d)**

$u = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20 m/s$

and $T = \frac{2u}{g} = \frac{2 \times 20}{10} = 4\ sec$

213 **(b)**

Distance travelled by train in first 1 *hour* is 60 *km* and distance in next 1/2 hour is 20 *km*.

So Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{60+20}{3/2}$

$= 53.33\ km/hour$

214 **(b)**

Time average velocity $= \frac{v_1+v_2+v_3}{3} = \frac{3+4+5}{3} = 4 m/s$

215 **(b)**

Between time interval 20 *sec* to 40 *sec*, there is non-zero acceleration and retardation. Hence distance travelled during this interval

= Area between time interval 20 *sec* to 40 *sec*

$= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20 = 50\ m$

216 **(d)**

Initial velocity of balloon with respect to ground

$v = 10 + 5 = 15\ m/sec$ upward

After 2 seconds its velocity, $v = u - gt$

$= 15 - 10 \times 2 = -5\ m/sec = 5\ m/sec$

(downward)

217 **(a)**

If t_1 and $2t_2$ are the time taken by particle to cover first and second half distance respectively

$t_1 = \frac{x/2}{3} = \frac{x}{6}$ ...(i)

$x_1 = 4.5\ t_2$ and $x_2 = 7.5\ t_2$

So, $x_1 + x_2 = \frac{x}{2} \Rightarrow 4.5\ t_2 + 7.5\ t_2 = \frac{x}{2}$

$t_2 = \frac{x}{24}$ ...(ii)

Total time $t = t_1 + 2t_2 = \frac{x}{6} + \frac{x}{12} = \frac{x}{4}$

So, average speed $= 4\ m/sec$

219 **(b)**

Here $v = 144\ km/h = 40 m/s$

$v = u + at \Rightarrow 40 = 0 + 20 \times a \Rightarrow a = 2\ m/s^2$

$\therefore s = \frac{1}{2}at^2 = \frac{1}{2} \times 2 \times (20)^2 = 400\ m$

220 **(a)**

This graph shows uniform motion because line having a constant slope

221 **(a)**

As the train are moving in the same direction. So the initial relative speed $(v_1 - v_2)$ and by applying retardation final relative speed becomes zero

From $v = u - at \Rightarrow 0 = (v_1 - v_2) - at \Rightarrow t = \frac{v_1 - v_2}{a}$

222 **(c)**

Here, $s_1 = 40$ m, $s_2 = 65$ m,

$t_1 = 5$ s, $a = ?$

$$a = \frac{s_2 - s_1}{t^2} = \frac{(65 - 40) \times 2}{(5)^2}$$

$$= \frac{50}{25} = 2 \text{ ms}^{-2}$$

Now, $s_1 = ut + \frac{1}{2}at^2$

$$40 = 5u + \frac{1}{2} \times 2 \times 25$$

Or $5u = 15$ or $u = 3 \text{ ms}^{-1}$

223 **(d)**

Let height of tower is h and body takes t time to reach to ground when it fall freely

$\therefore h = \frac{1}{2}gt^2$

In last second i.e. t^{th} *sec* body travels =0.36 h

It means in rest of the time i.e. in $(t-1) sec$ it travels

$= h - 0.36\ h = 0.64\ h$

Now applying equation of motion for $(t-1) sec$

$0.64\ h = \frac{1}{2}g(t-t)^2$

From (i) and (ii) we get, $t = 5$ sec and $h = 125m$

224 **(b)**

For downward motion.

$v^2 = u^2 + 2gh$
For upward motion,
$v^2 = u^2 - 2gh$
The graph will be parabolic in both case. But velocities will be opposite. But speed never be negative.
Hence, (b) is correct.

225 **(b)**
The ball is thrown vertically upwards, then according to equation of motion.

$$(0)^2 - u^2 = -2gh \qquad \text{... (i)}$$

And $$0 = u - gt \qquad \text{... (ii)}$$

From Eqs. (i) and (ii),

$$h = \frac{gt^2}{2}$$

When the ball is falling downwards after reaching the maximum height

$$s = ut' + \frac{1}{2}g(t')^2$$

$$\frac{h}{2} = (0)t' + \frac{1}{2}g(t')^2$$

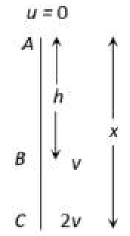
$$\Rightarrow \qquad t' = \sqrt{\frac{h}{g}}$$

$$t' = \frac{t}{\sqrt{2}}$$

Hence, the total time from the time of projection of reach a point at half of its maximum height while returning $= t + t'$

$$= t + \frac{t}{\sqrt{2}} = \left(1 + \frac{1}{\sqrt{2}}\right)t$$

227 **(b)**
Let at point A initial velocity of body is equal to zero
for path AB: $v^2 = 0 + 2gh$ ... (i)
for path AC: $(2v)^2 = 0 + 2gx$
$4v^2 = 2gx$ ...(ii)
Solving (i) and (ii), $x = 4h$



228 **(a)**
$v = u + at \Rightarrow v = 0 + 5 \times 10 = 50\ m/s$

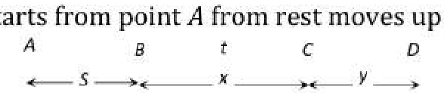
229 **(b)**
Time of ascent = Time of descent=5sec

230 **(b)**
Region OA shows that graph bending toward time axis $i.e.$ acceleration is negative.
Region AB shows that graph is parallel to time axis $i.e.$ velocity is zero. Hence acceleration is zero.
Region BC shows that graph is bending towards displacement axis $i.e.$ acceleration is positive.
Region CD shows that graph having constant slope $i.e.$ velocity is constant. Hence acceleration is zero

231 **(c)**
$$v_{av} = \frac{2v_1v_2}{v_1 + v_2} = \frac{2 \times 40 \times 60}{100} = 48\ kmph$$

232 **(d)**
$$u = at, x = \int u\,dt = \int at\,dt = \frac{at^2}{2}$$
For $t = 4$ sec, $x = 8a$

233 **(c)**
Let car starts from point A from rest moves up to point B with acceleration f



Velocity of car at point B, $\quad v = \sqrt{2fS}$
[As $v^2 = u^2 + 2as$]
Car moves distance BC with this constant velocity in time t
$x = \sqrt{2fS}.t \quad$ [As $s = ut$] ... (i)
So the velocity of car at point C also will be $\sqrt{2fS}$ and finally car stops after covering distance y
Distance $CD \Rightarrow y = \frac{(\sqrt{2fS})^2}{2(f/2)} = \frac{2fS}{f} = 2S$ ...(ii)
So, the total distance $AD = AB + BC + CD = 15S$ [Given]
$\Rightarrow S + x + 2S = 15\,S \Rightarrow x = 12S$
Substituting the value of x in equation (i) we get
$x = \sqrt{2fS}.t \Rightarrow 12S = \sqrt{2fS}.t \Rightarrow 144S^2 = 2fS.t^2$

$\Rightarrow S = \frac{1}{72} f t^2$

234 **(d)**

$v = \alpha\sqrt{x} \Rightarrow \frac{dx}{dt} = \propto \sqrt{x} \Rightarrow \frac{dx}{\sqrt{x}} = \alpha dt$

By integrating both sides $\int x^{-1/2}\, dx = \int \alpha\, dt$

$\Rightarrow \frac{\sqrt{x}}{1/2} = \alpha t \Rightarrow \sqrt{x} = \frac{1}{2}\alpha t \Rightarrow x = \frac{1}{4}\alpha^2 t^2 \ \therefore x \propto t^2$

235 **(a)**

$S_n = u + \frac{g}{2}(2n-1)$; when $u = 0, S_1 : S_2 : S_3 = 1 : 3 : 5$

236 **(b)**

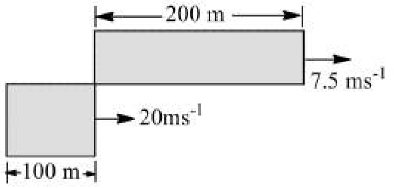
$\vec{v} = \vec{u} + \vec{a}t \Rightarrow \vec{v} = 3\hat{\imath} + 4\hat{\jmath} + (0.4\hat{\imath} + 0.3\hat{\jmath}) \times 10$

$v = 3\hat{\imath} + 4\hat{\jmath} + 4\hat{\imath} + 3\hat{\jmath} = 7\hat{\imath} + 7\hat{\jmath}$

$\Rightarrow |\vec{v}| = 7\sqrt{2}$ units

237 **(a)**

From the figure, the relative displacement is



$s_{rel} = (200 + 100)\text{m} = 300\text{m}$

$v_{rel} = v_1 - v_2 = (20 - 7.5)\text{ms}^{-1}$

$= 12.5\text{ms}^{-1}$

$\therefore t = \frac{s_{rel}}{v_{rel}} = \frac{300}{12.5} = 24\text{s}$

238 **(d)**

At highest point $v = 0$ and $H_{max} = \frac{u^2}{2g}$

239 **(d)**

$v = \frac{ds}{dt} = 3t^2 - 12t + 3$ and $a = \frac{dv}{dt} = 6t - 12$

For $a = 0$, we have $t = 2$ and at $t = 2, v = -9\ ms^{-1}$

240 **(d)**

$\frac{11h}{36} = \frac{9.8}{2}(2n-1)$

or $\frac{11}{36} \times \frac{1}{2} \times 9.8n^2 = \frac{9.8}{2}(2n-1)$

or $2n - 1 = \frac{11}{36}n^2$ or $11n^2 = 72n - 36$

or $11n^2 - 72n + 36 = 0$

or $11n^2 - 66n - 6n + 36 = 0$

or $11n(n-6) - 6(n-6) = 0$

or $(11n - 6)(n - 6) = 0$

$\Rightarrow n = 6$ (Rejecting fractional value)

$h = \frac{1}{2} \times 10 \times 6 \times 6\text{m} = 180\text{m}$

241 **(d)**

Given, $x = 2 - 5t + 6t^2$ ... (i)

Differentiating with respect to t

$$\frac{dx}{dt} = -5 + 12t$$

At $t = 0\text{ s}, \frac{dx}{dt} = -5\text{ ms}^{-1}$

Hence, initial velocity $v = -5\text{ ms}^{-1}$

242 **(d)**

The braking retardation will remain same and assumed to be constant, let it be a.

From the 3rd equation of motion, $v^2 = u^2 + 2as$

Ist case : $0 = \left(60 \times \frac{5}{18}\right)^2 - 2a \times s_1$

Or $s_1 = \frac{(60 \times 5/18)^2}{2a}$

IInd case : $0 = \left(120 \times \frac{5}{18}\right)^2 - 2a \times s_2$

Or $s_2 = \frac{(120 \times 5/18)^2}{2a}$

$\therefore \frac{s_1}{s_2} = \frac{1}{4} \Rightarrow s_2 = 4s_1 = 4 \times 20 = 80\text{ m}$

243 **(d)**

Net displacement = 0 and total distance = $OP + PQ + QO$

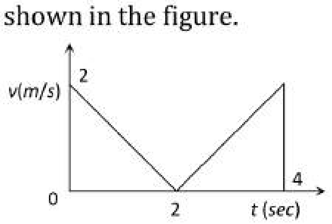
$= 1 + \frac{2\pi \times 1}{4} + 1 = \frac{14.28}{4}\ km$

Average speed $= \frac{14.28}{4 \times 10/60}$

$= \frac{6 \times 14.28}{4} = 21.42\ km/h$

244 **(b)**

The velocity time graph for given problem is shown in the figure.



Distance travelled S = Area under curve $= 2 + 2 = 4m$

245 **(c)**

From acceleration-velocity graph, we have $a = k\,v$ where k is a constant which represents the slope of the given line.

As, $a = v\frac{dv}{ds}$, so $v = \frac{dv}{ds} = kv$

or $\frac{dv}{ds} = k$ = a constant

Thus, the slope of velocity-displacement graphs is same as that of acceleration velocity. Which is constant.

246 **(b)**

Given, $a = \frac{dv}{dt} = 6t + 5$

Or $dv = (6t + 5)\, dt$

Integrating, we get

$$\int_0^v dv = \int_0^t (6t + 5)\, dt$$

Or $v = \left(\frac{6t^2}{2} + 5t\right)$

Again $v = \frac{ds}{dt}$

$\therefore$ $ds = \left(\frac{6t^2}{2} + 5t\right) dt$

Integrating again, we get

$$\int_0^s ds = \int_0^t \left(\frac{6t^2}{2} + 5t\right) dt$$

$\therefore$ $s = \frac{3t^3}{3} + \frac{5t^2}{2}$

When, $t = 2$ s, $s = 3 \times \frac{2^3}{3} + \frac{5 \times 2^2}{2} = 3 \times \frac{8}{3} + \frac{5 \times 4}{2}$

$= 8 + 10 = 18$ m

247 **(c)**

When a particle is moving with uniform acceleration, let v be the velocity of particle at a distance s,

Then average velocity $= \frac{0+v}{2} = \frac{v}{2}$

Time taken, $t_1 = \frac{s}{(v/2)} = \frac{2s}{v}$

When particle moves with uniform velocity, time taken, $t_2 = \frac{2s}{v}$

When particle moves with uniform acceleration,

Time taken, $t_3 = \frac{3s}{(0+v)/2} = \frac{6s}{v}$

Total time$= t_1 + t_2 + t_3 = \frac{2s}{v} + \frac{2s}{v} + \frac{6s}{v} = \frac{10s}{v}$

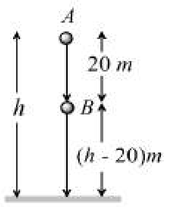
$\therefore$ $v_{av} = \frac{s+2s+3s}{10s/v} = \frac{6v}{10}$ or $\frac{v_{av}}{v} = \frac{6}{10} = \frac{3}{5}$

248 **(c)**

For first ball $h = \frac{1}{2}gt^2$ ...(i)

For second ball

$(h - 20) = \frac{1}{2}g(t-1)^2$ ...(ii)



Subtract equation (ii) from (i)

$20 = -5 + 10t \Rightarrow \therefore\ t = 2.5$ sec

Hence, height $h = \frac{1}{2} \times 10 \times (2.5)^2 = 31.2\ m$

249 **(d)**

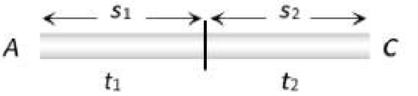
In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region

251 **(c)**

$\because S_1 = ut + \frac{1}{2}at^2$ ... (i)

and velocity after first t sec

$v = u + at$



$t_1 = t_2 = t$ (given)

Now, $S_2 = vt + \frac{1}{2}at^2$

$= (u + at)t + \frac{1}{2}at^2$ ... (ii)

Equation (ii) $-$ (i) $\Rightarrow S_2 - S_1 = at^2$

$\Rightarrow a = \frac{S_2 - S_1}{t^2} = \frac{65 - 40}{(5)^2} = 1 m/s^2$

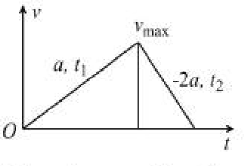
From equation (i), we get,

$S_1 = ut + \frac{1}{2}at^2 \Rightarrow 40 = 5u + \frac{1}{2} \times 1 \times 25$

$\Rightarrow 5u = 27.5\ \therefore u = 5.5\ m/s$

252 **(d)**

Let acceleration is a and retardation is $-2a$



Then for acceleration motion

$t_1 = \frac{v}{a}$ ...(i)

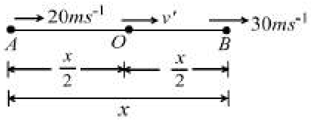
For retarding motion

$t_2 = \frac{v}{2a}$ ...(ii)

Given $t_1 + t_2 = 9 \Rightarrow \frac{v}{a} + \frac{v}{2a} = 9 \Rightarrow \frac{3v}{2a} = 9 \Rightarrow \frac{v}{a} = 6$

Hence, duration of acceleration, $t_1 = \frac{v}{a} = 6\ sec$

253 **(a)**



$\because v'' = \sqrt{\frac{(v_1)^2 + (v_2)^2}{2}} = \sqrt{\frac{900 + 400}{2}} = \sqrt{650}$

$= 25.5\ ms^{-1}$

254 **(a)**

$x_1 = \frac{1}{2}at^2$ and $x_2 = ut \therefore x_1 - x_2 = \frac{1}{2}at^2 - ut$

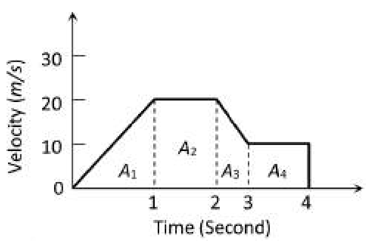
$y = \frac{1}{2}at^2 - ut$.This equation is of parabola

$\frac{dy}{dt} = at - u$ and $\frac{d^2y}{dt^2} = a$

As $\frac{d^2y}{dt^2} > 0$ *i.e.*, graph shows possess minima at $t = \frac{u}{a}$

255 **(b)**

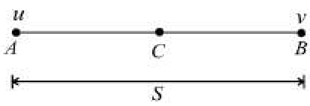
Distance = Area under $v - t$ graph $= A_1 + A_2 + A_3 + A_4$



$= \frac{1}{2} \times 1 \times 20 + (20 \times 1) + \frac{1}{2}(20 + 10) \times 1 + (10 \times 1)$

$= 10 + 20 + 15 + 10 = 55m$

256 **(d)**



Let S be the distance between AB and a be constant acceleration of a particle. Then

$v^2 - u^2 = 2aS$

Or $aS = \frac{v^2 - u^2}{2}$ ...(i)

Let v_c be velocity of a particle at midpoint C

$\therefore v_c^2 - u^2 = 2a\left(\frac{S}{2}\right)$

$v_c^2 = u^2 + aS = u^2 + \frac{v^2 - u^2}{2}$ [Using (i)]

$v_c = \sqrt{\frac{u^2 + v^2}{2}}$

257 **(a)**

Given line have positive intercept but negative slope. So its equation can be written as

$v = -mx + v_0$ ....(i) [where $m = \tan\theta = \frac{v_0}{x_0}$]

By differentiating with respect to time we get

$\frac{dv}{dt} = -m\frac{dx}{dt} = -mv$

Now substituting the value of v from eq. (i) we get

$\frac{dv}{dt} = -m[-mx + v_0] = m^2x - mv_0 \therefore a$

$= m^2x - mv_0$

i.e. the graph between a and x should have positive slope but negative intercept on a-axis. So graph (a) is correct

258 **(c)**

$(2v)^2 - v^2 = 2gh'$ or $4v^2 - v^2 = 2gh'$

or $3v^2 = 2gh'$ or $3 \times 2gh = 2gh'$ or $h' = 3h$

259 **(d)**

$S \propto u^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$

260 **(b)**

$10t = 48 + \frac{1}{2} \times 1 \times t^2$ or $t^2 - 20t + 96 = 0$

or $t^2 - 8t - 12t + 96 = 0$ or $t(t - 8) - 12(t - 8) = 0$

or $(t - 12)(t - 8) = 0$ or $t = 8$ s or 12 s

But we are interested in minimum time.

261 **(c)**

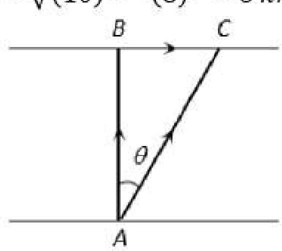
Given $\overrightarrow{AB}$ = Velocity of boat = km/hr

$\overrightarrow{AC}$ = Resultant velocity of boat = 10 km/hr

$\overrightarrow{BC}$ = Velocity of river

$= \sqrt{AC^2 - AB^2}$

$= \sqrt{(10)^2 - (8)^2} = 6\ km/hr$



262 **(a)**

$\frac{dv}{dt} = -2.5\sqrt{v}$

$\Rightarrow \frac{dv}{\sqrt{v}} = -2.5dt$

$\Rightarrow \int_{6.25}^{0} v^{-1/2}\ dv = -2.5\int_0^t dt$

$\Rightarrow -2.5[t]_0^t = [2v^{1/2}]_{6.25}^{0}$

$\Rightarrow t = 2$ s

263 **(c)**

Both the stones will have the same speed when they hit the ground.

264 **(c)**

$S_n = u + \frac{a}{2}(2n-1) \Rightarrow 1.2 = 0 + \frac{a}{2}(2 \times 6 - 1)$

$\Rightarrow a = \frac{1.2 \times 2}{11} = 0.218\ m/s^2$

266 **(b)**

$\Delta t = \sqrt{\frac{2\times19.6}{9.8}}s - \sqrt{\frac{2\times18.6}{9.8}}s = 2 - 1.95 = 0.05s$

267 **(b)**

Here $v = 144\ km/h = 40m/s$

$v = u + at \Rightarrow 40 = 0 + 20 \times a \Rightarrow a = 2\ m/s^2$

$\therefore s = \frac{1}{2}at^2 = \frac{1}{2} \times 2 \times (20)^2 = 400\ m$

268 **(c)**

$\Delta x = \frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2$

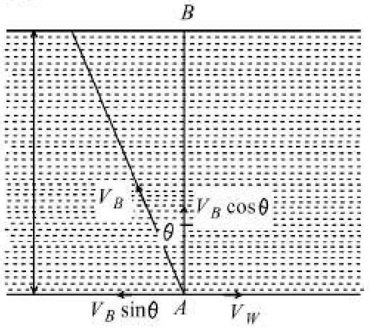
$= \frac{1}{2}g[t^2 - (t-1)^2] = \frac{1}{2}g(2t-1)$

$= \frac{1}{2} \times 9.8 \times 5m = 24.5m$

269 **(c)**

Net acceleration of a body when thrown upward = acceleration of body – acceleration due to gravity $= a - g$

270 **(a)**



From figure, $V_B \sin\theta = V_W$

$\sin\theta = \frac{V_W}{V_B} = \frac{1}{2} \Rightarrow \theta = 30°$ $[\because V_B = 2V_W]$

Time taken to cross the river,

$t = \frac{D}{V_B \cos\theta} = \frac{D}{V_B \cos 30°} = \frac{2D}{V_B\sqrt{3}}$

271 **(a)**

$h_{max} = \frac{u^2}{2g} = \frac{(15)^2}{2 \times 10} = 11.25m$

272 **(d)**

$v = \alpha\sqrt{x} \Rightarrow \frac{dx}{dt} = \propto \sqrt{x} \Rightarrow \frac{dx}{\sqrt{x}} = \alpha dt$

By integrating both sides $\int x^{-1/2}\,dx = \int \alpha\,dt$

$\Rightarrow \frac{\sqrt{x}}{1/2} = \alpha t \Rightarrow \sqrt{x} = \frac{1}{2}\alpha t \Rightarrow x = \frac{1}{4}\alpha^2 t^2 \ \therefore x \propto t^2$

273 **(d)**

I is not possible because total distance covered by a particle increases with time

II is not possible because at a particular time, position cannot have two values

III is not possible because at a particular time, velocity cannot have two values

IV is not possible because speed can never be negative

274 **(d)**

The nature of the path is decided by the direction of velocity, and the direction of acceleration. The trajectory can be a straight line, circle or a parabola depending on these factors

275 **(a)**

If u is the initial velocity then distance covered by it in 2 *sec*

$S = ut + \frac{1}{2}at^2 = u \times 2 + \frac{1}{2} \times 10 \times 4$

$= 2u + 20$ ... (i)

Now distance covered by it in 3rd *sec*

$S_{3rd} = u + \frac{1}{2}(2 \times 3 - 1)10$

$= u + 25$ ... (ii)

From (i) and (ii), $2u + 20 = u + 25 \Rightarrow u = 5$

$\therefore S = 2 \times 5 + 20 = 30\ m$

276 **(b)**

$v = g \times t = 32 \times 1 = 32 ft/sec$

277 **(d)**

In case of motion under gravity, time taken to go up is equal to the time taken to fall down through the same distance.

Time of desent(t_2) = time of ascent$(t_1) = \frac{u}{g}$

$\therefore$ Total time of flight $T = t_1 + t_2 = \frac{2u}{g}$

Or $u = \frac{g(t_1+t_2)}{2}$

278 **(a)**

$H_{max} \propto u^2 \therefore u \propto \sqrt{H_{max}}$

i.e. to triple the maximum height, ball should be thrown with velocity $\sqrt{3}\,u$

279 **(d)**

$x = 30 + 180 = 120m$

$y = 9x^2$

$\Rightarrow \frac{dy}{dt} = v_y = 18x\frac{dx}{dt} = 18x\left(\frac{1}{3}\right)$

$\Rightarrow \frac{dy}{dt} = v_y = 6x$

$a_y = \frac{d^2y}{dt^2} = \frac{dv_y}{dt} = 6\left(\frac{dx}{dt}\right) = 6\left(\frac{1}{3}\right)$

$\Rightarrow a_y = 2\text{ms}^{-2}$ along y-axis.

Hence, $a_y = (2\text{ms}^{-2})\hat{\jmath}$

280 **(d)**

I is not possible because total distance covered by a particle increases with time

II is not possible because at a particular time, position cannot have two values

III is not possible because at a particular time, velocity cannot have two values

IV is not possible because speed can never be negative

281 **(a)**

$\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k} \;\therefore r = \sqrt{x^2 + y^2 + z^2}$

$r = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}m$

282 **(a)**

Velocity required by body in 10 *sec*

$v = 0 + 2 \times 10 = 20\ m/s$

And distance travelled by it in 10 *sec*

$S_1 = \frac{1}{2} \times 2 \times (10)^2 = 100\ m$

Then it moves with constant velocity ($20\ m/s$) for 30 *sec*

$S_2 = 20 \times 30 = 600\ m$

After that due to retardation ($4\ m/s^2$) it stops

$S_3 = \frac{v^2}{2a} = \frac{(20)^2}{2 \times 4} = 50m$

Total distance travelled $S_1 + S_2 + S_3 = 750m$

283 **(b)**

Let v_w be velocity of water and v_b be the velocity of motor boat in still water. If x is the distance covered, then as per question

$x = (v_b + v_w) \times 6 = (v_b - v_w) \times 10$

On solving, $v_w = v_b/4$

$\therefore\ x = [v_b + v_b/4] \times 6 = 7.5v_b$

Time taken by motor boat to cross the same distance in still water is

$t = \frac{x}{x_b} = \frac{7.5}{v_b} = 7.5\text{h}$

284 **(d)**

$x \propto t^3 \therefore x = Kt^3$

$\Rightarrow v = \frac{dx}{dt} = 3Kt^2$ and $a = \frac{dv}{dt} = 6Kt$

i.e. $a \propto t$

285 **(b)**

$\int_{6.25}^{0} \frac{dv}{\sqrt{v}} = -2.5 \int_0^t dt$

$|2\sqrt{v}|_{6.25}^{0} = -2.5t$

$2\sqrt{6.25} = 2.5t$

$t = 2sec$

286 **(b)**

Total time of motion is 2 *min* 20 *sec* = 140 *sec*

As time period of circular motion is 40 *sec* so in 140 *sec*. Athlete will complete 3.5 revolution *i.e.*, He will be at diametrically opposite point

i.e.,Displacement $= 2R$

287 **(b)**

Total time of motion is 2 *min* 20 *sec* = 140 *sec*

As time period of circular motion is 40 *sec* so in 140 *sec*. Athlete will complete 3.5 revolution *i.e.*, He will be at diametrically opposite point

i.e.,Displacement $= 2R$

288 **(a)**

$v = u + at \Rightarrow v = 0 + 5 \times 10 = 50\ m/s$

289 **(a)**

Let initial ($t = 0$) velocity of particle= u

For first 5 *sec* of motion $s_5 = 10$ *metre*

$s = ut + \frac{1}{2}at^2 \Rightarrow 10 = 5u + \frac{1}{2}a(5)^2$

$2u + 5a = 4$

For first 8 sec of motion $s_8 = 20$ *metre*

$20 = 8u + \frac{1}{2}a(8)^2 \Rightarrow 2u + 8a = 5$

By solving $u = \frac{7}{6}m/s$ and $a = \frac{1}{3}m/s^2$

Now distance travelled by particle in Total 10 *sec*

$s_{10} = u \times 10 + \frac{1}{2}a(10)^2$

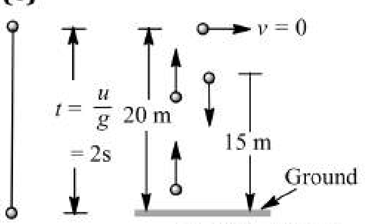
By substituting the value of u and a we will get

$s_{10} = 28.3\ m$

so the distance in last 2 *sec* $= s_{10} - s_8$

$= 28.3 - 20 = 8.3m$

290 **(c)**



Position of balls

$h_1 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 1^2 = 5\text{m}$

$h_2 = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 2^2 = 20\text{m}$

From ground, 5m, 20m, 15m (shown in figure)

291 **(d)**

In the positive region the velocity decreases linearly (during rise) and in the negative region velocity increases linearly (during fall) and the direction is opposite to each other during rise and fall, hence fall is shown in the negative region

292 **(b)**

$$H_{\max} = \frac{u^2}{2g} = \frac{19.6 \times 19.6}{2 \times 9.8} = 19.6\, m$$

293 **(d)**

Given $a = 19.6 m/s^2 = 2g$

Resultant velocity of the rocket after 5 sec

$v = 2g \times 5 = 10g\ m/s$

Height achieved after 5 $sec, h_1 = \frac{1}{2} \times 2g \times 25 =$ $245m$

On switching off the engine it goes up to height h_2 where its velocity becomes zero

$0 = (10g)^2 - 2gh_2 \Rightarrow h_2 = 490m$

$\therefore$ Total height of rocket $= 245 + 490 = 735\ m$

294 **(b)**

Let the stone remains in air for t s. From $S = ut + \frac{1}{2}gt^2$

Here, $u = 0,\ S = \frac{1}{2}gt^2$

Total distance travelled by the stone in last second is

$$D = S_t - S_{t-1} = \frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2$$

Distance travelled by the stone in first three seconds is

$$S_3 = \frac{1}{2} \times g \times 3^2 = \frac{9}{2}g$$

According to given problem, $D = S_3$

$\therefore \frac{g}{2}(2t-1) = \frac{9}{2}g$ or $2t - 1 = 9 \Rightarrow t = 5s$

295 **(d)**

Let height of tower is h and body takes t time to reach to ground when it fall freely

$$\therefore h = \frac{1}{2}gt^2$$

In last second i.e. t^{th} sec body travels =0.36 h

It means in rest of the time i.e. in $(t-1)sec$ it travels

$= h - 0.36\, h = 0.64\, h$

Now applying equation of motion for $(t-1)sec$

$$0.64\, h = \frac{1}{2}g(t-t)^2$$

From (i) and (ii) we get,$t = 5$ sec and $h = 125m$

296 **(c)**

$1 = \frac{v}{t_1}, 3 = \frac{v}{t_2}, 1200 = \frac{1}{2}(t_1 + t_2)v,$

$$1200 = \frac{1}{2}\left(v + \frac{v}{3}\right)v = \frac{1}{2}\frac{4v^2}{3} = \frac{2v^2}{3}$$

or $v^2 = 1800,$

$$\therefore\ 1200 = \frac{1}{2}t \times \sqrt{1800}$$

$$t = \frac{2400}{\sqrt{1800}}s = \frac{2400}{42.43}s = 56.6\ s$$

297 **(d)**

From equation of motion

$$s = ut + \frac{1}{2}at^2$$

$$x = 0 + \frac{1}{2} \times 10t^2 = 5t^2 \quad \text{... (i)}$$

$$x + 3 = 0 + \frac{1}{2} \times 10(t + 0.5)^2$$

$$x + 3 = 5\left(t^2 + \frac{1}{4} + t\right) \quad \text{... (ii)}$$

Subtract Eq. (i) from Eq. (ii)

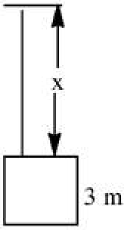
$$3 = 5\left(\frac{1}{4} + t\right) = \frac{5}{4} + 5t$$

$$3 - \frac{5}{4} = 5t$$

$$\frac{7}{4} = 5t \Rightarrow t = \frac{7}{20}\ s$$

Now, $\quad v = u + at$

$$v = 0 + 10 \times \frac{7}{20} = 3.5\ ms^{-1}$$



298 **(d)**

$$\text{Velocity of particle} = \frac{\text{Total displacement}}{\text{Total time}}$$

$$= \frac{\text{Diameter of circle}}{5} = \frac{2 \times 10}{5} = 4\, m/s$$

299 **(b)**

Let the initial velocity of ball be u

Time of rise $t_1 = \frac{u}{g+a}$ and height reached $= \frac{u^2}{2(g+a)}$

Time of fall t_2 is given by

$$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)}$$

$$\Rightarrow t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)}\sqrt{\frac{g+a}{g-a}}$$

$\therefore t_2 > t_1$ because $\frac{1}{g+a} < \frac{1}{g-a}$

301 **(d)**

$\vec{r} = 3t\hat{\imath} - t^2\hat{\jmath} + 4\hat{k}$

Velocity, $\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(3t\hat{\imath} - t^2\hat{\jmath} + 4\hat{k}) = 3\hat{\imath} - 2t\hat{\jmath}$

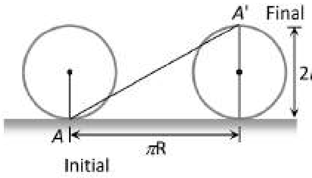
At $t = 5s \Rightarrow \vec{v} = 3\hat{\imath} - 10\hat{\jmath}$

$|\vec{v}| = \sqrt{(3)^2 + (-10)^2} = \sqrt{9+100} = \sqrt{109}$

$= 10.44\ ms^{-1}$

302 **(c)**

Horizontal distance covered by the wheel in half revolution $= \pi R$



So the displacement of the point which was initially in contact with ground

$= AA' = \sqrt{(\pi R)^2 + (2R)^2}$

$= R\sqrt{\pi^2+4} = \sqrt{\pi^2+4}$ [As $R = 1m$]

303 **(b)**

$x = 9t^2 - t^3; v = \frac{dx}{dt} = 18t - 3t^2$, For maximum speed

$\frac{dv}{dt} = \frac{d}{dt}[18t - 3t^2] = 0 \Rightarrow 18 - 6t = 0 \therefore t$

$= 3$ sec

i.e., Particle achieve maximum speed at $t = 3$ sec. At this instant position of this particle, $x = 9t^2 - t^3$

$= 9(3)^2 - (3)^3 = 81 - 27 = 54\ m$

304 **(a)**

The distance covered by the ball during the last t *seconds* of its upward motion = Distance covered by it in first t seconds of its downward motion

From $h == ut + \frac{1}{2}gt^2$

$h = \frac{1}{2}g\,t^2$ [As $u = 0$ for it downward motion]

305 **(c)**

If the body starts from rest and moves with constant acceleration then the ratio of distances in consecutive equal time interval $S_1 : S_2 : S_3 = 1:3:5$

306 **(d)**

$3t = \sqrt{3x} + 6 \Rightarrow 3x = (3t-6)^2$

$\Rightarrow x = 3t^2 - 12t + 12$

$v = \frac{dx}{dt} = 6t - 12$, for $v = 0, t = 2$ sec

$x = 3(2)^2 - 12 \times 2 + 12 = 0$

307 **(b)**

Free fall of an object (in vacuum) is a case of motion with uniform acceleration

308 **(d)**

Net displacement = 0 and total distance = $OP + PQ + QO$

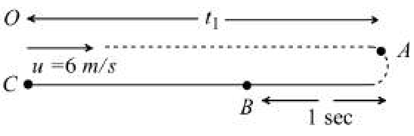
$= 1 + \frac{2\pi \times 1}{4} + 1 = \frac{14.28}{4}\ km$

Average speed $= \frac{14.28}{4 \times 10/60}$

$= \frac{6 \times 14.28}{4} = 21.42\ km/h$

309 **(b)**

Let the particle moves toward right with velocity $6\ m/s$. Due to retardation after time t_1 its velocity becomes zero



From $v = u - at \Rightarrow 0 = 6 - 2t_1 \Rightarrow t_1 = 3sec$

But retardation work on it for 4 *sec*.It means after reaching point A direction of motion get reversed and acceleration works on the particle for next one second.

$S_{OA} = ut_1 - \frac{1}{2}at_1^2 = 6 \times 3 - \frac{1}{2}(2)(3)^2 = 18 - 9 = 9m$

$S_{AB} = \frac{1}{2} \times 2 \times (1)^2 = 1m$

$\therefore S_{BC} = s_{oa} - s_{aB} = 9 - 1 = 8m$

Now velocity of the particle at pint B in return journey $v = 0 + 2 \times 1 = 2m/s$

In return journey from B to C, particle moves with constant velocity $2m/s$ to cover the distance $8m$.

Time taken $= \frac{\text{Distance}}{\text{Velocity}} = \frac{8}{2} = 4\ sec$

Total time taken by particle to return at point O *is*

$\Rightarrow T = t_{OA} + t_{AB} + t_{BC} = 3 + 1 + 4 = 8\ sec$

310 **(d)**

$x = ae^{-\alpha t} + be^{\beta t}$

Velocity $v = \frac{dx}{dt} = \frac{d}{dt}(ae^{-\alpha t} + be^{\beta t})$

$= a.e^{-\alpha t}(-\alpha) + be^{\beta t}(\beta) = -a\alpha e^{-\alpha t} + b\beta e^{\beta t}$

Acceleration $= -a\alpha e^{-\alpha t}(-\alpha) + b\beta e^{bt}.\beta$

$= a\,\alpha^2 e^{-\alpha t} + b\beta^2 e^{\beta t}$

Acceleration is positive so velocity goes on increasing with time

311 **(c)**

Speed of the object at reaching the ground $v = \sqrt{2gh}$

If heights are equal then velocity will also be equal

312 **(a)**

$s \propto t^2$[Given] $\therefore s = Kt^2$

Acceleration $a = \frac{d^2s}{dt^2} = 2k$ [constant]

It means the particle travels with uniform acceleration

313 **(d)**

If t_1 and t_2 are the time, when body is at the same height then,

$h = \frac{1}{2}gt_1t_2 = \frac{1}{2} \times g \times 2 \times 10 = 10\, g$

314 **(d)**

The horizontal acceleration a of the wedge should be such that in time the wedge moves the horizontal distance BC. The body must fall through a vertical distance AB under gravity. Hence,

$BC = \frac{1}{2}at^2$ and $AB = \frac{1}{2}gt^2$

$\tan\theta = \frac{AB}{BC} = \frac{g}{a}$ or $a = \frac{g}{\tan\theta} = g\cot\theta$

315 **(a)**

Horizontal velocity of dropped packet $= u$

Vertical velocity $= \sqrt{2gh}$

$\therefore$ Resultant velocity at earth $= \sqrt{u^2 + 2gh}$

316 **(c)**

$S_n = \frac{1}{2}g\cos\theta\,(2n-1), S_{n+1}$

$= \frac{1}{2}g\cos\theta\,\{2(n+1)-1\}$

$\frac{S_n}{S_{n+1}} = \frac{2n-1}{2n+1}$

317 **(c)**

$x = at + bt^2 - ct^3, a = \frac{d^2x}{dt^2} = 2b - 6ct$

318 **(b)**

$\vec{v} = \vec{u} + \vec{a}t \Rightarrow \vec{v} = 3\hat{\imath} + 4\hat{\jmath} + (0.4\hat{\imath} + 0.3\hat{\jmath}) \times 10$

$v = 3\hat{\imath} + 4\hat{\jmath} + 4\hat{\imath} + 3\hat{\jmath} = 7\hat{\imath} + 7\hat{\jmath}$

$\Rightarrow |\vec{v}| = 7\sqrt{2}$ units

319 **(d)**

Initial velocity of balloon with respect to ground

$v = 10 + 5 = 15\, m/sec$ upward

After 2 seconds its velocity, $v = u - gt$

$= 15 - 10 \times 2 = -5\, m/sec = 5\, m/sec$ (downward)

320 **(c)**

On rebound, there is an instantaneous change in the direction of velocity. This settle the answer.

321 **(b)**

Given, $x = 4\,(t-2) + a(t-2)^2$

$$v = \frac{dx}{dt} = 4 + 2a(t-2)$$

At $t = 0$, $v = 4(1-a)$

Acceleration $a = \frac{d^2x}{dt^2} = 2a$

322 **(c)**

$\frac{dx}{dt} = 4t^3 - 2t$

or $dx = 4t^3dt - 2t\, dt$

Integrating, $x = \frac{4t^4}{4} - \frac{2t^2}{2} = t^3 - t^2$

When $x = 2, t^4 - t^2 - 2 = 0,$

$t^2 = \frac{-(-1) \pm \sqrt{1+8}}{2}$

or $t^2 = \frac{1 \pm 3}{2} = 2$ (ignoring – ve sign)

Again, $\frac{d^2x}{dt^2} = 12t^2 - 2$

When $t^2 = 2$, acceleration$=12\times 2 - 2 = 22\text{ms}^{-2}$

323 **(d)**

Displacement form 0 to 5 s $=$ 40 m

Displacement from 5 to 10 s $=$ 40 m

Displacement from 0 to 15 s $= -20$ m

And displacement from 15 to 20 s $= 0$ m

$\therefore$ Net displacement $= 40 + 40 - 20 + 0 = 60$ m

Total time taken $= 5 + 5 + 15 + 5 = 30$ min.

Hence, average speed $= \frac{\text{displacement (m)}}{\text{time (min)}} = \frac{60}{30}$

$= 2\text{ m min}^{-1}$.

324 **(a)**

Since slope of graph remains constant for velocity-time graph

325 **(d)**

$x = ae^{-\alpha t} + be^{\beta t}$

Velocity $v = \frac{dx}{dt} = \frac{d}{dt}(ae^{-\alpha t} + be^{\beta t})$

$= a.e^{-\alpha t}(-\alpha) + be^{\beta t}(\beta) = -\alpha a e^{-\alpha t} + b\beta e^{\beta t}$

Acceleration $= -\alpha a e^{-\alpha t}(-\alpha) + b\beta e^{bt}.\beta$

$= a\,\alpha^2 e^{-\alpha t} + b\beta^2 e^{\beta t}$

Acceleration is positive so velocity goes on increasing with time

326 **(b)**

Given acceleration $a = 6t + 5$

$\therefore a = \frac{dv}{dt} = 6t + 5, dv = (6t+5)dt$

Integrating it, we have $\int_0^v dv = \int_0^t (6t+5)dt$

$v = 3t^2 + 5t + C$, where C is a constant of integration

When $t = 0, v = 0$ so $C = 0$

$\therefore v = \frac{ds}{dt} = 3t^2 + 5t$ or, $ds = (3t^2 + 5t)dt$

Integrating it within the conditions of motion, *i.e.*, as t changes from 0 to 2s, s changes from 0 to s, we have

$$\int_0^s ds = \int_0^2 (3t^2 + 5t)dt$$

$$\therefore s = \left[t^3 + \frac{5}{2}t^2\right]_0^2 = 8 + 10 = 18\, m$$

327 **(b)**

At maximum height velocity $v = 0$

We know that $v = u + at$, hence

$0 = u - gT \Rightarrow u = gT$

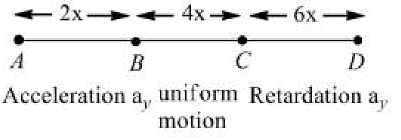
When $v = \frac{u}{2}$, then

$$\frac{u}{2} = u - gt \Rightarrow gt = \frac{u}{2} \Rightarrow gt = \frac{gT}{2} \Rightarrow t = \frac{T}{2}$$

Hence at $t = \frac{T}{2}$, it acquires velocity $\frac{u}{2}$

328 **(b)**

Let t_1,t_2 and t_3 be the time taken by the particles to cover the distance $2x$, $4x$ and $6x$ respectively. Let v be the velocity of the particle at B *ie*, maximum velocity. The particle moves with uniform acceleration from A to B.



For motion for A to B.

Average velocity $= \frac{0+v}{2} = \frac{v}{2}$

Time taken, $t_1 = \frac{2x}{v/2} = \frac{4x}{v}$

Particle moves with uniform retardation from C to D.

Time taken , $t_3 = \frac{6x}{(0+v)/2} = \frac{12x}{v}$

Total time $= t_1 + t_2 + t_3$

$$= \frac{4x}{v} + \frac{4x}{v} + \frac{12x}{v} = \frac{20x}{v}$$

$$v_{av} = \frac{2x + 4x + 6x}{20x/v} = \frac{12v}{20}$$

or $\frac{v}{v} = \frac{12}{20} = \frac{3}{5}$.

329 **(a)**

$S_n = u + \frac{a}{2}(2n - 1) = \frac{a}{2}(2n - 1)$ because $u = 0$

Hence $\frac{S_4}{S_3} = \frac{7}{5}$

330 **(c)**

Net acceleration of a body when thrown upward = acceleration of body – acceleration due to gravity $= a - g$

331 **(d)**

When A returns to the 'level' of top of tower, its downward velocity is $4ms^{-1}$. This velocity is the same a that of B. So, both A and B hit the ground with the same velocity.

332 **(c)**

A body is moving on a straight line with constant velocity. Between A and B, the straight line is the shortest distance. This is the distance travelled. The particle starts at A and reaches B along the straight line. Therefore displacement is also $AB, D = S$

333 **(b)**

Let A and B will meet after time t *sec*. it means the distance travelled by both will be equal

$S_A = ut = 40t$ and $S_B = \frac{1}{2}at^2 = \frac{1}{2} \times 4 \times t^2$

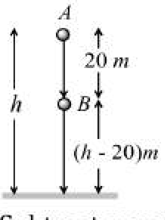
$$S_A = S_B \Rightarrow 40t = \frac{1}{2}4t^2 \Rightarrow t = 20\, sec$$

334 **(c)**

For first ball $h = \frac{1}{2}gt^2$ ...(i)

For second ball

$(h - 20) = \frac{1}{2}g(t - 1)^2$ ...(ii)



Subtract equation (ii) from (i)

$20 = -5 + 10t \Rightarrow \therefore\ t = 2.5$ sec

Hence, height $h = \frac{1}{2} \times 10 \times (2.5)^2 = 31.2\, m$

335 **(b)**

$\vec{v} = \vec{u} + \vec{a}t$

$v = (2\hat{\imath} + 3\hat{\jmath}) + (0.3\hat{\imath} + 0.2\hat{\jmath}) \times 10$

$= 5\hat{\imath} + 5\hat{\jmath}$

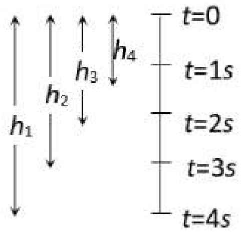
$|\vec{v}| = 5\sqrt{2}$

336 **(c)**

$$S \propto t^2 \Rightarrow \frac{S_1}{S_2} = \left(\frac{10}{20}\right)^2 \Rightarrow S_2 = 4S_1$$

337 **(a)**

For first marble, $h_1 = \frac{1}{2}g \times 16 = 8g$



For second marble, $h_2 = \frac{1}{2}g \times 9 = 4.5g$

For third marble, $h_3 = \frac{1}{2}g \times 4 = 2g$

For fourth marble, $h_4 = \frac{1}{2}g \times 1 = 0.5g$

$\therefore h_1 - h_2 = 8g - 4.5g = 3.5g = 35m.$

$h_2 - h_3 = 4.5g - 2g = 2.5g = 25m$ and

$h_3 - h_4 = 2g - 0.5g = 1.5g = 15m$

338 **(b)**

$$\frac{|\text{Average velocity}|}{|\text{Average speed}|} = \frac{|\text{displacement}|}{|\text{distance}|} \le 1$$

Because displacement will either be equal or less than distance. It can never be greater than distance

339 **(a)**

$$H_{\max} = \frac{u^2}{2g} \Rightarrow H_{\max} \propto \frac{1}{g}$$

On planet B value of g is 1/9 times to that of A. So value of $H_{\max}$ will become 9 times $i.e.$ $2 \times 9 =$ 18 *metre*

340 **(b)**

According to given relation acceleration $a = \alpha t + \beta$

As $a = \frac{dv}{dt} \Rightarrow \alpha t + \beta = \frac{dv}{dt}$

Since particle starts from rest, its initial velocity is zero

$i.e.$, At time $t = 0$, velocity $= 0$

$$\Rightarrow \int_0^v dv = \int_0^t (\alpha t + \beta)dt \Rightarrow v = \frac{\alpha t^2}{2} + \beta t$$

341 **(c)**

Total distance to be covered for crossing the bridge

= length of train + length of bridge

$= 150m + 850m = 1000m$

Time $= \frac{\text{Distance}}{\text{Velocity}} = \frac{1000}{45 \times \frac{5}{18}} = 80$ *sec*

342 **(c)**

Given, $3s = 9t + 5t^2$ or $s = \frac{1}{3}(9t + 5t^2)$

Velocity $v = \frac{ds}{dt} = \frac{1}{3}(9 + 10t)$

Acceleration $a = \frac{d}{dt}\left(\frac{ds}{dt}\right) = \frac{d^2s}{dt^2} = \frac{10}{3}$ units.

343 **(b)**

Given acceleration $a = 6t + 5$

$\therefore a = \frac{dv}{dt} = 6t + 5, dv = (6t + 5)dt$

Integrating it, we have $\int_0^v dv = \int_0^t (6t + 5)dt$

$v = 3t^2 + 5t + C$, where C is a constant of integration

When $t = 0, v = 0$ so $C = 0$

$\therefore v = \frac{ds}{dt} = 3t^2 + 5t$ or, $ds = (3t^2 + 5t)dt$

Integrating it within the conditions of motion, $i.e.$, as t changes from 0 to $2s$, s changes from 0 to s, we have

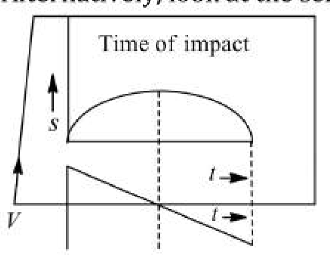
$$\int_0^s ds = \int_0^2 (3t^2 + 5t)dt$$

$$\therefore s = \left[t^3 + \frac{5}{2}t^2\right]_0^2 = 8 + 10 = 18\,m$$

344 **(c)**

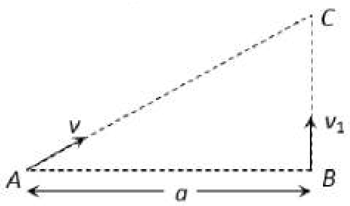
Think of the lope of the given displacement-time graph at different points and you would arrive at the correct answer.

Alternatively, look at the self-illustrative figure.



345 **(b)**

Let two boys meet at point C after time 't' from the starting. Then $AC = vt, BC = v_1 t$



$(AC)^2 = (AB)^2 + (BC)^2 \Rightarrow v^2t^2 = a^2 + v_1^2t^2$

By solving we get $t = \sqrt{\frac{a^2}{v^2 - v_1^2}}$

347 **(a)**

Here, $t_1 = \frac{x}{v} + \frac{x}{v} = \frac{2x}{v}, t_2 = \frac{x}{v+\omega} = \frac{x}{v-\omega} + \frac{2xv}{v^2-\omega^2}$

or $t_2 = \frac{2xv}{v^2\left(1-\frac{\omega^2}{v^2}\right)} = \frac{2x}{v\left(1-\frac{\omega^2}{v^2}\right)}$

or $t_2 = \frac{t_1}{1-\frac{\omega^2}{v^2}}$

or $t_2 > t_1$

348 **(d)**

$S \propto u^2$. If u becomes 3 times then S will become 9 times *i.e.* $9 \times 20 = 180m$

349 **(d)**

Let acceleration is a and retardation is $-2a$. Then for accelerating motion

$t_1 = \frac{v}{a}$ ....(i)

For retarding motion, $t_2 = \frac{v}{2a}$ ....(ii)

Given,

$$t_1 + t_2 = 9 \Rightarrow \frac{v}{a} + \frac{v}{2a} = 9 \Rightarrow \frac{3v}{2a} = 9 \Rightarrow \frac{v}{a} = 6$$

Hence, duration of acceleration, $t_1 = 6$ s

350 **(c)**

$h = \frac{1}{2}gT^2, h' = \frac{1}{2}g\left(\frac{T}{2}\right)^2 h' = \frac{h}{4},$

Height above the ground $= h - \frac{h}{4} = \frac{3h}{4}$

351 **(b)**

Given, $y = bx^2$

$$\frac{dy}{dt} = 2bx\frac{dx}{dt} \quad \text{... (i)}$$

$$\frac{dy}{dt} = at \quad (\because v_y = u_y + a_y t)$$

$$at = 2bx\frac{dx}{at}$$

$$at\, dt = 2bx\, dx$$

Take integration of both sides

$$\int at\, dt = \int 2bx\, dx$$

$$\frac{at^2}{2} = bx^2 + c \quad \text{... (ii)}$$

At $t = 0, x = 0, c = 0$

Then $\frac{at^2}{2} = bx^2$

$$x = \sqrt{\frac{at^2}{2b}} = \sqrt{\frac{a}{2b}}t$$

$$\therefore \quad v_x = \frac{dx}{dt} = \sqrt{\frac{a}{2b}}$$

352 **(c)**

$S_n \propto (2n - 1)$. In equal time interval of 2 *seconds*

Ratio of distance $= 1 : 3 : 5$

353 **(c)**

$v^2 = u^2 + 2as$, If $u = 0$, then $v^2 \propto S$

i.e., Graph should be parabola symmetric to displacement axis

354 **(b)**

Between time interval 20s the 4s, there is non-zero acceleration and retardation. Hence, distance travelled during this interval = Area between time interval 20 s to 40 s

$$= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20$$
$$= 50 \text{ m}$$

355 **(c)**

$$h = ut + \frac{1}{2}gt^2 \Rightarrow 81 = -12t + \frac{1}{2} \times 10 \times t^2 \Rightarrow t$$
$$= 5.4\ sec$$

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357 **(d)**

Given, $\mathbf{r} = 3t\hat{\mathbf{i}} - t^2\hat{\mathbf{j}} + 4\hat{\mathbf{k}}$

$$\therefore \quad \frac{d\mathbf{r}}{dt} = \mathbf{v} = 3\hat{\mathbf{i}} - 10\hat{\mathbf{j}}$$

At $t = 5$ s

$$\mathbf{v} = 3\hat{\mathbf{i}} - 10\hat{\mathbf{j}}$$

$$v = \sqrt{(3)^2 + (10)^2} = \sqrt{109} = 10.44 \text{ m/s}$$

358 **(d)**

Given, $v = 10$ g $\text{kmh}^{-1} = 30 \text{ mh}^{-1}$

From first equation of motion.

$$v = u + at$$

$$\therefore \quad 30 = 0 + a \times 5 \quad (\because u = 0)$$

Or $\quad a = 6 \text{ ms}^{-2}$

So, distance travelled by metro train in 5 s

$$s_1 = \frac{1}{2}at^2 = \frac{1}{2} \times (6) \times (5)^2 = 75 \text{ m}$$

Distance travelled before coming to rest

$$= 45 \text{ m}$$

So, from third equation of motion

$$0^2 = (30)^2 - 2a' \times 45$$

Or $\quad a' = \frac{30 \times 30}{2 \times 45} = 10\ \text{ms}^{-2}$

Time taken in travelling 45 m is

$$t_3 = \frac{30}{10} = 3\ \text{s}$$

Now, total distance = 395 m

ie, $\quad 75 + s' + 45 = 395$ m

Or $\quad s' = 395 - (75 + 45) = 275$ m

$\therefore \quad t_2 = \frac{275}{30} = 9.2$ s

Hence, total time taken in whole journey

$$= t_1 + t_2 + t_3$$

$$= 5 + 9.2 + 3 = 17.2\ \text{s}$$

359 **(b)**

$x = \frac{1}{t+5} \Rightarrow v = \frac{dx}{dt} = -\frac{1}{(t+5)^2}$

Acceleration, $a = \frac{dv}{dt} = \frac{2}{(t+5)^3} \Rightarrow a \propto (\text{velocity})^{3/2}$

360 **(b)**

$v = \frac{ds}{dt} = 12t - 3t^2$

Velocity is zero for $t = 0$ and $t = 4$ sec

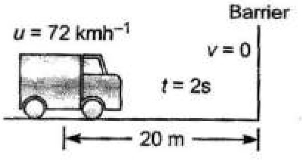
361 **(a)**

Distance = Area covered between velocity and time axis

$= \frac{1}{2}(30 + 10)10 = 200\ meter$

362 **(b)**

Initial speed of car,



$u = 72\ \text{kmh}^{-1} = 72 \times \frac{5}{18}\text{ms}^{-1} = 20\ \text{ms}^{-1}$

Distance from barrier $s = 20$ m

Time taken by car to hit the barrier, $t = 2$ s

Using first equation of motion $v = u + at$

$$a = \frac{v - u}{t}$$

$$\therefore a = \frac{0 - 20}{2} = -10\ \text{ms}^{-2}$$

−vesign indicates that acceleration is retarding or it is deceleration which decreases the speed of car.

363 **(d)**

$S = \left(4 \times 1.5 + 4 \times 1.5 + \frac{1}{2} \times 10 \times 1.5 \times 1.5\right)\text{m}$

$= (6 + 6 + 5 \times 2.25)\text{m} = 23.25\text{m}$

364 **(a)**

From first equation of motion

$$v = u + at$$

As object starts from rest, so $u = 0$

$\therefore \quad v = at$ or $v \propto t$

Therefore, $v - t$ graph is a straight line passing through O.

365 **(a)**

From equation of motion, we have

$$v = u + \text{g}t$$

Where u is initial velocity and t is time.

For ball A, $v_A = u - \text{g}t$

For ball B, $u_B = 0 + \text{g}t$

$\therefore$ Relative speed, $\Delta\mathbf{v} = \mathbf{v}_A - \mathbf{v}_B$

$$= (u - \text{g}t)\hat{\mathbf{j}} - (-\text{g}t\hat{\mathbf{j}}) = u\hat{\mathbf{j}}$$

366 **(b)**

$x = 9t^2 - t^3$; $v = \frac{dx}{dt} = 18t - 3t^2$, For maximum speed

$\frac{dv}{dt} = \frac{d}{dt}[18t - 3t^2] = 0 \Rightarrow 18 - 6t = 0 \ \therefore t$

$= 3$ sec

i.e., Particle achieve maximum speed at $t = 3$ sec.

At this instant position of this particle, $x = 9t^2 - t^3$

$= 9(3)^2 - (3)^3 = 81 - 27 = 54\ m$

367 **(c)**

Average velocity $= \frac{\text{Displacement}}{\text{Time interval}}$

A particle moving in a given direction with non-zero velocity cannot have zero speed.

In general, average speed is not equal to magnitude of average velocity. However, it can be so if the motion is along a straight line without change in direction

368 **(a)**

Slope of velocity-time graph measures acceleration. For graph (a) slope is zero. Hence $a = 0$ *i.e.* motion is uniform

369 **(c)**

From equation of motion, we have

$$s = ut + \frac{1}{2}\,at^2$$

When $s = 24$ m, $t = 4$ s,

$$\therefore \qquad 24 = 4u + \frac{1}{2}\,a(4)^2$$

Or $\qquad 24 = 4u + 8a$

Or $\qquad 6 = u + 2a \qquad ....(i)$

When body travels a total distance of $24 + 64 = 88$ m in 8 s, we get

$$88 = 8u + \frac{1}{2}a\,(8)^2$$

Or $\qquad 88 = 8u + 32a$

Or $\qquad 11 = u + 4a \qquad ....(ii)$

Solving Eqs. (i) and (ii), we get

$$u = 1\ \text{ms}^{-1}$$

370 **(d)**

$$V_{av} = \frac{S+S}{\frac{S}{v_1}+\frac{S}{v_2}} = \frac{2v_1v_2}{v_1+v_2}$$

371 **(a)**

$$S_n = u + \frac{a}{2}(2n-1) \Rightarrow S_3 = 0 + \frac{4/3}{2}(2\times 3 - 1)$$

$$\Rightarrow S_3 = \frac{10}{3}m$$

372 **(a)**

$t^2 = x^2 - 1$ or $x^2 = t^2 + 1$

Or $2x\frac{dx}{dt} = 2t$ or $xv = t$

Or $2x\frac{dx}{dt} + v\frac{dx}{dt} = 1$

Or $x\frac{dv}{dt} = 1 - v^2$

Or $\frac{dv}{dt} = \frac{1-v^2}{x} = \frac{1-\frac{t^2}{x^2}}{x} = \frac{x^2-t^2}{x^3}$

But $x^2 - t^2 = 1$

$$\therefore \frac{dv}{dt} = \frac{1}{x^3}$$

373 **(b)**

$v^2 = u^2 + 2as$

$$a = \frac{v^2-u^2}{2s} = \frac{(20)^2-(10)^2}{2\times 135} = \frac{300}{270} = \frac{10}{9}m/s^2$$

From first equation of motion

$$v = u + at \Rightarrow t = \frac{v-u}{a} = \frac{20-10}{10/9} = \frac{10}{10/9}$$

$$= 9\ sec$$

374 **(a)**

$x_1 = \frac{1}{2}at^2$ and $x_2 = ut$ $\therefore x_1 - x_2 = \frac{1}{2}\,at^2 - ut$

$y = \frac{1}{2}at^2 - ut$.This equation is of parabola

$\frac{dy}{dt} = at - u$ and $\frac{d^2y}{dt^2} = a$

As $\frac{d^2y}{dt^2} > 0$ *i.e.*, graph shows possess minima at $t = \frac{u}{a}$

375 **(a)**

Distance b/w the cars A and B remains constant.

Let the distance be 'x'

Velocity of C w.r.t. A and B $V = 45 + 36 = 81\ km/h$

Distance $= 81 \times \frac{5}{60} = 6.75\ Km$

376 **(a)**

$$\frac{1}{2}at^2 = vt \Rightarrow t = \frac{2v}{a}$$

377 **(b)**

Only directions of displacement and velocity gets changed, acceleration is always directed vertically downward

378 **(a)**

$$\because a = \frac{dv}{dt} = 2(t-1) \Rightarrow dv = 2(t-1)dt$$

$$\Rightarrow v = \int_0^5 2(t-1)dt = 2\left[\frac{t^2}{2} - t\right]_0^5 = 2\left[\frac{25}{2} - 5\right]$$

$$= 15\ m/s$$

379 **(c)**

Vertical component of velocities of both the balls are same and equal to zero. So $t = \sqrt{\frac{2h}{g}}$

381 **(a)**

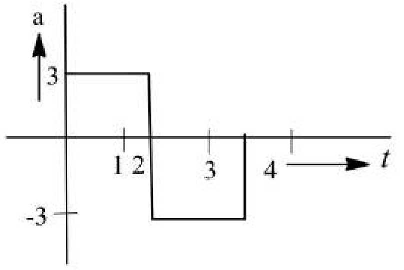
A particle starts from rest at $t = 0$

The equation of motion

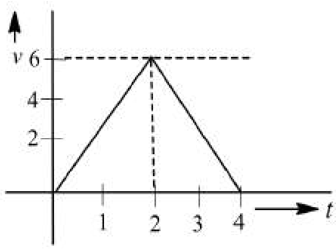
$$v = u + at = 0 + 3 \times 2 = 6\ \text{ms}^{-1}$$

The velocity for next 2 s

$$v' = v + at$$
$$= 6 - 3 \times 2 = 0$$
$$v' = 0$$



Hence, $v - t$ graph will be as shown.



382 **(b)**

The given condition is possible only when body is at its highest position after 5 seconds

It means time of ascent = 5 sec

and time of flight $T = \frac{2u}{g} = 10$

$\Rightarrow u = 49\ m/s$

383 **(a)**

This graph shows uniform motion because line having a constant slope

384 **(d)**

Relative velocity

$= 10 + 5 = 15\ m/sec$

$\therefore t = \frac{150}{15} = 10\ sec$

385 **(b)**

The given condition is possible only when body is at its highest position after 5 seconds

It means time of ascent = 5 sec

and time of flight $T = \frac{2u}{g} = 10$

$\Rightarrow u = 49\ m/s$

386 **(b)**

Let two balls meet at depth h from platform

So $h = \frac{1}{2}g(18)^2 = v(12) + \frac{1}{2}g(12)^2 \Rightarrow v = 75\ ms^{-1}$

387 **(b)**

$$h = \frac{1}{2}gt^2$$

$$h' = \frac{1}{2}g(t - t_0)^2$$

$$h - h' = \frac{1}{2}g[t^2 - (t - t_0)^2]$$

$$= \frac{1}{2}g[t^2 - t^2 - t_0^2 + 2tt_0]$$

$$\Delta h = \frac{1}{2}gt_0(2t - t_0)$$

Δh is increasing with time

388 **(a)**

Time taken by each ball to reach highest point, $t = \frac{1}{n}$ s.

As the juggler throws the second ball, when the first ball is at its highest point, so $v = 0$

Using $v = u + at$, we have $0 = u + (-g)(1/n)$

or $u = (g/n)$

Also $v^2 = u^2 + 2as$

$\therefore 0 = (g/n)^2 + 2(-g)h$ or $h = \frac{g}{2n^2}$.

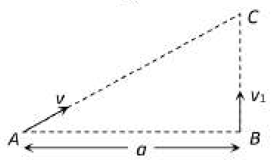
389 **(b)**

$$\frac{(S)_{(last\ 2s)}}{(S)_{7s}} = \frac{\frac{1}{2} \times 2 \times 10}{\frac{1}{2} \times 2 \times 10 + 2 \times 10 + \frac{1}{2} \times 2 \times 10}$$

$$= \frac{1}{4}$$

390 **(b)**

Let two boys meet at point C after time 't' from the starting. Then $AC = vt, BC = v_1 t$



$(AC)^2 = (AB)^2 + (BC)^2 \Rightarrow v^2t^2 = a^2 + v_1^2t^2$

By solving we get $t = \sqrt{\frac{a^2}{v^2 - v_1^2}}$

391 **(b)**

$$Average\ velocity = \frac{Total\ distance\ covered}{Time\ of\ flight}$$

$$= \frac{2H_{max}}{2u/g}$$

$$\Rightarrow v_{av} = \frac{2u^2/2g}{2u/g} \Rightarrow v_{av} = u/2$$

Velocity of projection = v [Given]

$\therefore v_{av} = u/2$

392 **(d)**

Up to time t_1 slope of the graph is constant and after t_1 slope is zero $i.e.$ the body travel with constant speed up to time t_1 and then stops

393 **(a)**

Given, $\frac{dv}{dt} = pt$

$dv = pt\,dt$

$$\int_0^v dv = P\int_0^{t_1} t\,dt$$

$$v = \frac{1}{2}pt_1^2$$

Again, $x = \frac{1}{2}p\int_0^{t_1} t_1^2 dt = \frac{1}{2}pt_1^3$

394 **(d)**

Because acceleration due to gravity is constant so the slope of line will be constant *i.e.*, velocity time curve for a body projected vertically upwards is straight line

395 **(c)**

Relativistic momentum $= \frac{m_0 v}{\sqrt{1-v^2/c^2}}$

If velocity is doubled then the relativistic mass also increases. Thus value of linear momentum will be more than double

396 **(c)**

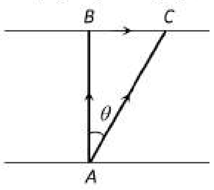
Given $\overrightarrow{AB}$ = Velocity of boat = km/hr

$\overrightarrow{AC}$ = Resultant velocity of boat = 10 km/hr

$\overrightarrow{BC}$ = Velocity of river

$= \sqrt{AC^2 - AB^2}$

$= \sqrt{(10)^2 - (8)^2} = 6\ km/hr$



397 **(d)**

Distance, $x = b_0 + b_1 t + b_2 t^2$

Velocity $v = \left(\frac{dx}{dt}\right) = b_1 + 2b_2 t$

Acceleration, $a = \frac{d^2x}{dt^2} = 2b_2$

398 **(d)**

We have standard result for this type of velocity

$$v = \sqrt{\frac{u^2 + v^2}{2}}$$

399 **(c)**

Let student catch the bus after t sec. So it will cover distance ut

Similarly distance travelled by the bus will be $\frac{1}{2}at^2$ for the given condition

$$ut = 50 + \frac{1}{2}at^2 = 50 + \frac{t^2}{2} \quad [a = 1\ m/s^2]$$

$$\Rightarrow u = \frac{50}{t} + \frac{t}{2}$$

To find the minimum value of u

$\frac{du}{dt} = 0$, so we get $t = 10\ sec$, then $u = 10\ m/s$

400 **(b)**

Speed of stone in a vertically upward direction is 4.9 m/s. So for vertical downward motion we will consider $u = -4.9\ m/s$

$$h = ut + \frac{1}{2}gt^2 = -4.9 \times 2 + \frac{1}{2} \times 9.8 \times (2)^2$$
$$= 9.8\ m$$

401 **(a)**

$v = u - gt$

At max height $\quad v^2 = u^2 - 2gh$

$$t = \frac{u}{g} \qquad h = \frac{u^2}{2g}$$

$$\frac{t_1}{t_2} = \frac{2}{3} \qquad \frac{h_1}{h_2} = \left(\frac{2}{3}\right)^2 = \frac{4}{9}$$

402 **(b)**

In figure (b), the particle is slowly accelerated first and reaches a constant velocity for the straight line portion. Then velocity decreases are finally it stops when it reaches the top straight line portion.

Hence, figure (b) represents one dimensional motion of a particle.

403 **(d)**

Average acceleration $= \frac{\text{Change in velocity}}{\text{Time taken}} = \frac{v_2 - v_1}{t_2 - t_1}$

$$= \frac{[10 + 2(5)^2] - [10 + 2(2)^2]}{3} = \frac{60 - 18}{3} 14 m/s^2$$

404 **(c)**

$$\frac{dv}{dt} = bt \Rightarrow dv = bt\,dt \Rightarrow v = \frac{bt^3}{2} + K_1$$

At $t = 0, v = v_0 \Rightarrow K_1 = v_0$

We get $v = \frac{1}{2}bt^2 + v_0$

Again $\frac{dx}{dt} = \frac{1}{2}bt^2 + v_0$

$$\Rightarrow x = \frac{1}{2}\frac{bt^3}{3} + v_0 t + K_2$$

At $t = 0, x = 0 \Rightarrow K_2 = 0$

$$\therefore x = \frac{1}{6}bt^3 + v_0 t$$

405 **(c)**

$$h = ut + \frac{1}{2}gt^2, t = 3\ \text{sec}, u = -4.9 m/s$$

$$\Rightarrow h = -4.9 \times 3 + 4.9 \times 9 = 29.4\ m$$

406 **(a)**

Using

$V = u + at$

$V = gt$ ...(i)

Comparing with $y = mx + c$

Equation (i) represents a straight line passing through origin inclined x-axis (slope $-g$)

407 **(b)**

Time of flight $= \frac{2u}{g} = \frac{2 \times 100}{10} = 20$ sec

408 **(d)**

$u = 0, S = 250m, t = 10$sec

$S = ut + \frac{1}{2}at^2 \Rightarrow 250 = \frac{1}{2}a[10]^2 \Rightarrow a = 5m/s^2$

So, $F = ma = 0.9 \times 5 = 4.5N$

409 **(d)**

$\frac{v_A}{v_B} = \frac{\tan\theta_A}{\tan\theta_B} = \frac{\tan 30°}{\tan 60°} = \frac{1/\sqrt{3}}{\sqrt{3}} = \frac{1}{3}$

410 **(d)**

Instantaneous velocity is given by the slope of the curve at that instant $v = \frac{ds}{dt} = \tan\theta$ from the figure it is clear that slope of the curve is maximum at point 'C'

411 **(c)**

Because acceleration is a vector quantity

412 **(d)**

If t_1 and t_2 are time of ascent and descent respectively then time of flight $T = t_1 + t_2 = \frac{2u}{g}$

$\Rightarrow u = \frac{g(t_1 + t_2)}{2}$

413 **(a)**

$h = ut - \frac{1}{2}gt^2 \Rightarrow 96 = 80t - \frac{32}{2}t^2$

$\Rightarrow t^2 - 5t + 6 = 0 \Rightarrow t = 2sec$ or $3\ sec$

415 **(c)**

Distance travelled by motor bike at $t = 18$s

$s_{\text{bike}} = s_1 = \frac{1}{2}(18)(60) = 540$ m

Distance travelled by car at $t = 18$s

$s_{\text{car}} = s_2 = (18)(60) = 720$ m

Therefore, separation between them at $t = 18$s is 180m. Let, separation between them decreases to zero at time t beyond 18s.

Hence, $s_{\text{bike}} = 540 + 60t$ and $s_{\text{car}} = 720 + 40t$

$s_{\text{car}} - s_{\text{bike}} = 0$

$\Rightarrow \quad 720 + 40t = 540 + 60t$

$\Rightarrow \quad t = 9$s beyond 18s or

Hence, $t = (18 + 9)$s$=27$s from start and distant travelled by both is $s_{\text{bike}} = s_{\text{car}} = 1080$m

416 **(d)**

Since, the initial position of cyclist coincides with final position, so his net displacement is zero.

Average speed $= \frac{\text{total distance travelled}}{\text{total time taken}}$

$= \frac{OP + PQ + QO}{10}$ km min^{-1}

$= \frac{1 + \frac{\pi}{2} \times 1 + 1}{10}$ km min^{-1}

$= \frac{\pi + 4}{20} \times 60$ kmh$^{-1} = 21.4$ kmh^{-1}

417 **(c)**

$t = \sqrt{\frac{2h}{(g + a)}} = \sqrt{\frac{2 \times 2.7}{(9.8 + 1.2)}} = \sqrt{\frac{5.4}{11}} = \sqrt{0.49}$

$= 0.7$ sec

As $u = 0$ and lift is moving upward with acceleration

418 **(c)**

When packet is released from the balloon, it acquires the velocity of balloon of value 12 m/s. Hence velocity of packet after 2 sec, will be

$v = u + gt = 12 - 9.8 \times 2 = -76\ m/s$

419 **(c)**

For first part,

$u = 0, t = T$ and acceleration $= a$

$\therefore v = 0 + aT = aT$ and $S_1 = 0 + \frac{1}{2}aT^2 = \frac{1}{2}aT^2$

For Second part,

$u = aT$, retardation $= a_1, v = 0$ and time taken $=$ T_1 (let)

$\therefore 0 = u - a_1T_1 \Rightarrow aT = a_1T_1$

And from $v^2 = u^2 - 2aS_2 \Rightarrow S_2 = \frac{u^2}{2a_1} = \frac{1}{2}\frac{a^2T^2}{a_1}$

$S_2 = \frac{1}{2}aT \times T_1 \quad \left(\text{As } a_1 = \frac{aT}{T_1}\right)$

$\therefore v_{av} = \frac{S_1 + S_2}{T + T_1} = \frac{\frac{1}{2}aT^2 + \frac{1}{2}aT \times T_1}{T + T_1}$

$= \frac{\frac{1}{2}aT(T + T_1)}{T + T_1} = \frac{1}{2}aT$

420 **(a)**

$S = ut + \frac{1}{2}gt^2$

$30 = -25t + \frac{10}{2}t^2$ or $t^2 - 5t - 6 = 0$

Or $(t - 6)(t + 1) = 0$ Take positive root

$\therefore t = 6$ sec

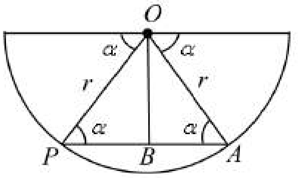
421 **(c)**

Let the particle touches the sphere t the point A.

Let $PA = 1$

$\therefore PB = \frac{l}{2}$

In $\Delta OPB, \cos\alpha = \frac{PB}{r}$



$\therefore PB = r\cos a$

or $\frac{l}{2} = r\cos a$

$\therefore l = 2r\cos\alpha$

But $l = \frac{1}{2}a_0t^2$

$\therefore\ t = \sqrt{\left(\frac{2l}{a_0}\right)} = \sqrt{\left(\frac{2\times 2r\cos a}{a_0}\right)} = \sqrt{\left(\frac{4\,r\cos a}{a_0}\right)}$

422 **(a)**

According to problem

Distance travelled by body A in 5^{th} sec and distance travelled by body B in 3^{rd} $sec.$ of its motion are equal.

$0 + \frac{a_1}{2}(2\times 5 - 1) = 0 + \frac{a_2}{2}[2\times 3 - 1]$

$9a_1 = 5a_2 \Rightarrow \frac{a_1}{a_2} = \frac{5}{9}$

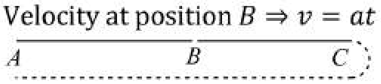
424 **(b)**

In this problem point starts moving with uniform acceleration a and after time t (Position B) the direction of acceleration get reversed i.e. the retardation of same value works on the point. Due to this velocity of points goes on decreasing and at position C its velocity becomes zero. Now the direction of motion of point reversed and it moves from C to A under the effect of acceleration a.

We have to calculate the total time in this motion.

Starting velocity at position A is equal to zero.

Velocity at position $B \Rightarrow v = at$ [As $u = 0$]



Distance between A and B, $S_{AB} = \frac{1}{2}at^2$

As same amount of retardation works on a point and it comes to rest therefore

$S_{BC} = S_{AB} = \frac{1}{2}a\,t^2$

$\therefore S_{AC} = S_{AB} + S_{BC} = a\,t^2$ and time required to cover this distance is also equal to t.

$\therefore$ Total time taken for motion between A and C

$= 2t$

Now for the return journey from C to A ($S_{AC} = at^2$)

$S_{AC} = u\,t + \frac{1}{2}at^2 \Rightarrow at^2 = 0 + \frac{1}{2}at_1^2 \Rightarrow t_1 = \sqrt{2}t$

Hence total time in which point returns to initial point

$T = 2t + \sqrt{2}\,t = (2+\sqrt{2})t$

425 **(c)**

$h = -vt_1 + \frac{1}{2}gt_1^2$ or $\frac{h}{t_1} = -v + \frac{1}{2}gt_1$ ...(i)

$h = vt_2 + \frac{1}{2}gt_1^2$ or $-\frac{h}{t_2} = -v + \frac{1}{2}gt_2$ ...(ii)

$\therefore\ \frac{h}{t_1} + \frac{h}{t_2} = \frac{1}{2}g(t_1 + t_2)$

or $h = \frac{1}{2}gt_1t_2$

For falls under gravity from the top of the tower

$h = \frac{1}{2}gt^2$

$\therefore\ \frac{1}{2}gt_1t_2 = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{t_1t_2}$

426 **(d)**

Since $c >> v$ (negligible)

427 **(a)**

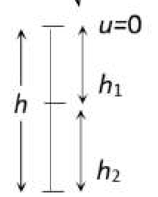
For first stone $u = 0$ and

For second stone $\frac{u^2}{2g}4h \Rightarrow u^2 = 8gh$

$\therefore u = \sqrt{8gh}$

Now, $h_1 = \frac{1}{2}gt^2$

$h_2 = \sqrt{8ght - \frac{1}{2}gt^2}$



$u = \sqrt{8gh}$

Where, t =time cross each other

$\therefore h_1 + h_2 = h$

$\Rightarrow \frac{1}{2}gt^2 + \sqrt{8ght} - \frac{1}{2}gt^2 = h \Rightarrow t = \frac{h}{\sqrt{8gh}} = \sqrt{\frac{h}{8g}}$

428 **(b)**

Let a_1 and a_2 be the retardations offered to be bullet by wood and iron respectively.

For $A \to B \to C$,

$v_1^2 - u^2 = 2a_1(4)$, and $0^2 - v_1^2 = 2a_2(1)$

Adding, we get

$-u^2 = 2(4a_1 + a_2)$ ...(i)

For $A' \to B' \to C'$,

$v_2^2 - u^2 = 2a_2(2)$

and $0^2 - v_2^2 = 2a_1(2)$

Adding, we get

$-u^2 = 2(2a_1 + 2a_2)$ ....(ii)

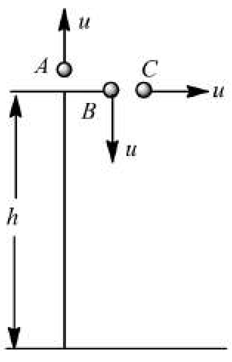
Equating Eqs. (i) and (ii) and solving, we get

$4a_1 + a_2 = 2a_1 + 2a_2$

$\Rightarrow a_2 = 2a_1$

429 **(c)**

Let the initial velocity of balls A, B and C are equal and its magnitude is u. Since, the ball A is projected with velocity u in upward direction, so when it will come back to the projection point, its velocity remains same. So, the final velocity of ball A, when it hits the ground is given as



$$v_A^2 = u^2 + 2gh$$

Hence, $v_A = \sqrt{u^2 + 2gh}$ ... (i)

And the final velocity of ball B is

$$v_B = \sqrt{u^2 + 2gh} \quad \text{... (ii)}$$

But the initial vertical velocity of the ball C is zero.

So, $v_C^2 = \sqrt{(0)^2 + 2gh}$

$\Rightarrow$ $v_C = \sqrt{2gh}$ ....(iii)

Hence, it is clear from Eqs. (i), (ii) and (iii), we get

$$v_A = v_B > v_C$$

430 **(b)**

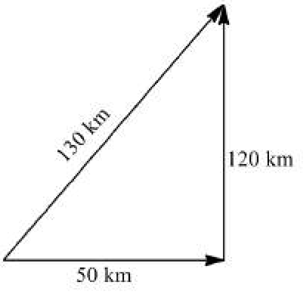
$$\text{Time} = \frac{\text{distance}}{\text{average speed}}$$

$\Rightarrow$ Average speed

$$= \frac{\text{distance}}{\text{time}}$$

$$v = \frac{130 + 120 + 50}{3}$$

$$= \frac{300}{3} = 100 \text{ kmh}^{-1}$$



431 **(b)**

$h = vt - \frac{1}{2}gt^2$ or $\frac{1}{2}gt^2 - vt + h = 0$

or $gt^2 - 2vt + 2h = 0 \Rightarrow t_1t_2 = \frac{2h}{g}$

$1 \times 3 = \frac{2h}{10}$ or $2h = 30\text{m}$ or $h = 15\text{m}$

432 **(b)**

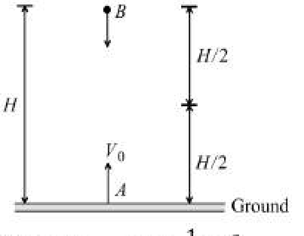
Area under acceleration-time graph gives the change in velocity. Hence,

$$v_{\max} = \frac{1}{2} \times 10 \times 11 = 55 \text{ ms}^{-1}$$

Therefore, the correct option is (b).

434 **(b)**

Let the two bodies A and B respectively meet at a time t, at a height $\frac{H}{2}$ from the ground



Using $S = ut + \frac{1}{2}at^2$

For a body $A, u = V_0, a = -g, S = \frac{H}{2}$

$\therefore \frac{H}{2} = V_0t - \frac{1}{2}gt^2$ ...(i)

For body $B, u = 0, a = +g, S = \frac{H}{2}$

$\therefore \frac{H}{2} = \frac{1}{2}gt^2$ ...(ii)

Equating equations (i) and (ii), we get

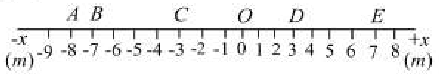
$V_0t - \frac{1}{2}gt^2 = \frac{1}{2}gt^2 \Rightarrow V_0t = gt^2$ or $t = \frac{V_0}{g}$

Substituting the value of t in equation (i), we get

$$\frac{H}{2} = V_0 \times \left(\frac{V_0}{g}\right) - \frac{1}{2}g\left(\frac{V_0}{g}\right)^2 = \frac{V_0^2}{g} - \frac{1}{2}\frac{V_0^2}{g}$$

$\frac{H}{2} = \frac{1}{2}\frac{V_0^2}{g}$ or $V_0^2 = gH \Rightarrow V_0 = \sqrt{gH}$

435 **(b)**



(i) The displacement of the main from A to E is $\Delta x = x_2 - x_1 = 7m - (-8m) = +15m$ directed in the positive x-direction

(ii) The displacement of the man from E to C is $\Delta x = -3m - (7m) = -10m$ directed in the negative x-direction

(iii) The displacement of the man from B to D is $\Delta x = 3m - (-7m) = +10m$ directed in the positive x-axis

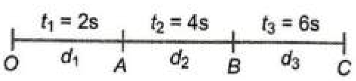
436 **(c)**

Let particle start from O and travels distance

$d_1(OA), d_2(AB), d_3(BC)$

From equation of motion, we have

$$s = ut + \frac{1}{2}at^2$$



For OA : $t = 2\text{ s}, u = 0$

$$d_1 = \frac{1}{2}a(2)^2 = 2a$$

For OB : $t = 4\text{ s}, u = 0$

$$\therefore \quad s_2 = \frac{1}{2}a(4)^2 = 8a$$

$$d_2 = 8a - 2a = 6a$$

For OC : $t = 6\text{ s}, u = 0$

$$\therefore \quad S = \frac{1}{2}a(6)^2 = 18a$$

Distance in last 2 s $= 18a - 8a = 10a$

$$\therefore \quad d_1 : d_2 : d_3 = 2a : 6a : 10a$$

$$d_1 : d_2 : d_3 = 1 : 3 : 5$$

437 **(b)**

Time of ascent = Time of descent=5*sec*

438 **(b)**

From equation of motion, we have

$v = u + gt$

Taking downward direction negative

$u = 10 + 5 = 15\text{ms}^{-1}, g = 10\text{ ms}^{-2}, t - 2\text{ s}$

$\therefore v = 15 - 2 \times 10 = -2\text{ ms}^{-1}$

439 **(d)**

Total distance $= 130 + 120 = 250\ m$

Relative velocity $= 30 - (-20) = 50\ m/s$

Hence $t = 250/50 = 5\ s$

440 **(b)**

The distance traveled in last second

$$S_{\text{Last}} = u + \frac{g}{2}(2t-1) = \frac{1}{2} \times 9.8(2t-1)$$
$$= 4.9(2t-1)$$

and distance traveled in first three second,

$$S_{\text{Three}} = 0 + \frac{1}{2} \times 9.8 \times 9 = 44.1\ m$$

According to problem $S_{\text{Last}} = S_{\text{Three}}$

$\Rightarrow 4.9(2t-1) = 44.1 \Rightarrow 2t - 1 = 9$

$\Rightarrow t = 5\ sec$

442 **(b)**

Let particle thrown with velocity u and its maximum height is H then $H = \frac{u^2}{2g}$

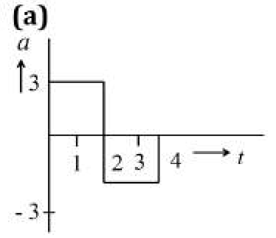
When particle is at height $H/2$, then its speed is $10\ m/s$

From equation $v^2 = u^2 - 2gh$

$$(10)^2 = u^2 - 2g\left(\frac{H}{2}\right) = u^2 - 2g\frac{u^2}{4g} \Rightarrow u^2 = 200$$

Maximum height $\Rightarrow H = \frac{u^2}{2g} = \frac{200}{2 \times 10} = 10\ m$

443 **(a)**



Taking the motion from 0 to 2 s

$u = 0, a = 3ms^{-2}, t = 2s, v = ?$

$v = u + at = 0 + 3 \times 2 = 6ms^{-1}$

Taking the motion from 2 s to 4 s

$v = 6 + (-3)(2) = 0ms^{-1}$

445 **(a)**

$$v = \frac{dx}{dt} = \frac{d}{dt}\left[\frac{k}{b}\left(1 - e^{-bt}\right)\right] = \frac{k}{b}\left[0 - (-b)e^{-bt}\right]$$
$$= ke^{-bt}$$

446 **(c)**

Using Newton's equation of motion

$$v^2 = u^2 + 2as$$

$\therefore \quad (5)^2 = (20)^2 + 2(a)100$

Or $\quad a = -\frac{400-25}{200} = -\frac{375}{200}\text{ms}^{-2}$

Therefore, fore F = mass m × acceleration a

$$= 20 \times \left(-\frac{375}{200}\right) = -37.5\text{ N}$$

447 **(c)**

$\frac{1}{2}gt^2 - \frac{1}{2}g(t-2)^2 = 40$

or $\frac{1}{2} \times 10(2t-2)(2) = 40$ or $2t - 2 = 4$ or $t =$ 3s

448 **(d)**

Let u be the velocity with which the stone is projected vertically upwards.

Given that, $v_{-h} = 2v_h$

$(v_{-h})^2 = 4v_h^2$

$\therefore u^2 - 2g(-h) = 4(u^2 - 2gh)$

$\therefore u^2 = \frac{10gh}{3}$

Now, $h_{\max} = \frac{u^2}{2g} = \frac{5h}{3}$

449 **(b)**

Bullet will take $\frac{100}{1000} = 0.1\ sec$ to reach target.

During this period vertical distance (downward) travelled by the bullet $= \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times (0.1)^2 m = 5cm$

So the gun should be aimed 5 cm above the target

450 **(a)**

Distance travelled in 4 sec

$24 = 4u + \frac{1}{2}\alpha \times 16 \quad$ ... (i)

Distance travelled in 8 sec

$88 = 8u + \frac{1}{2}\alpha \times 64 \quad$ ... (ii)

After solving (i) and (ii), we get $u = 1m/s$

451 **(b)**

Velocity at the time of striking the floor,

$u = \sqrt{2gh_1} = \sqrt{2 \times 9.8 \times 10} = 14m/s$

Velocity with which it rebounds

$v = \sqrt{2gh_2} = \sqrt{2 \times 9.8 \times 2.5} = 7\ m/s$

$\therefore$ Change in velocity $\Delta v = 7 - (-14) = 21m/s$

$\therefore$ Acceleration $= \frac{\Delta v}{\Delta t} = \frac{21}{0.01}$

$= 2100m/s^2$(upwards)

452 **(a)**

Time taken by the car to cover first half of the distance is

$t_1 = \frac{100}{60}$

Time taken by the car to cover speed half of the distance is

$t_2 = \frac{100}{v}$

Average speed , $v_{av} = \frac{\text{Total distance travelled}}{\text{TOtal time taken}}$

$v_{av} = \frac{100+100}{t_1 + t_2} \Rightarrow 40 = \frac{200}{\frac{100}{60} + \frac{100}{v}}$

$\frac{1}{60} + \frac{1}{v} = \frac{1}{20} \Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{60}$

$\frac{1}{v} = \frac{2}{60} = \frac{1}{30}$

$v = 30km\ h^{-1}$

453 **(b)**

Free fall of an object (in vacuum) is a case of motion with uniform acceleration

454 **(c)**

For first projectile, $h_1 = ut - \frac{1}{2}gt^2$

For second projectile, $h_2 = u(t-T) - \frac{1}{2}g(t-T)^2$

When both meet i.e. $h_1 = h_2$

$ut - \frac{1}{2}gt^2 = u(t-T) - \frac{1}{2}g(t-T)^2$

$\Rightarrow uT + \frac{1}{2}gT^2 = gtT \Rightarrow t = \frac{u}{g} + \frac{T}{2}$

and $h_1 = u\left(\frac{u}{g} + \frac{T}{2}\right) - \frac{1}{2}g\left(\frac{u}{g} + \frac{T}{2}\right)^2$

$= \frac{u^2}{2g} - \frac{gT^2}{8}$

455 **(d)**

The distance covered by a body moving with uniform acceleration is given by

$$s = ut + \frac{1}{2}at^2$$

As body starts from rest, therefore initial velocity $u = 0$

$\therefore$ Distance covered by the body

$$s = \frac{1}{2}at^2$$

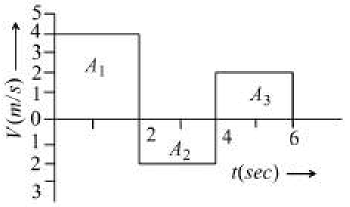
Or $\quad s \propto t^2$

456 **(a)**

Displacement = Summation of all the area with sign

$= (A_1) + (-A_2) + (A_3)$

$= (2 \times 4) + (-2 \times 2) + (2 \times 2)$



$\therefore$ Displacement $= 8\ m$

Distance = Summation of all the areas without sign

$= |A_1| + |-A_2| + |A_3| = |8| + |-4| + |4|$

$= 8 + 4 + 4$

$\therefore$ Distance $= 16\ m$

457 **(a)**

$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}\ \therefore r = \sqrt{x^2 + y^2 + z^2}$

$r = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}m$

458 **(d)**

Given, $x = 6t^2 - t^3$

$$\frac{dx}{dt} = 12t - 3t^2 \qquad ....(i)$$

$$\frac{dx}{dt} = 0 \Rightarrow t = 4\text{ s}$$

Now, again differentiating Eq. (i), we get

$$\frac{d^2x}{dt^2} = 12 - 6t = 12 - 6(4) = -12$$

Since, $\frac{d^2x}{dt^2}$ is negative, hence $t = 4$ s gives the maximum value for $x - t$ curve.

Moreover, acceleration $a = \frac{d^2x}{xt^2}$, at $t = 0, \frac{d^2x}{dt^2} = 12\text{ ms}^{-2}$

459 **(a)**

Let the speed of trains be x

$\therefore \frac{x-u}{x+u} = \frac{1}{2} \Rightarrow 2x - 2u = x + u \Rightarrow x = 3u$

460 **(b)**

$$Average\ velocity = \frac{Total\ distance\ covered}{Time\ of\ flight}$$

$$= \frac{2H_{max}}{2u/g}$$

$\Rightarrow v_{av} = \frac{2u^2/2g}{2u/g} \Rightarrow v_{av} = u/2$

Velocity of projection $= v$ [Given]

$\therefore v_{av} = u/2$

461 **(c)**

For no collision, the speed of car A should be reduced to v_B before the cars meet, *ie*, final relative velocity of car A with respect to car B is zero *ie*, $v_r = 0$

Here initial relative velocity, $u_r = v_A - v_B$

Relative acceleration, $a_r = -a - 0 = -a$

Let relative displacement $= s_r$

The equation

$v_r^2 = u_r^2 + 2a_r s_r$

$(0)^2 = (v_A - v_B) - 2as,$

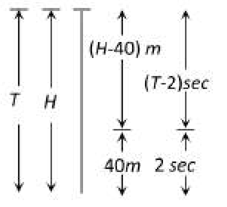
$s_r = \frac{(v_A - v_B)^2}{2a}$

For no collision, $s_r \le s$

$ie, \frac{(v_A - v_B)}{2a} \le s$

462 **(b)**

Let height of minaret is H and body take time T to fall from top to bottom



$H = \frac{1}{2}gT^2 \qquad ...(i)$

In last 2 *sec* body travels distance of 40 m so in $(T-2)$ *sec* distance travelled $= (H - 40)m$

$(H - 40) = \frac{1}{2}g(T-2)^2 \qquad ...(ii)$

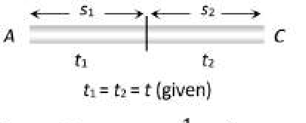
By solving (i) and (ii), $T = 3$ *sec* and $H = 45m$

463 **(c)**

$\because S_1 = ut + \frac{1}{2}at^2 \quad ...(i)$

and velocity after first t *sec*

$v = u + at$



Now, $S_2 = vt + \frac{1}{2}at^2$

$= (u + at)t + \frac{1}{2}at^2 \qquad ...(ii)$

Equation (ii) $-$ (i) $\Rightarrow S_2 - S_1 = at^2$

$\Rightarrow a = \frac{S_2 - S_1}{t^2} = \frac{65 - 40}{(5)^2} = 1m/s^2$

From equation (i), we get,

$S_1 = ut + \frac{1}{2}at^2 \Rightarrow 40 = 5u + \frac{1}{2} \times 1 \times 25$

$\Rightarrow 5u = 27.5\ \therefore u = 5.5\ m/s$

464 **(c)**

As $v^2 = v^2 - 2as \Rightarrow u^2 = 2as\ (\because v = 0)$

$\Rightarrow u^2 \propto s \Rightarrow \frac{u_2}{u_1} = \left(\frac{s_2}{s_1}\right)^{1/2}$

$\Rightarrow u_2 = \left(\frac{9}{4}\right)^{\frac{1}{2}} u_1 = \frac{3}{2} u_1 = 300 m/s$

466 **(d)**

For first ball

$$\frac{1}{2} g t^2 = 176.4$$

$$\Rightarrow \quad t = \sqrt{\frac{176.4 \times 2}{10}}$$

$$t = 5.9 \text{ s}$$

For second ball, $t = 3.9$ s

$$u(3.9) + \frac{1}{2} g (3.9)^2 = 176.4$$

$$\Rightarrow \quad 3.9u + \frac{10}{2}(3.9)^2 = 176.4$$

$$\Rightarrow \quad u = 25.7 \text{ ms}^{-1}$$

This value is approximated to 24.5 ms^{-1}.

467 **(b)**

Given, $a = \alpha t + \beta$

$$\frac{dv}{dt} = \alpha t + \beta$$

$$\int_0^t dv = \int_0^t \alpha t \, dt + \int_0^t \beta \, dt$$

$$v = \frac{\alpha t^2}{2} + \beta t$$

468 **(a)**

$\frac{dt}{dx} = 2\alpha x + \beta \Rightarrow v = \frac{1}{2\alpha x + \beta}$

$\because a = \frac{dv}{dt} = \frac{dv}{dx} \cdot \frac{dx}{dt}$

$a = v \frac{dv}{dx} = \frac{-v.2\alpha}{(2\alpha x + \beta)^2} = -2\alpha . v . v^2 = -2\alpha v^3$

$\therefore$ Retardation $= 2\alpha v^3$

469 **(d)**

Instantaneous velocity is given by the slope of the curve at that instant $v = \frac{ds}{dt} = \tan\theta$ from the figure it is clear that slope of the curve is maximum at point 'C'

470 **(c)**

Given, $v = pt$

$$\int_0^X dx = p \int_0^2 t \, dt$$

$$= \frac{pt^2}{2} = \frac{4 \times 4}{2} = 8\text{m}$$

471 **(d)**

Average velocity $= \frac{Total\ Displacement}{Time\ taken} = \frac{25}{75/15} =$ $5 m/s$

472 **(a)**

$$h_{\max} = \frac{u^2}{2g} = \frac{(15)^2}{2 \times 10} = 11.25 m$$

473 **(b)**

Between time interval 20 *sec* to 40 *sec*, there is non-zero acceleration and retardation. Hence distance travelled during this interval

= Area between time interval 20 *sec* to 40 *sec*

$= \frac{1}{2} \times 20 \times 3 + 20 \times 1 = 30 + 20 = 50 \; m$

474 **(b)**

Since acceleration is constant, therefore there is uniform increase in velocity. So, the $v - t$ graph is a straight line slopping upward to the right. When acceleration becomes zero, velocity is constant. So $v - t$ graph is a straight line parallel to the time-axis.

475 **(b)**

Let 'a' be the retardation of boggy then distance covered by it be S. If u is the initial velocity of boggy after detaching from train ($i.e.$ uniform speed of train)

$v^2 = u^2 + 2as \Rightarrow 0 = u^2 - 2as \Rightarrow s_b = \frac{u^2}{2a}$

Time taken by boggy to stop

$v = u + at \Rightarrow 0 = u - at \Rightarrow t = \frac{u}{a}$

In this time t distance travelled by train $= s_t = ut = \frac{u^2}{a}$

Hence ratio $\frac{s_b}{s_1} = \frac{1}{2}$

476 **(a)**

Horizontal velocity of dropped packet $= u$

Vertical velocity $= \sqrt{2gh}$

$\therefore$ Resultant velocity at earth $= \sqrt{u^2 + 2gh}$

477 **(d)**

Let the body be projected upwards with velocity u from top of tower. Taking vertical downward motion of boy form top of tower to ground, we have

$u = -u, a = g = 10\text{ms}^{-2}, s = 50\text{m}, t = 10\text{s}$

As $s = ut + \frac{1}{2}at^2$,

So, $50 = -u \times 10 + \frac{1}{2} \times 10 \times 10^2$

On solving $u = 45 \text{ms}^{-1}$

If t_1 and t_2 are the timings taken by the ball to reach points A and B respectively, then

$20 = 45t_1 + \frac{1}{2} \times 10 \times t_1^2$

and $40 = -45t_2 + \frac{1}{2} \times 10 \times t_2^2$

On solving, we get $t_1 = 9.4$ s and $t_2 = 9.8$s

Time taken to cover the distance AB

$= (t_2 - t_1) = 9.8 = 9.4 = 0.4$s.

478 **(c)**

Let the ball be at height h at time t and time $(t + \Delta t)$.

Then,

$h = ut - \frac{1}{2}gt^2$ ....(i)

and $h = u(t + \Delta t) - \frac{1}{2}g(t - \Delta t)^2$ ...(ii)

Equating Eqs. (i) and (ii), we get

$t = \frac{2u - g\Delta t}{2g}$ ....(iii)

Substituting Eq. (iii) in Eq. (i), we get

$h = \frac{4u^2 - g^2(\Delta t)^2}{8g}$

$\Rightarrow u = \frac{1}{2}\sqrt{8gh + g^2(\Delta t)^2}$

479 **(d)**

Velocity of particle $= \frac{\text{Total displacement}}{\text{Total time}}$

$= \frac{\text{Diameter of circle}}{5} = \frac{2 \times 10}{5} = 4\ m/s$

480 **(d)**

$\Delta t = \sqrt{\frac{2 \times 12}{10}} - \sqrt{\frac{2 \times 10}{10}}$

$= 1.549\text{s} - 1.414\text{s} = 0.135\text{s}$

481 **(a)**

$t = \sqrt{\frac{2 \times 44.1}{9.8}}\text{s} = \sqrt{9}\text{s} = 3\text{s}$,

$44.1 = v \times 2 + \frac{1}{2} \times 9.8 \times 2 \times 2$

or $2v = 44.1 - 4.9 \times 4 = 24.5$

or $v = \frac{24.5}{2}\text{ms}^{-1} = 12.25\text{ms}^{-1}$

482 **(a)**

Here, $u = 0, a = g$

Distance travelled in n^{th} second is given by

$D_n = u + \frac{a}{2}(2n - 1)$ $\therefore D_n \propto (2n - 1)$

$\therefore D_1 : D_2 : D_3 : D_4 : D_5 \ldots = 1 : 3 : 5 : 7 : 9 : \ldots$

483 **(d)**

$s = 3t^3 + 7t^2 + 14t + 8m$

$a = \frac{d^2s}{dt^2} = 18t + 14$ at $t = 1$ sec $\Rightarrow a = 32\ m/s^2$

484 **(b)**

For stone to be dropped from rising balloon of velocity 29 m/s

$u = -29\ m/s, t = 10 sec$

$\therefore h = -29 \times 10 + \frac{1}{2} \times 9.8 \times 100$

$= -290 + 490 = 200\ m$

485 **(a)**

Distance travelled in 4 sec

$24 = 4u + \frac{1}{2}\alpha \times 16$ ... (i)

Distance travelled in 8 sec

$88 = 8u + \frac{1}{2}\alpha \times 64$ ... (ii)

After solving (i) and (ii), we get $u = 1 m/s$

486 **(c)**

From acceleration time graph, acceleration is constant for first part of motion so, for this part velocity of body increases uniformly with time and as $a = 0$ then the velocity becomes constant. Then again increased because of acceleration

487 **(c)**

$h = ut + \frac{1}{2}gt^2 \Rightarrow 1 = 0 \times t_1 + \frac{1}{2}gt_1^2 \Rightarrow t_1$

$= \sqrt{2/g}$

Velocity after travelling 1 m distance

$v^2 = u^2 + 2gh \Rightarrow v^2 = (0)^2 + 2g \times 1 \Rightarrow v = \sqrt{2g}$

For second 1 m distance

$1 = \sqrt{2g} \times t_2 + \frac{1}{2}gt_2^2 \Rightarrow gt_2^2 + 2\sqrt{2g}t_2 - 2 = 0$

$t_2 = \frac{-2\sqrt{2g} \pm \sqrt{8g + 8g}}{2g} = \frac{-\sqrt{2} \pm 2}{\sqrt{g}}$

Taking +ve sign $t_2 = (2 - \sqrt{2})/\sqrt{g}$

$\therefore \frac{t_1}{t_2} = \frac{\sqrt{2/g}}{(2-\sqrt{2})/\sqrt{g}} = \frac{1}{\sqrt{2}-1}$ and so on

488 **(b)**

$x = 4(t - 2) + a(t - 2)^2$

At $t = 0, x = -8 + 4a = 4a - 8$

$v = \frac{dx}{dt} = 4 + 2a(t - 2)$

At $t = 0, v = 4 - 4a = 4(1 - a)$

But acceleration, $a = \frac{d^2x}{dt^2} = 2a$

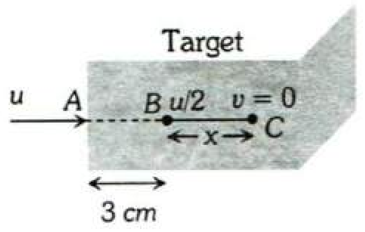
489 **(d)**

$\frac{v_A}{v_B} = \frac{\tan 30°}{\tan 60°} = \frac{1}{\sqrt{3}} \times \frac{1}{\sqrt{3}} = \frac{1}{3}$

490 **(b)**

Let initial velocity of the bullet $= u$

After penetrating 3 cm its velocity becomes $\frac{u}{2}$



From $v^2 = u^2 - 2as$

$\left(\frac{u}{2}\right)^2 = u^2 - 2a(3)$

$\Rightarrow 6a = \frac{3u^2}{4} \Rightarrow a = \frac{u^2}{8}$

Let further it will penetrate through distance x and stops at point C

For distance $BC, v = 0, u = u/2, s = x, a = u^2/8$

For $v^2 = u^2 - 2as \Rightarrow 0 = \left(\frac{u}{2}\right)^2 - 2\left(\frac{u^2}{8}\right).x \Rightarrow x = 1\ cm$

491 **(c)**

$h_{n^{th}} = u - \frac{g}{2}(2n - 1)$

$h_{5^{th}} = u - \frac{10}{2}(2 \times 5 - 1) = u - 45$

$h_{6^{th}} = u - \frac{10}{2}(2 \times 6 - 1) = u - 55$

Given $h_{5^{th}} = 2 \times h_{6^{th}}$. By solving we get $u = 65\ m/s$

492 **(c)**

A body is moving on a straight line with constant velocity. Between A and B, the straight line is the shortest distance. This is the distance travelled. The particle starts at A and reaches B along the straight line. Therefore displacement is also $AB, D = S$

A ―――――― B

493 **(c)**

$s = ut + \frac{1}{2}at^2$

For Ist body

$u = 0$ and $a = g$ [freely falling body]

Distance covered in 2 s,

$s_1 = 0 + \frac{1}{2}g(3)^2$

For IInd body

Distance covered in 2 s,

$s_2 = 0 + \frac{1}{2}g(2)^2$

$\therefore\ s_1 - s_2 = \frac{1}{2}g[(3)^2 - (2)^2]$

$= \frac{1}{2}g(9 - 4) = 25\ \text{m}$

494 **(d)**

$v = \frac{ds}{dt} = 3t^2 - 12t + 3$ and $a = \frac{dv}{dt} = 6t - 12$

For $a = 0$, we have $t = 2$ and at $t = 2, v = -9\ ms^{-1}$

495 **(d)**

For a stone which is thrown downwards from a balloon rising upwards, the equation of motion is

$$h = -ut + \frac{1}{2}gt^2$$

$$= -29 \times 10 + \frac{1}{2} \times 9.8 \times (10)^2$$

$$= -290 + 490 = 200\ \text{m}$$

496 **(d)**

At the point A, the tangent to the curve is parallel to time axis. So, velocity at A is zero. But acceleration is not zero. Note that the displacement corresponding to the point A is not zero.

497 **(a)**

From equation of motion, we have

$$h = ut + \frac{1}{2}gt^2$$

taking upward direction as negative and downward direction as positive, we have

$h = 65$ m,

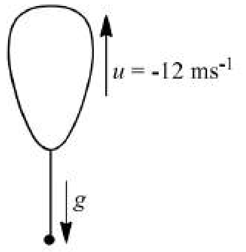
$u = -12\ \text{ms}^{-1}$ and $g = 10\ \text{ms}^{-2}$

$\therefore\quad 65 = -12t + \frac{1}{2} \times 10 \times t^2$

$\therefore\quad 5t^2 - 12t - 65 = 0$

$\Rightarrow\quad (t - 5)(5t + 13) = 0$

$\therefore\quad t = 5\ \text{s}$



498 **(b)**

Let two balls meet at depth h from platform

So $h = \frac{1}{2}g(18)^2 = v(12) + \frac{1}{2}g(12)^2 \Rightarrow v = 75\ ms^{-1}$

499 **(a)**

$\because a = \frac{dv}{dt} = 2(t-1) \Rightarrow dv = 2(t-1)dt$

$$\Rightarrow v = \int_0^5 2(t-1)dt = 2\left[\frac{t^2}{2} - t\right]_0^5 = 2\left[\frac{25}{2} - 5\right]$$

$$= 15\ m/s$$

500 **(c)**

Instantaneous velocity of running mass after t sec will be

$$v_t = \sqrt{v_x^2 + v_y^2}$$

Where, $v_x = v\sin\theta - gt$ = vertical component of velocity,

$v_y = v\cos\theta$ =horizontal component of velocity

$$v_t = \sqrt{(v\cos\theta)^2 + (v\sin\theta - gt)^2}$$

$$v_t = \sqrt{v^2 + g^2t^2 - 2v\sin\theta\, gt}$$

501 **(b)**

$x = a + bt^2, v = \frac{dx}{dt} = 2bt$

Instantaneous velocity $v = 2 \times 3 \times 3 = 18\ cm/sec$

502 **(c)**

Since, body has uniform acceleration. So, velocity of particle is increasing with time. Hence, this is displacement-time graph with X as time axis and Y as displacement axis.

503 **(a)**

$$t = \sqrt{\frac{2h}{g}} \Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$$

504 **(d)**

$\because v = 0 + na \Rightarrow a = v/n$

Now, distance travelled in n sec.$\Rightarrow S_n = \frac{1}{2}an^2$ and distance travelled in $(n-2)sec \Rightarrow S_{n-2} = \frac{1}{2}a(n-2)^2$

$\therefore$ Distance travelled in last 2 seconds,

$= S_n - S_{n-2} = \frac{1}{2}an^2 - \frac{1}{2}a(n-2)^2$

$\frac{a}{2}[n^2 - (n-2)^2] = \frac{a}{2}[n + (n-2)][n - (n-2)]$

$$= a(2n-2) = \frac{v}{n}(2n-2) = \frac{2v(n-1)}{n}$$

505 **(a)**

$x^2 = at^2 + 2bt + c$

Differentiating w.r.t. time, we get

$2x\frac{dx}{dt} = 2at + 2b$ or $xv = at + b$ or $v = \frac{at+b}{x}$

Again differentiating w.r.t. time, we get

$x\frac{dx}{dt} + v\frac{dx}{dt} = a$

or $xA + v^2 = a$ or $xA = a - v^2$

or $xA = a - \left(\frac{at+b}{x}\right)^2$ or $xA = \frac{ax^2 - a^2t^2 - b^2 - 2abt}{x^2}$

or $xA = \frac{a^2t^2 + 2abt + ac - a^2t^2 - b^2 - 2abt}{x^2}$

or $A = \frac{ac - b^2}{x^3}$ or $A \propto x^{-3}$

506 **(b)**

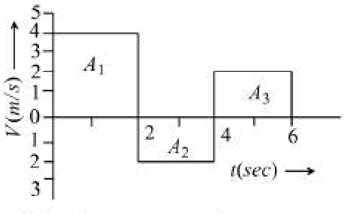
Time average velocity $= \frac{v_1 + v_2 + v_3}{3} = \frac{3+4+5}{3} = 4m/s$

507 **(a)**

Displacement = Summation of all the area with sign

$= (A_1) + (-A_2) + (A_3)$

$= (2 \times 4) + (-2 \times 2) + (2 \times 2)$



$\therefore$ Displacement $= 8\ m$

Distance = Summation of all the areas without sign

$= |A_1| + |-A_2| + |A_3| = |8| + |-4| + |4|$

$= 8 + 4 + 4$

$\therefore$ Distance $= 16\ m$

508 **(b)**

$v^2 = u^2 + 2gh \Rightarrow (3u)^2 = (-u)^2 + 2gh \Rightarrow h = \frac{4u^2}{g}$

509 **(b)**

$$\text{Time} = \frac{\text{Total length}}{\text{Relative velocity}} = \frac{50+50}{10+15} = \frac{100}{25}$$
$$= 4\,sec$$

510 **(c)**

For first projectile, $h_1 = ut - \frac{1}{2}gt^2$

For second projectile, $h_2 = u(t-T) - \frac{1}{2}g(t-T)^2$

When both meet i.e. $h_1 = h_2$

$$ut - \frac{1}{2}gt^2 = u(t-T) - \frac{1}{2}g(t-T)^2$$

$$\Rightarrow uT + \frac{1}{2}gT^2 = gtT \Rightarrow t = \frac{u}{g} + \frac{T}{2}$$

and $h_1 = u\left(\frac{u}{g} + \frac{T}{2}\right) - \frac{1}{2}g\left(\frac{u}{g} + \frac{T}{2}\right)^2$

$$= \frac{u^2}{2g} - \frac{gT^2}{8}$$

511 **(b)**

$v = u + at \Rightarrow -2 = 10 + a \times 4 \Rightarrow a$
$= -3m/sec^2$

512 **(c)**

$\therefore x = a\cos\omega t$

$\therefore v = \frac{dx}{dt} = -a\omega \sin \omega t$

The instantaneous speed is given by modulus of instantaneous velocity.

$\therefore$ speed$= |u| = |-a\omega \sin \omega t|$

Hence, (c) is correct.

513 **(b)**

Maximum acceleration will be represented by CD part of the graph

Acceleration $= \frac{dv}{dt} = \frac{(60-20)}{0.25} = 160\ km/h^2$

514 **(a)**

$$S_{3rd} = 10 + \frac{10}{2}(2 \times 3 - 1) = 35$$

$$S_{2nd} = 10 + \frac{10}{2}(2 \times 2 - 1) = 25$$

$$\therefore \frac{S_{3rd}}{S_{2nd}} = \frac{35}{25}\ ie = \frac{7}{5}$$

515 **(c)**

If the body starts from rest and moves with constant acceleration then the ratio of distances in consecutive equal time interval $S_1 : S_2 : S_3 = 1 : 3 : 5$

516 **(d)**

Area between $v - t$ graph and time-axis

$$= \frac{1}{2} \times 2 \times 20 + 3 \times 20 + \frac{1}{2} \times 1 \times 20 + \frac{1}{2} \times 1 \times 20$$

$= 100$ m.

517 **(c)**

Given, $s = t^3 - 6t^2 + 3t + 4$

Velocity $v = \frac{ds}{dt} = 3t^2 - 12t + 3$ ... (i)

Acceleration $a = \frac{dv}{dt} = 6t - 12$ ... (ii)

Since, acceleration is zero, so, $6t - 12 = 0$, or $t = 2$ s

So, velocity v at

$t = 2$ s, is $= 3 \times 2^2 - 12 \times 2 + 3 = -9\ \text{ms}^{-1}$

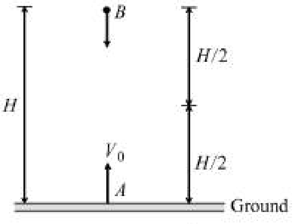
518 **(b)**

Maximum acceleration will be represented by CD part of the graph

Acceleration $= \frac{dv}{dt} = \frac{(60-20)}{0.25} = 160\ km/h^2$

519 **(b)**

Let the two bodies A and B respectively meet at a time t, at a height $\frac{H}{2}$ from the ground



Using $S = ut + \frac{1}{2}at^2$

For a body $A, u = V_0, a = -g, S = \frac{H}{2}$

$\therefore \frac{H}{2} = V_0 t - \frac{1}{2}gt^2$ ...(i)

For body $B, u = 0, a = +g, S = \frac{H}{2}$

$\therefore \frac{H}{2} = \frac{1}{2}gt^2$ ...(ii)

Equating equations (i) and (ii), we get

$V_0 t - \frac{1}{2}gt^2 = \frac{1}{2}gt^2 \Rightarrow V_0 t = gt^2$ or $t = \frac{V_0}{g}$

Substituting the value of t in equation (i), we get

$$\frac{H}{2} = V_0 \times \left(\frac{V_0}{g}\right) - \frac{1}{2}g\left(\frac{V_0}{g}\right)^2 = \frac{V_0^2}{g} - \frac{1}{2}\frac{V_0^2}{g}$$

$\frac{H}{2} = \frac{1}{2}\frac{V_0^2}{g}$ or $V_0^2 = gH \Rightarrow V_0 = \sqrt{gH}$

520 **(c)**

Displacement $x = at + bt^2 - ct^3$

Velocity, $v = \frac{dx}{dt} = a + 2bt - 3ct^2$ ... (i)

And acceleration, $a = \frac{a^2x}{dt^2} = 2b - 6ct$ ... (ii)

When acceleration $a = 0, t = \frac{b}{3c}$

Substituting the value of t in Eq. (i), we get

$$v = a + \frac{b^2}{3c}$$

521 **(c)**

If a stone is dropped from height h then

$h = \frac{1}{2}gt^2$ ...(i)

if a stone is thrown upward with velocity u then

$h = -u\,t_1 + \frac{1}{2}gt_1^2$ ...(ii)

If a stone is thrown downward with velocity u then

$h = ut_2 + \frac{1}{2}gt_2^2$ ...(iii)

From (i) (ii) and (iii) we get

$-ut_1 + \frac{1}{2}gt_1^2 = \frac{1}{2}gt^2$ ...(iv)

$ut_2 + \frac{1}{2}gt_2^2 = \frac{1}{2}gt^2$ ...(v)

Dividing (iv) and (v) we get

$$\therefore \frac{-ut_1}{ut_2} = \frac{\frac{1}{2}g(t^2 - t_1^2)}{\frac{1}{2}g(t^2 - t_2^2)}$$

Or $-\frac{t_1}{t_2} = \frac{t^2 - t_1^2}{t^2 - t_2^2}$

By solving $t = \sqrt{t_1 t_2}$

522 **(a)**

For upstream motion, kmh^{-1}=5kmh^{-1}

For downstream motion,

$v = (8+3)\text{kmh}^{-1} = 11\text{kmh}^{-1}$

523 **(d)**

$$40^2 - 30^2 = 2aS, v^2 - 30^2 = 2a\frac{S}{2}$$

or $2(v^2 - 30^2) = 2aS$

Comparing, $2(v^2 - 900) = 1600 - 900 = 700$

or $v^2 = 900 + 350 = 1250$ or $v = 35.35\ \text{kmh}^{-1}$

524 **(d)**

$u = 72\ kmph = 20\ m/s, v = 0$

By using $v^2 = u^2 - 2as \Rightarrow a = \frac{u^2}{2s} = \frac{(20)^2}{2\times 200} = 1\ m/s^2$

525 **(a)**

The portion OA of the graphs is convex upward. It represents negative acceleration. The portion AB represents negative acceleration. The portion AB represents that x is not changing with time. Clearly, it is a case of zero acceleration. The portion BC of the graph is concave upward. It represents positive acceleration. The portion CD is a straight line sloping upward to the right. It represents uniform velocity and hence acceleration is zero

526 **(b)**

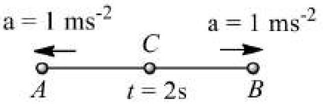
$\therefore v = |t - 2|\text{ms}^{-1}$

$v = t - 2$, when $t > 2s$

$v = 2 - t$, when $t < 2s$

$\therefore a = \frac{dv}{dt} = 1\text{ms}^{-1}$ when $t > 2s$

$a = -1\text{ms}^{-1}$ when $t < 2\text{s}$



In the direction of motion from A to C, bee decelerates but for C to B, bee accelerates.

Let $AC = s_1, BC = s_2$

$u_A = 2\text{ms}^{-1}, t = 0$

$u_c = 0$ at $t = 4\text{s}$

$$\therefore s_1 = \left(\frac{u_A + u_C}{2}\right)t_1$$

$$s_2 = \left(\frac{u_C + u_B}{2}\right)t_2$$

$\therefore s = s_1 + s_2 = \left(\frac{2+0}{2}\right)2 + \left(\frac{0+2}{2}\right)2 = 4\text{m}$

527 **(c)**

Slope is negative at the point E.

528 **(d)**

$$\int_{v_0}^{v} \frac{dv}{kv^3} = \int_0^t dt$$

$-\frac{1}{k}\int_{v_0}^{v} v^{-3}dv = t$ or $-\frac{1}{k}\left|\frac{v^{-3+1}}{-3+1}\right|_{v_0}^{v} = t$

or $\frac{1}{2k}\left[\frac{1}{v^2} - \frac{1}{v_0^2}\right] = t$ or $\frac{1}{v^2} - \frac{1}{v_0^2} = 2kt$

or $\frac{1}{v^2} = \frac{1}{v_0^2} + 2kt$ or $\frac{1}{v^2} = \frac{1+2v_0^2kt}{v_0^2}$

or $v = \frac{v_0}{\sqrt{2v_0^2kt+1}}$

529 **(a)**

$\mathbf{r} = x\hat{\mathbf{i}} + y\hat{\mathbf{j}} + z\hat{\mathbf{k}}$

$$\therefore \mathbf{r} = \sqrt{x^2 + y^2 + z^2}$$

$$\mathbf{r} = \sqrt{6^2 + 8^2 + 10^2} = 10\sqrt{2}\text{m}$$

530 **(d)**

$$v = \sqrt{49 + y}, a = \frac{dv}{dy}.\frac{dy}{dt} = v\frac{dv}{dy}$$

$= (49 + y)^{1/2} \times \frac{1}{2}(49 + y)^{1/2-1} = \frac{1}{2}\text{ms}^{-2}$

531 **(a)**

When two particles moves towards each other then

$v_1 - v_2 = 6$ ...(i)

When these particles moves in the same direction then

$v_1 - v_2 = 4$ ...(ii)

By solving $v_1 = 5$ and $v_2 = 1\ m/s$

532 **(d)**

In 's-t' graph (positive -time)

The straight line parallel with time axis represent state of rest

533 **(a)**

$H_{max} \propto u^2 \therefore u \propto \sqrt{H_{max}}$

$i.e.$ to triple the maximum height, ball should be thrown with velocity $\sqrt{3}\,u$

534 **(c)**

For first case $v^2 - 0^2 = 2gh \Rightarrow (3)^2 = 2gh$

For second case $v^2 = (-u)^2 + 2gh = 4^2 + 3^2 \therefore$

$v = 5km/h$

535 **(c)**

Let man will catch the bus after 't' sec. So he will cover distance ut

Similarly distance travelled by the bus will be $\frac{1}{2}at^2$

For the given condition

$u\,t = 45 + \frac{1}{2}a\,t^2 = 45 + 1.25t^2$ [As $a = 2.5\ m/s^2$]

$\Rightarrow u = \frac{45}{t} + 1.25t$

To find the minimum value of u

$\frac{du}{dt} = 0$ sp we get $t = 6\ sec$ then,

$u = \frac{45}{6} + 1.25 \times 6 = 7.5 + 7.5 = 15\ m/s$

536 **(a)**

From the equation of motion

$$S = ut + \frac{1}{2}\,at^2$$

$$S_1 = 0 + \frac{1}{2}\,a(P-1)^2$$

And $S_2 = 0 + \frac{1}{2}\,aP^2$

From $S_n = u + \frac{a}{2}(2n-1)$

$$S_{(P^2-P+1)^{th}} = \frac{a}{2}[2(P^2 - P + 1) - 1]$$

$$= \frac{a}{2}[2P^2 - 2P + 1] = S_1 + S_2$$

537 **(d)**

Time of flight $T = \frac{2u}{g} 4\text{ sec} \Rightarrow u = 20\ m/s$

538 **(c)**

$h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{2h/g}$

$t_a = \sqrt{\frac{2a}{g}}$ and $t_b = \sqrt{\frac{2b}{g}} \Rightarrow \frac{t_a}{t_b} = \sqrt{\frac{a}{b}}$

539 **(c)**

For upward motion

Effective acceleration $= -(g+a)$

And for downward motion

Effective acceleration $= (g-a)$

But both are constants. So the slope of speed-time graph will be constant

540 **(b)**

$$H_{max} = \frac{u^2}{2g} = \frac{19.6 \times 19.6}{2 \times 9.8} = 19.6\ m$$

541 **(a)**

$$v = \frac{dx}{dt} = \frac{d}{dt}\left[\frac{k}{b}\left(1 - e^{-bt}\right)\right] = \frac{k}{b}[0 - (-b)e^{-bt}]$$

$$= ke^{-bt}$$

542 **(b)**

$$v = u + at = u + \left(\frac{F}{m}\right)t = 20 + \left(\frac{100}{5}\right) \times 10$$

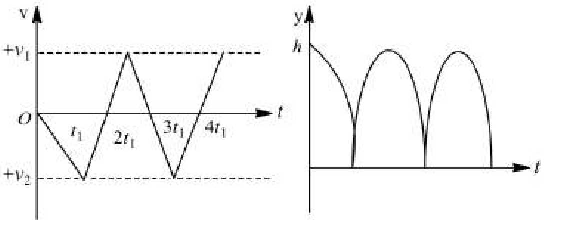
$$= 220\ m/s$$

543 **(c)**

$h = \frac{1}{2}\text{g}t^2$, (parabolic)

$v = -\text{g}t$and after the collision, $v = \text{g}t$ (straight line)

Collision is perfectly elastic then ball reaches to same height again and again with same velocity



545 **(d)**

Displacement (in magnitude)

$= \frac{1}{2}\left(3 \times 2 - \frac{1}{2} \times 1 \times 2 + 1 \times 1\right)$m=3m

546 **(d)**

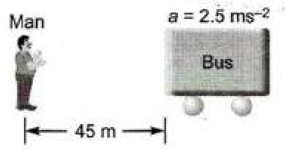
$h = ut - \frac{1}{2}gt^2$

$= 10 \times 1 - \frac{1}{2} \times 10 \times 1$

$= 10 - 5 = 5m$

547 **(c)**

In order that the man catches the bus, let his minimum velocity be v, then from equation of motion.



$v^2 = u^2 + 2as$

We have, $u = 0, a = 2.5\ \text{ms}^{-2}, s = 45$ m

$\therefore \quad v^2 = 2 \times 2.5 \times 45$

$\Rightarrow \quad v = \sqrt{225} = 15\ \text{ms}^{-1}$

548 **(a)**

$S_n = u + \frac{a}{2}[2n - 1]$

$S_{5^{th}} = 7 + \frac{4}{2}[2 \times 5 - 1] = 7 + 18 = 25m$

549 **(c)**

Maximum height of ball $= 5\ m$

So velocity of projection $\Rightarrow u = \sqrt{2gh} = 10\ m/s$

Time interval between two balls (time of ascent)

$= \frac{u}{g} = 1\ sec = \frac{1}{60}\ min$

So number of ball thrown per min = 60

550 **(a)**

$9y = \frac{1}{2} \times 10 \times 3 \times 3$ or $y = 5$m

Again, $n \times 5 = \frac{1}{2} \times 10 \times 1 \times 1 = 5$ or $n = 1$

551 **(a)**

$t = \sqrt{\frac{2h}{g}} \Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} = \sqrt{\frac{1}{2}} = \frac{1}{\sqrt{2}}$

552 **(c)**

$v_{av} = \frac{2v_1 v_2}{v_1 + v_2} = \frac{2 \times 40 \times 60}{100} = 48\ kmph$

553 **(a)**

$v = \sqrt{3x + 16}$ or $v^2 = 3x + 16$ or $v^2 - 16 = 3x$

Comparing with $v^2 - u^2 = 2aS$, we get, $u = 4$ units , $2a = 3$

or $a = 1.5$ units.

554 **(b)**

$\int_0^x dx = \int_0^1 (v_0 + gt + ft^2)dt$

$x = v_0 + g\left(\frac{1}{2}\right) + f\left(\frac{1}{3}\right)$

555 **(b)**

$v = g \times t = 32 \times 1 = 32 ft/sec$

556 **(b)**

Average speed is the ratio of distance to time taken

Distance travelled from 0 to $5s = 40\ m$

Distance travelled from 5 to $10s = 0\ m$

Distance travelled from 10 to $15s = 60\ m$

Distance travelled from 15to $20s = 20$

So, total distance $= 40 + 0 + 60 + 20 = 120\ m$

Total time taken = 20 *minutes*

Hence, average speed

$= \frac{\text{distance travelled } (m)}{\text{time (min)}} = \frac{120}{20} = 6\ m/min$

557 **(a)**

Here, $u = 0, a = g$

Distance travelled in n^{th} second is given by

$D_n = u + \frac{a}{2}(2n - 1) \ \therefore D_n \propto (2n - 1)$

$\therefore D_1 : D_2 : D_3 : D_4 : D_5 \ldots = 1 : 3 : 5 : 7 : 9 : \ldots$

558 **(c)**

Given, $\quad v = (180 - 16x)^{1/2}$

Or $\quad v^2 = 180 - 16x$

Differentiating with respect to t, we get

$$2v\frac{dv}{dt} = 0 - 16\frac{dx}{dt}$$

$$2v\frac{dv}{dt} = -16v$$

$$\Rightarrow \quad \frac{dv}{dt} = -8$$

Hence, particle decelerates at the rate of 8 ms^{-2}.

559 **(a)**

$S_n = u + \frac{a}{2}[2n - 1]$

$S_{5^{th}} = 7 + \frac{4}{2}[2 \times 5 - 1] = 7 + 18 = 25m$

560 **(c)**

$$v^2 = u^2 + 2as$$

$$0 = \left(50 \times \frac{5}{18}\right)^2 + 2a \times 6$$

$$a = -16\ \text{ms}^{-2} \qquad (a = \text{retardation})$$

Again, $\quad v^2 = u^2 + 2as$

$$0 = \left(100 \times \frac{5}{18}\right)^2 - 16 \times 2 \times s$$

$$s = \frac{(100 \times 5)^2}{18 \times 18 \times 32} = 24.1 \approx 24\ \text{m}$$

561 **(c)**

$S_n = \frac{1}{2} g\cos\theta\,(2n-1), S_{n+1}$

$= \frac{1}{2} g\cos\theta\,\{2(n+1)-1\}$

$\frac{S_n}{S_{n+1}} = \frac{2n-1}{2n+1}$

562 **(c)**

$v = \frac{\text{Total distance}}{\text{Time taken}} = \frac{x}{\frac{x/3}{v} + \frac{x/3}{3v} + \frac{x/3}{2v} + \frac{18}{11}v}$

564 **(d)**

Slope of displacement time graph is negative only at point time E

565 **(d)**

Let the man will be able to catch the bus after t s

Then

$10t = 48 + \frac{1}{2} \times 1 \times t^2$

$t^2 - 20t + 96 = 0$

$(t-12)(t-8) = 0$

$t = 8s$ and $t = 12s$

Thus the man will be able to catch the bus after $8s$

566 **(a)**

$v_1 - v_2 = at$

or $t = \frac{v_1 - v_2}{a}$.

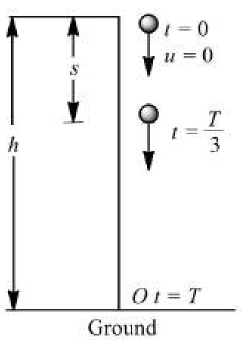
567 **(c)**

Second law of motion gives

$$h = ut + \frac{1}{2} gT^2$$

or $h = 0 + \frac{1}{2} gT^2 \quad (\because u = 0)$

$\therefore \quad T = \sqrt{\left(\frac{2h}{g}\right)}$



At $\quad t = \frac{T}{3}$s,

$$s = 0 + \frac{1}{2} g \left(\frac{T}{3}\right)^2$$

Or $\quad s = \frac{1}{2} g . \frac{T^2}{9}$

Or $\quad s = \frac{g}{18} \times \frac{2h}{g} \qquad \left(\because T = \sqrt{\frac{2h}{g}}\right)$

$\therefore \quad s = \frac{h}{9}$m

Hence, the position of ball from the ground

$$= h - \frac{h}{9} = \frac{8h}{9} \text{m}.$$

568 **(c)**

Displacement of the particle will be zero because it comes back to its starting point

Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{30m}{10sec}$

$= 3\ m/s$

569 **(a)**

We know that the velocity of body is given by the slope of displacement – time graph so it is clear that initially slope of the graph is positive and after some time it becomes zero (corresponding to the peak of graph) and it will become negative

570 **(d)**

Slope of line $= -\frac{2}{3}$

Equation of line is $(v - 20) = -\frac{2}{3}(s - 0)$

$\Rightarrow v = 20 - \frac{2}{3}s \quad$ ...(i)

Velocity at $s = 15m$ *ie*,

$v = \frac{ds}{dt}\Big|_{s=15\text{m}} = 20 - \frac{2}{3}(15) = 10\text{ms}^{-1}$

Differentiate Eq. (i) with respect to time,

acceleration $= \frac{dv}{dt} = \frac{2}{3}\frac{ds}{dt}$

$\therefore \frac{dv}{dt}\Big|_{s=15\text{m}} = -\frac{2}{3}\frac{ds}{dt}\Big|_{s=15\text{m}} = -\frac{20}{3}\text{ms}^{-2}$

571 **(b)**

Let u be the initial upward velocity of the ball from A and let h be the height of the tower.

Taking the downward motion of the first stone from A to the ground, we have

$h = -ut_1 + \frac{1}{2}gt_1^2 \quad$ ...(i)

Taking the downward motion of the second stone from A to the ground, we have

$h = ut_2 + \frac{1}{2}gt_2^2 \quad$ ...(ii)

Multiplying Eq.(i) t_2 and Eq. (ii) by t_1 and adding we get

$h(t_1 + t_2) = \frac{1}{2}gt_1t_2(t_1 + t_2)$

So, $h = \frac{1}{2}gt_1t_2 \quad$ ...(iii)

For falls under gravity from the top of the tower

$h = \frac{1}{2} g t_3^2$ ...(iv)

From Eqs. (iii) and (iv), $t_3^2 = t_1 t_2$ or $t_3 = \sqrt{t_1 t_2}$

$= \sqrt{6 \times 4} = 6$ s

572 **(c)**

Since direction of v is opposite to the direction of g and h so from equation of motion

$$h = -vt + \frac{1}{2} g t^2 \Rightarrow g t^2 - 2vt - 2h = 0$$

$$\Rightarrow t = \frac{2v \pm \sqrt{4v^2 + 8gh}}{2g} \Rightarrow t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$$

573 **(c)**

$y = a + bt + ct^2 - dt^4$

$\therefore v = \frac{dy}{dt} = b + 2ct - 4dt^3$ and $a = \frac{dv}{dt} = 2c - 12dt^2$

Hence, at $t = 0$, $v_{\text{initial}} = b$ and $a_{\text{initial}} = 2c$

574 **(b)**

Power, $P = \frac{W}{t}$

$P = \frac{Fs}{t}, P = \frac{mas}{t}$ $(\because F = ma)$

$P = \frac{mv\,s}{t^2}$, $\left(\because a = \frac{v}{t}\right)$

$P = \frac{ms \cdot s}{t^3}$ $\left(\because v = \frac{s}{t}\right)$

$Pt^2 = ms^3$

$\therefore s \propto t^{3/2}$

575 **(b)**

Relative velocity of bird $w.r.t.$ train $= 25 + 5 = 30\ m/s$

Time taken by the bird to cross the train $t = \frac{210}{30} = 7\ sec$

577 **(b)**

$$t = \sqrt{\frac{2h}{g}} \Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}}$$

578 **(c)**

Time taken by the body to reach the point A is t_1 (During upward journey).

The body crosses this point again (during downward journey) after t_2, ie, the body takes the time $(t_2 - t_1)$ to come again at point A.

So, the time taken by the body to reach at point B (a maximum height).

$$t = t_1\left(\frac{t_2 - t_1}{2}\right)$$

[$\because$ Time pf ascending = Time of descending]

$$t = \frac{t_1 + t_2}{2}$$

So, maximum height $H = \frac{1}{2}\,gt^2$

$$= \frac{1}{2} g\left(\frac{t_1 + t_2}{2}\right)^2$$

$$= 2g\left(\frac{t_1 + t_2}{4}\right)^2$$

579 **(b)**

$v = u + at$ As $u = 0, v = at$

The graph (b) is correct as $v = 0$ at $t = 0$, and in the straight line graph $y = mx, y = v, m = a$ and $t = x$

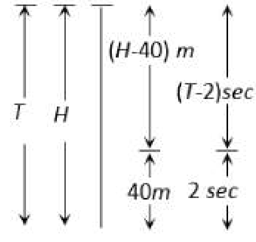
580 **(c)**

$v^2 = u^2 + 2as$, If $u = 0$, then $v^2 \propto S$

$i.e.$, Graph should be parabola symmetric to displacement axis

581 **(b)**

Let height of minaret is H and body take time T to fall from top to bottom



$H = \frac{1}{2} g T^2$ ...(i)

In last 2 sec body travels distance of 40 m so in $(T - 2)$ sec distance travelled $= (H - 40)m$

$(H - 40) = \frac{1}{2} g (T - 2)^2$ ...(ii)

By solving (i) and (ii), $T = 3\ sec$ and $H = 45m$

582 **(b)**

Distance travelled by train in first 1 $hour$ is 60 km and distance in next 1/2 hour is 20 km.

So Average speed $= \frac{\text{Total distance}}{\text{Total time}} = \frac{60+20}{3/2}$

$= 53.33\ km/hour$

583 **(b)**

$$h_n = \frac{g}{2}(2n - 1) \Rightarrow h_{5\text{th}} = \frac{10}{2}(2 \times 5 - 1) = 45\ m$$

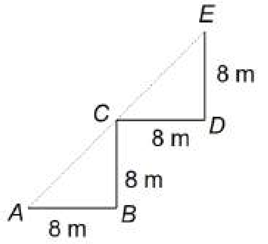
584 **(c)**

This person cannot walk straight more than 10 steps.

Distance covered in 10 steps

$= 10 \times 0.8 = 8$m

As the person has to turn after every 10 steps, the only way to have maximum displacement is walk as shown in the figure.



The maximum displacement $= AE = AC + CE$

$= 8\sqrt{2} + 8\sqrt{2} = 16\sqrt{2}\text{m}$

585 **(b)**

Time taken by first drop to reach the ground $t = \sqrt{\frac{2h}{g}} \Rightarrow t = \sqrt{\frac{2\times5}{10}} = 1\text{ sec}$

As the water drops fall at regular intervals from a tap therefore time difference between any two drops $= \frac{1}{2}\text{sec}$

In this given time, distance of second drop from the tap $= \frac{1}{2}g\left(\frac{1}{2}\right)^2 = \frac{10}{8} = 1.25\,m$

Its distance from the ground $= 5 - 1.25 = 3.75m$

586 **(d)**

Since $c >> v$ (negligible)

587 **(d)**

$$\text{Average speed} = \frac{\text{Total distance travelled}}{\text{Total time taken}}$$

$$= \frac{x}{\frac{2x/5}{v_1} + \frac{3x/5}{v_2}} = \frac{5v_1v_2}{3v_1 + 2v_2}$$

588 **(b)**

$$\text{Time} = \frac{\text{Total length}}{\text{Relative velocity}} = \frac{50+50}{10+15} = \frac{100}{25}$$

$$= 4\,sec$$

589 **(d)**

$$\text{Average velocity} = \frac{3x}{\frac{x}{60} + \frac{x}{20} + \frac{x}{10}} = \frac{3x}{\frac{x+3x+6x}{60}}$$

$$= \frac{3x \times 60}{10x} = 18\text{kmh}^{-1}$$

$$= \frac{18 \times 5}{18}\text{ms}^{-1} = 5\text{ms}^{-1}$$

590 **(a)**

If t_1 and t_2 are the time taken by particle to cover first and second half distance respectively.

$$t_1 = \frac{x/2}{3} = \frac{x}{6}$$

$$x_1 = 4.5t_2 \text{ and } x_2 = 7.5t_2$$

So, $x_1 + x_2 = \frac{x}{2}$

$$\Rightarrow 4.5t_2 + 7.5t_2 = \frac{x}{2}$$

$$t_2 = \frac{x}{24}$$

Total time $t = t_1 + 2t_2 = \frac{x}{6} + \frac{x}{12} = \frac{x}{4}$

So, average speed $= 4\text{ m/s}$

591 **(a)**

$\vec{r} = 20\hat{\imath} + 10\hat{\jmath} \therefore r = \sqrt{20^2 + 10^2} = 22.5\,m$

593 **(a)**

$v = \sqrt{2 \times 9.8 \times 100} = \sqrt{1960}\text{ms}^{-1}$

$\frac{\sqrt{1960}+0}{2} = \frac{2}{t}$ or $t = \frac{4}{\sqrt{1960}}\text{s} = \frac{4}{44.27}\text{s} = 0.09\text{s}$

594 **(a)**

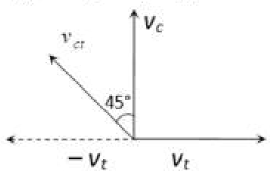
$$S_n = u + \frac{a}{2}(2n-1) \Rightarrow S_3 = 0 + \frac{4/3}{2}(2\times3-1)$$

$$\Rightarrow S_3 = \frac{10}{3}m$$

595 **(b)**

$\overrightarrow{v_{ct}} = \overrightarrow{v_c} - \overrightarrow{v_t}$

$\overrightarrow{v_{ct}} = \overrightarrow{v_c} + (-\overrightarrow{v_t})$



Velocity of car $w.r.t.$ train (v_{ct}) is towards West-North

596 **(d)**

Body reaches the point of projection with same velocity

597 **(c)**

In first case: $s_1 = ut_1 + \frac{1}{2}at_1^2$

$200 = 2u + 2a \quad (\because t_1 = 2s)$

$u + a = 100 \qquad$ ...(i)

In second case: $s_2 = ut_2 + \frac{1}{2}at_2^2$

$420 = 6u + 18a \quad (\because t_2 = 2 + 4 + 6s)$

$3a + u = 70 \qquad$ ...(ii)

Solving Eqs. (i) and (ii), we get

$a = -15\text{ms}^{-2}$

and $u = 115\text{cms}^{-1}$

$\therefore v = u + at$

$= 115 - 15 \times 7 = 10\text{cms}^{-1}$

598 **(b)**

$$\frac{dv}{dt} = a - bv$$

or $\int_0^v \frac{dv}{a-bv} = \int_0^t dt$

or $-\frac{1}{b}[\log(a-bv)]_0^v = t$

or $\left(\frac{a-bv}{a}\right) = e^{-bt}$

or $a - \frac{b}{a}v = e^{-bt}$

$v = \frac{a}{b}(1 - e^{-bt})$

599 **(b)**

Speed of stone in a vertically upward direction is $20 m/s$. So for vertical downward motion we will consider $u = -20\ m/s$

$v^2 = u^2 + 2gh = (-20)^2 + 2 \times 9.8 \times 200$

$= 4320\ m/s$

$\therefore v \simeq 65 m/s$

600 **(b)**

$u = 12\text{ms}^{-1}, \text{g} = 9.8\text{ms}^{-2}, t = 10\text{s}$

$S = \left(12 \times 10 + \frac{1}{2} \times 9.8 \times 10 \times 10\right)\text{m}$

$= (120 + 4.9 \times 100)\text{m} = 610\text{m}$

601 **(d)**

$$V_{av} = \frac{S+S}{\frac{S}{v_1} + \frac{S}{v_2}} = \frac{2v_1v_2}{v_1 + v_2}$$

602 **(c)**

Acceleration of the body along AB is $g \cos\theta$

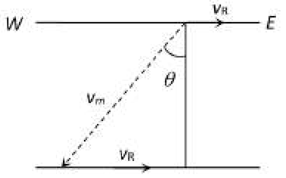
Distance travelled in time $t\ sec = AB = \frac{1}{2}(g\ cos\ \theta)t^2$

From $\Delta\ ABC, AB = 2R\cos\theta\ ; 2R\cos\theta = \frac{1}{2}g\cos\theta t^2$

$\Rightarrow t^2 = \frac{4R}{g}$ or $t = 2\sqrt{\frac{R}{g}}$

603 **(c)**

For shortest possible path man should swim with an angle $(90 + \theta)$ with downstream



From the fig,

$$\sin\theta = \frac{v_r}{v_m} = \frac{5}{10} = \frac{1}{2}$$

$\Rightarrow \therefore\ \theta = 30°$

So angle with downstream $= 90° + 30° = 120°$

604 **(d)**

Given, acceleration $a = -kv^3$

Initial velocity at cut-off, $v_1 = v_0$

Initial time of cut-off, $t = 0$

And final time after cut-off, $t_2 = t$

Again, $a = \frac{dv}{dt} = -kv^3$

Or $\frac{dv}{v^3} = -kdt$

Integrating both sides, with in the condition of motion.

$$\int_{v_0}^{v} \frac{dv}{v^3} = -\int_0^t k\ dt$$

Or $\left[-\frac{1}{2v^2}\right]_{v_0}^{v} = -[kt]_0^t$

Or $\frac{1}{2v^2} - \frac{1}{2v_0^2} = kt$

Or $v = \frac{v_0}{\sqrt{1 + 2\ kt\ v_0^2}}$

605 **(c)**

$$v = \frac{\text{Total distance}}{\text{Time taken}} = \frac{x}{\frac{x/3}{v} + \frac{x/3}{3v} + \frac{x/3}{2v}} = \frac{18}{11}v$$

606 **(b)**

$$\frac{|\text{Average velocity}|}{|\text{Average speed}|} = \frac{|\text{displacement}|}{|\text{distance}|} \leq 1$$

Because displacement will either be equal or less than distance. It can never be greater than distance

607 **(d)**

$u = 200\ m/s, v = 100\ m/s, s = 0.1\ m$

$$a = \frac{u^2 - v^2}{2s} = \frac{(200)^2 - (100)^2}{2 \times 0.1} = 15 \times 10^4\ m/s^2$$

608 **(a)**

$h = -vt + \frac{1}{2}\text{g}t^2$ or $ft^2 - 2vt - h = 0$

$$t = \frac{-(-2v) \pm \sqrt{4v^2 + 4gh}}{2\text{g}} = \frac{2v \pm 2\sqrt{v^2 + gh}}{2\text{g}}$$

$$= \frac{v}{\text{g}} \pm \frac{[v^2 + 2\text{g}h]^{1/2}}{\text{g}} = \frac{v}{\text{g}}\left[1 \pm \sqrt{1 + \frac{2\text{g}h}{v^2}}\right]$$

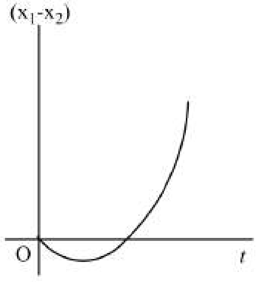
Now, retain only the positive sign.

609 **(b)**

There, $x_2 = vt$ and $x_1 = \frac{at^2}{2}$

$$x_1 - x_2 = -\left(vt - \frac{at^2}{2}\right)$$

So, the graph would be like.



610 **(b)**

For one dimensional motion along a plane

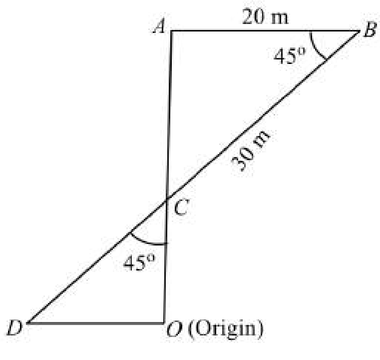
$S = ut + \frac{1}{2}at^2 \Rightarrow 9.8 = 0 + \frac{1}{2}g\sin 30° t^2 \Rightarrow t = 2\text{sec}$

611 **(b)**

The time of fall is independent of the mass

612 **(c)**

Taking the starting point as O, we have 30 m north OA, 20 m east AB, and finally $30\sqrt{2}$ m$(S-W)BD$.



From $\Delta\, CAB$,

$$AC = 20\text{ m}, OC = 10\text{ m}$$

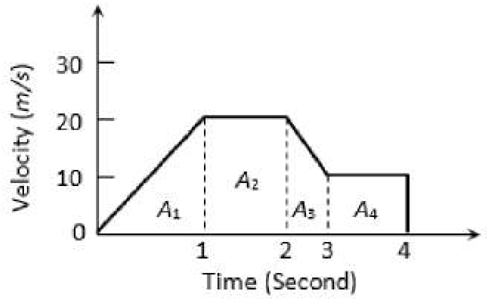
In $\Delta\, OCD$,

$$OD = OC, OD = 10\text{ m}$$

Hence, final displacement from origin is 10 m.

613 **(b)**

Distance = Area under $v-t$ graph $= A_1 + A_2 + A_3 + A_4$

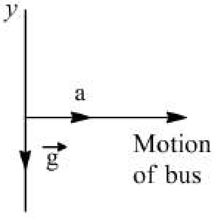


$= \frac{1}{2} \times 1 \times 20 + (20 \times 1) + \frac{1}{2}(20+10) \times 1 + (10 \times 1)$

$= 10 + 20 + 15 + 10 = 55m$

615 **(c)**

Let $\vec{a}_{rel}$ = acceleration of ball with respect to ground – acceleration of bus with respect to ground



$= -g\hat{j} - a\hat{i}$

$|\vec{a}_{rel}| = \sqrt{g^2 + a^2}$

Hence, (c) is correct.

616 **(a)**

$S = ut + \frac{1}{2}gt^2$

$30 = -25t + \frac{10}{2}t^2$ or $t^2 - 5t - 6 = 0$

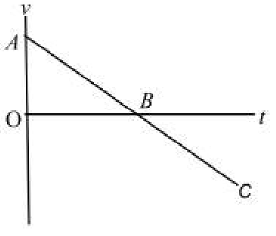
Or $(t-6)(t+1) = 0$ Take positive root

$\therefore t = 6$ sec

617 **(a)**

Taking initial position as origin and direction of motion (*ie*, vertically up) as positive. As the particle is thrown with initial velocity, at highest point its velocity is zero and then it returns back to its reference position. This situation is best depicted in figure of option (a).

In figure, AB part denotes upward motion and BC part denotes downward motion.



618 **(a)**

Distance b/w the cars A and B remains constant. Let the distance be 'x'

Velocity of C w.r.t. A and B $V = 45 + 36 = 81\ km/h$

Distance $= 81 \times \frac{5}{60} = 6.75\ Km$

619 **(c)**

Height $= \frac{1}{2}(12+8)3.6\text{m} = 36\text{m}$

620 **(b)**

At maximum height velocity $v = 0$

We know that $v = u + at$, hence

$0 = u - gT \Rightarrow u = gT$

When $v = \frac{u}{2}$, then

$\frac{u}{2} = u - gt \Rightarrow gt = \frac{u}{2} \Rightarrow gt = \frac{gT}{2} \Rightarrow t = \frac{T}{2}$

Hence at $t = \frac{T}{2}$, it acquires velocity $\frac{u}{2}$

621 **(d)**

$\frac{\tan 30°}{\tan 45°} = \frac{1}{\sqrt{3}} + 1 = 1 : \sqrt{3}$

622 **(c)**

Parachute bails out at height H from ground.

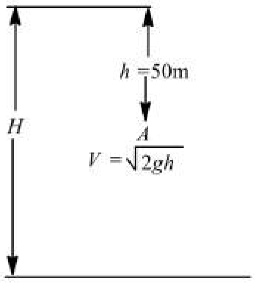
Velocity at A

$v = \sqrt{2\,gh}$

$= \sqrt{2 \times 9.8 \times 50} = \sqrt{980}\text{ms}^{-1}$

The velocity at ground $v_1 = 3\text{ ms}^{-1}$ (given)

Acceleration $= -2\text{ ms}^{-2}$ (given_



$\therefore H - h = \frac{v^2 - v_1^2}{2 \times 2}$

$= \frac{980 - 9}{4} = \frac{971}{4} = 242.75$

$\therefore \quad H = 242.75 + h$

$= 242.75 + 50 = 293\text{ m}$

623 **(c)**

$h = ut + \frac{1}{2}gt^2, t = 3\text{ sec}, u = -4.9 m/s$

$\Rightarrow h = -4.9 \times 3 + 4.9 \times 9 = 29.4\, m$

624 **(d)**

This problem can be solved by using the concept of relative velocity

$v + 30 = 75$

or $v = 45\text{kmh}^{-1}$

625 **(d)**

As $v = 0 + na$

$\Rightarrow \quad a = \frac{v}{n}$

Now, distance travelled in n sec

$\Rightarrow \quad S_n = \frac{1}{2}an^2$

Distance travelled in $(n-2)$ sec

$\Rightarrow \quad S_{n-2} = \frac{1}{2}\,a(n-2)^2$

Distance travelled in last 2 s,

$S_n - S_{n-2} = \frac{1}{2}\,an^2 - \frac{1}{2}a\,(n-2)^2$

$= \frac{a}{2}[n^2 - (n-2)^2]$

$= \frac{a}{2}[n + (n-2)][n - (n-2)]$

$= a(2n-2) = \frac{v}{n}(2n-2) = \frac{2v(n-1)}{n}$

626 **(b)**

Let s_1 be the distance travelled by train with acceleration 1ms^{-2} for time t_1 and s_2 be the distance travelled by train with retardation 3 ms^{-2} for time t_2. If v is the velocity of train after time t_1, then

$v = 1 \times t_1$ ... (i)

And $s_1 = \frac{1}{2} \times 1 \times t_1^2 = \frac{t_1^2}{2}$ ... (ii)

$v = 3t_2$ ... (iii)

And $s_2 = vt_2 - \frac{1}{2} \times 3 \times t_2^2$

From Eqs. (i) and (iii),

$t_1 = 3t_2 \text{ or } t_2 = \frac{t_1}{3}$

$\therefore s_1 + s_2 = \frac{t_1^2}{2} + t_1 \times \frac{t_1}{3} - \frac{3}{2} \times \frac{t_1^2}{9}$

$= \frac{2}{3}t_1^2$

$1215 = \frac{2}{3}t_1^2$

$$t_1 = \sqrt{\frac{3 \times 1215}{2}} = 42.69 \text{ s}$$

Total time $= t_1 + t_2 = t_1 + \frac{t_1}{3} = 56.9$ s

627 **(a)**

For the given condition initial height $h = d$ and velocity of the ball is zero. When the ball moves downward its velocity increases and it will be maximum when the ball hits the ground & just after the collision it becomes half and in opposite direction. As the ball moves upward its velocity again decreases and becomes zero at height $d/2$. This explanation match with graph (A)

628 **(d)**

Since $x = 1.2t^2$ which is in form $x = \frac{1}{2}at^2$

Thus the motion is uniformly accelerated

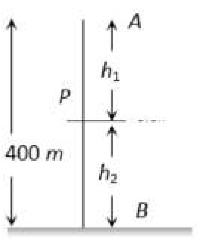
629 **(c)**

In a straight line-path with constant velocity distance travelled = displacement

$ie, s = D$

630 **(c)**

Let both balls meet at point P after time t



The distance travelled by ball $A, h_1 = \frac{1}{2}gt^2$

The distance travelled by ball $B, h_2 = ut - \frac{1}{2}gt^2$

$h_1 + h_2 = 400\ m \Rightarrow ut = 400, t = 400/50$
$= 8\ sec$

$\therefore h_1 = 320m$ and $h_2 = 80\ m$

631 **(c)**

The displacement of the particle is determined by the area bounded by the curve. This area is

$$s = \frac{\pi}{4} v_m t_0$$

The average velocity is

$$< v >= \frac{s}{t_0} = \frac{\pi}{4} v_m$$

Such motion cannot be realized in practical terms since at the initial and final moment, the acceleration (which is slope of $v - t$) is infinitely large. Hence, both (i) and (ii) are correct.

632 **(d)**

At highest point $v = 0$ and $H_{\max} = \frac{u^2}{2g}$

633 **(c)**

$$\text{Acceleration} = a = \frac{dv}{dt} = 0.1 \times 2t = 0.2t$$

Which is time dependent $i.e.$ non-uniform acceleration

634 **(b)**

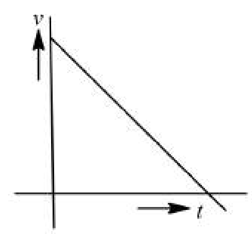
If acceleration is variable (depends on time) then

$$v = u + \int (f)dt = u + \int (a\,t)dt = u + \frac{a\,t^2}{2}$$

635 **(a)**

During upward motion the velocity is decreasing while during downward motion the velocity is increasing in downward direction.

The graph plot is as shown.



636 **(c)**

$$x = at + bt^2 - ct^3, a = \frac{d^2x}{dt^2} = 2b - 6ct$$

637 **(c)**

Since direction of v is opposite to the direction of g and h so from equation of motion

$$h = -vt + \frac{1}{2}gt^2 \Rightarrow gt^2 - 2vt - 2h = 0$$

$$\Rightarrow t = \frac{2v \pm \sqrt{4v^2 + 8gh}}{2g} \Rightarrow t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$$

638 **(b)**

$$t = \sqrt{\frac{2h}{g}} \Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}}$$

639 **(b)**

Let A and B will meet after time $t\ sec.$ it means the distance travelled by both will be equal

$S_A = ut = 40t$ and $S_B = \frac{1}{2}at^2 = \frac{1}{2} \times 4 \times t^2$

$$S_A = S_B \Rightarrow 40t = \frac{1}{2}4t^2 \Rightarrow t = 20\ sec$$

640 **(c)**

For first case $v^2 - 0^2 = 2gh \Rightarrow (3)^2 = 2gh$

For second case $v^2 = (-u)^2 + 2gh = 4^2 + 3^2 \therefore$
$v = 5km/h$

641 **(a)**

When the body is projected vertically upward then at the highest point its velocity is zero but acceleration is not equal to zero ($g = 9.8 m/s^2$)

642 **(d)**

An aeroplane flies 400m north and 300m south so the net displacement is 100m towards north.

Then it flies 1200m upward so $r = \sqrt{(100)^2 + (1200)^2}$

$= 1204 \text{ m} \simeq 1200 \text{ m}$

643 **(c)**

Maximum height of ball = $5\ m$

So velocity of projection $\Rightarrow u = \sqrt{2gh} = 10\ m/s$

Time interval between two balls (time of ascent)

$= \frac{u}{g} = 1\ sec = \frac{1}{60}\ min$

So number of ball thrown per min = 60

644 **(d)**

$u = 0, S = 250m, t = 10\text{sec}$

$S = ut + \frac{1}{2}at^2 \Rightarrow 250 = \frac{1}{2}a[10]^2 \Rightarrow a = 5m/s^2$

So, $F = ma = 0.9 \times 5 = 4.5N$

645 **(d)**

As $v^2 = u^2 + 2as \Rightarrow (2y)^2 = u^2 + 2as \Rightarrow = 3u^2$

Now, after covering an additional distance s, if velocity becomes v,then,

$v^2 = u^2 + 2a(2s) = u^2 + 4as = u^2 + 6u^2 = 7u^2$

$\therefore v = \sqrt{7}u$

646 **(c)**

$S = \frac{1}{2} \times 1 \times 20 + 1 \times 20 + \frac{1}{2} \times (20 + 10) \times 1 + 1 \times 10$

$= 55\text{m}$

647 **(a)**

If u is the initial velocity then distance covered by it in 2 sec

$S = ut + \frac{1}{2}at^2 = u \times 2 + \frac{1}{2} \times 10 \times 4$

$= 2u + 20$ ... (i)

Now distance covered by it in 3rd sec

$S_{3^{rd}} = u + \frac{1}{2}(2 \times 3 - 1)10$

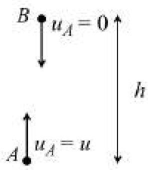
$= u + 25$ ... (ii)

From (i) and (ii), $2u + 20 = u + 25 \Rightarrow u = 5$

$\therefore S = 2 \times 5 + 20 = 30\ m$

648 **(a)**

At time t



Velocity of A, $v_A = u - gt$ upward

Velocity of B, $v_B = gt$ downward

It we assume that height h is smaller than or equal to the maximum height reached by A, then at every instant v_A and v_B are in opposite directions

$\therefore V_{AB} = v_A + V_B$

$= u - gt + gt$ [Speeds in opposite directions get added]

$= u$

649 **(d)**

For the round trip he should cross perpendicular to the river

$\therefore$ Time for trip to that side $= \frac{1km}{4km/hr} = 0.25hr$

To come back, again he take 0.25 hr to cross the river. Total time is 30 min, he goes to the other bank and come back at the same point

650 **(b)**

Let car B catches, car A after 't'sec, then

$60t + 2.5 = 70t - \frac{1}{2} \times 20 \times t^2$

$\Rightarrow 10t^2 - 10t + 2.5 = 0 \Rightarrow t^2 - t + 0.25 = 0$

$\therefore t = \frac{\sqrt{1 - 4 \times (0.25)}}{2} = \frac{1}{2}hr$

651 **(d)**

The separation between the two bodies, two seconds after the release of second body

$= \frac{1}{2} \times 9.8[(3)^2 - (2)^2] = 24.5\ m$

652 **(d)**

For the round trip he should cross perpendicular to the river

$\therefore$ Time for trip to that side $= \frac{1km}{4km/hr} = 0.25hr$

To come back, again he take 0.25 hr to cross the river. Total time is 30 min, he goes to the other bank and come back at the same point

654 **(a)**

$t = \sqrt{\frac{2 \times 19.6}{9.8}} = 2s\ ; 1.9 = \sqrt{\frac{2 \times h}{9.8}}$

or $h = \frac{1.9 \times 1.9 \times 9.8}{2}$m=17.689m

Required distance = 19.6 −17.689 m = 1.9m.

655 **(a)**

$\sqrt{x} = t + 1$

Squaring both sides, we get

$x=(t+1)^2=t^2+2t+1$

Differentiating it w.r.t time t, we get

$$\frac{dx}{dt}=2t+2$$

Velocity, $v=\frac{dx}{dt}=2t+2$

656 **(a)**

The velocity of the particle is

$$\frac{dx}{dt}=\frac{d}{dt}(2-5t+6t^2)=(0-5+12t)$$

For initial velocity $t=0$, hence $v=-5\ m/s$

657 **(b)**

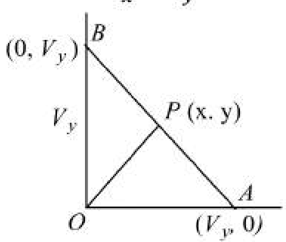
Let time interval be chosen as 1 s

$$\frac{PA}{PB}=\frac{OA}{OB}=\frac{v_x}{v_y}$$

So, $P(x,y)$divides AB is the ratio $v_x{:}\,v_y$.

Using section formula,

$$x=\frac{v_x\times 0+v_y\times v_x}{v_x+v_y}=\frac{v_xv_y}{v_x+v_y}$$



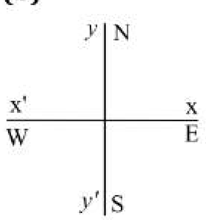
$$y=\frac{v_xv_y+v_y\times 0}{v_x+v_y}=\frac{v_xv_y}{v_x+v_y}$$

$$v=\sqrt{x^2+y^2}=\sqrt{2}\frac{v_xv_y}{v_x+v_y}$$

Now, replace v_x by v_1 and v_y by v_2.

$$v=\frac{\sqrt{2}v_1v_2}{v_1+v_2}$$

658 **(b)**



Let $\vec{v}_t$= actual velocity of train

$\vec{v}_t$= actual velocity of car

$\therefore$ $\vec{v}_{tc}$= relative velocity of train with respect to car

$\therefore$ $\vec{v}_c=25\hat{\imath}$

and $\vec{v}_{tc}=25\sqrt{3}\,\hat{\jmath}$

$\therefore$ $\vec{v}_{tc}=\vec{v}_t-\vec{v}_c$

$\therefore$ $\vec{v}_t=\vec{v}_{tc}+\vec{v}_c$

$=25\sqrt{3}\hat{\jmath}+25\hat{\imath}$

$$v_t=\sqrt{\left(25\sqrt{3}\right)^2+(25)^2}$$

$=25\sqrt{4}=50\text{kmh}^{-1}$

659 **(a)**

$$S\propto u^2\ \therefore\frac{S_1}{S_2}=\left(\frac{u_1}{u_2}\right)^2\Rightarrow\frac{2}{S_2}=\frac{1}{4}\Rightarrow S_2=8\ m$$

660 **(d)**

Total distance $=130+120=250\ m$

Relative velocity $=30-(-20)=50\ m/s$

Hence $t=250/50=5\ s$

663 **(a)**

Average velocity $=\frac{2v_1v_2}{v_1+v_2}$

Given, $v_{av}=40$ km/h, $v_1=60$ km/h and $v_2=?$

$$\therefore\quad 40=\frac{2\times 60\times v_2}{60+v_2}$$

$$80v_2=2400$$

$$v_2=30\text{ km/h}$$

664 **(b)**

If a in the relative acceleration, then

$3=\frac{1}{2}a\times 5\times 5$ or $a=\frac{6}{25}\text{ms}^{-2}$

Again, $S=\frac{1}{2}\times\frac{6}{25}\times 10\times 10=12\text{m}$

665 **(d)**

$$v_1=\frac{u+v_1'}{2}=\frac{u+u+at_1}{2}=u+\frac{1}{2}at_1$$

$$v_2=\frac{v_1'+v_2'}{2}=\frac{(u+at_1)+u+a(t_1+t_2)}{2}$$

$$=u+at_1+\frac{1}{2}at_2$$

$$v_3=\frac{v_2'+v_3'}{2}$$

$$=\frac{(u+at_1+at_2)+u+a(t_1+t_2+t_3)}{2}$$

$$=u+at_1+at_2+\frac{1}{2}at_3$$

Then, $v_1-v_2=-\frac{1}{2}a(t_1+t_2)$

$$v_2-v_3=-\frac{1}{2}a(t_2+t_3)$$

$$\therefore\ \frac{v_1-v_2}{v_2-v_3}=\frac{t_1+t_2}{t_2+t_3}$$

666 **(b)**

Relative velocity of bird $w.r.t.$ train $=25+5=30\ m/s$

Time taken by the bird to cross the train $t=\frac{210}{30}=7\ sec$

667 **(a)**

Distance covered in 5^{th} second

$S_{5^{th}} = u + \frac{a}{2}(2n-1) = 0 + \frac{a}{2}(2\times5-1) = \frac{9a}{2}$

and distance covered in 5 second,

$S_5 = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}\times a\times 25 = \frac{25a}{2}$

$\therefore \frac{S_{5^{th}}}{S_5} = \frac{9}{25}$

668 **(b)**

$x = \frac{1}{t+5} \Rightarrow v = \frac{dx}{dt} = -\frac{1}{(t+5)^2}$

Acceleration, $a = \frac{dv}{dt} = \frac{2}{(t+5)^3} \Rightarrow a \propto (\text{velocity})^{3/2}$

669 **(a)**

(a) Take vertically upward direction as positive and vertically downward direction as negative.

670 **(a)**

Time taken by the car to cover first half of the distance is

$t_1 = \frac{100}{60}$

Time taken by the car to cover speed half of the distance is

$t_2 = \frac{100}{v}$

Average speed , $v_{av} = \frac{\text{Total distance travelled}}{\text{TOtal time taken}}$

$v_{av} = \frac{100+100}{t_1+t_2} \Rightarrow 40 = \frac{200}{\frac{100}{60}+\frac{100}{v}}$

$\frac{1}{60} + \frac{1}{v} = \frac{1}{20} \Rightarrow \frac{1}{v} = \frac{1}{20} - \frac{1}{60}$

$\frac{1}{v} = \frac{2}{60} = \frac{1}{30}$

$v = 30km\,h^{-1}$

671 **(d)**

In 's-t' graph (positive -time)

The straight line parallel with time axis represent state of rest

672 **(a)**

Given line have positive intercept but negative slope. So its equation can be written as

$v = -mx + v_0$ ....(i) [where $m = \tan\theta = \frac{v_0}{x_0}$]

By differentiating with respect to time we get

$\frac{dv}{dt} = -m\frac{dx}{dt} = -mv$

Now substituting the value of v from eq. (i) we get

$\frac{dv}{dt} = -m[-mx + v_0] = m^2x - mv_0 \therefore a$

$= m^2x - mv_0$

$i.e.$ the graph between a and x should have positive slope but negative intercept on a-axis. So graph (a) is correct

673 **(c)**

$h_{n^{th}} = u - \frac{g}{2}(2n-1)$

$h_{5^{th}} = u - \frac{10}{2}(2\times5-1) = u - 45$

$h_{6^{th}} = u - \frac{10}{2}(2\times6-1) = u - 55$

Given $h_{5^{th}} = 2\times h_{6^{th}}$. By solving we get $u = 65\ m/s$

674 **(b)**

$H_{\max} \propto u^2$, It body projected with double velocity then maximum height will become four times $i.e.$ $200\ m$

675 **(b)**

$v \propto \sqrt{h}\ \therefore \frac{v_1}{v_2} = \sqrt{\frac{a}{b}}$

So, (b) is the correct choice.

The velocity acquired by a body in falling freely from rest through height h is $\sqrt{2gh}$.

$[u = 0, v = ?, 'a' = g, 'S' = h, v^2 - u^2 = 2aS]$

676 **(a)**

Here, $s_n = \frac{1}{n}an^2$

s_{nth} = distance travelled in n second – distance travelled in $(n-1)$ second

$= \left(\frac{2n-1}{2}\right)a$

$\therefore \frac{s_{nth}}{s_n} = \frac{2n-1}{n^2} = \frac{2}{n} - \frac{1}{n^2}$

677 **(c)**

$\mathbf{r}_i = (-3.0\text{ m})\hat{\mathbf{i}} + (2.0\text{ m})\hat{\mathbf{j}} + (8.0\text{ m})\hat{\mathbf{k}}$

$r_f = (9.0\text{ m})\hat{\mathbf{i}} + (2.0\text{ m})\hat{\mathbf{j}} + (-8.0\text{ m})\hat{\mathbf{k}}$

$\therefore$Displacement $= \mathbf{r}_f - \mathbf{r}_i$

$= \left[(9.0\text{ m})\hat{\mathbf{i}} + (2.0\text{ m})\hat{\mathbf{j}} + (-8.0\text{ m})\hat{\mathbf{k}}\right]$

$-[(-3.0\text{m})\hat{\mathbf{i}} + (2.0\text{m})\hat{\mathbf{j}} + (8.0\text{m})\hat{\mathbf{k}}]$

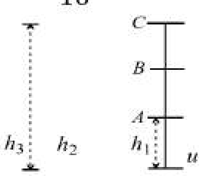
$= [(12.0\text{m})\hat{\mathbf{i}} - (16.0\text{m})\hat{\mathbf{j}}]$

679 **(d)**

$A \Rightarrow \frac{u^2}{4} - u^2 = -2gh_1$

$B \Rightarrow \frac{u^2}{9} - u^2 = -2gh_2$

$C \Rightarrow \frac{u^2}{16} - u^2 = -2gh_3$



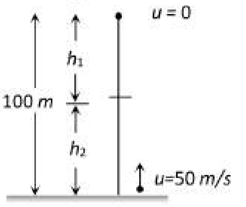
$\therefore AB = \frac{u^2}{2g}\left\{\frac{8}{9} - \frac{3}{4}\right\} = \frac{u^2}{2g} \cdot \frac{5}{36}$

$BC = \frac{u^2}{2g}\left\{\frac{15}{16} - \frac{8}{9}\right\} = \frac{u^2}{2g} \cdot \frac{7}{144}$

$\therefore \frac{AB}{BC} = \frac{5}{36} \times \frac{144}{7} = \frac{20}{7}$

680 **(b)**

$h_1 = \frac{1}{2}gt^2, h_2 = 50t - \frac{1}{2}gt^2$

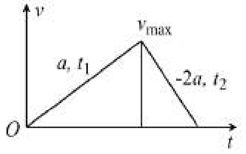


Given $h_1 + h_2 = 100\ m$

$\Rightarrow 50t = 100 \Rightarrow t = 2\ sec$

681 **(d)**

Let acceleration is a and retardation is $-2a$



Then for acceleration motion

$t_1 = \frac{v}{a}$ ...(i)

For retarding motion

$t_2 = \frac{v}{2a}$ ...(ii)

Given $t_1 + t_2 = 9 \Rightarrow \frac{v}{a} + \frac{v}{2a} = 9 \Rightarrow \frac{3v}{2a} = 9 \Rightarrow \frac{v}{a} = 6$

Hence, duration of acceleration, $t_1 = \frac{v}{a} = 6\ sec$

682 **(b)**

$a = \frac{dv}{dt} = 6t + 5$ or $dv = (6t + 5)dt$

Integrating it, we have

$v = \frac{6t^2}{2} + 5t + C = 3t^2 + 5t + C$

where C is constant of integration

When $v = 0$ so $c = 0$

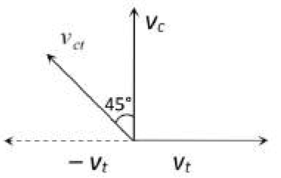
$\therefore v = \frac{ds}{dt} = 3t^2 + 5t$ or $ds = (3t^2 + 5t)dt$

Integrating it within the conditions of motion *ie*, as t changes from 0 to 1 s changes from 0 to s, we have $s = t^3 + \frac{5t^2}{2} = 1 + \frac{5}{2} = 3.5$m.

683 **(b)**

$\overrightarrow{v_{ct}} = \overrightarrow{v_c} - \overrightarrow{v_t}$

$\overrightarrow{v_{ct}} = \overrightarrow{v_c} + (-\overrightarrow{v_t})$



Velocity of car $w.r.t.$ train (v_{ct}) is towards West-North

684 **(c)**

Let student catch the bus after t sec. So it will cover distance ut

Similarly distance travelled by the bus will be $\frac{1}{2}at^2$ for the given condition

$ut = 50 + \frac{1}{2}at^2 = 50 + \frac{t^2}{2}$ $[a = 1\ m/s^2]$

$\Rightarrow u = \frac{50}{t} + \frac{t}{2}$

To find the minimum value of u

$\frac{du}{dt} = 0$, so we get $t = 10\ sec$, then $u = 10\ m/s$

685 **(c)**

$v^2 = u^2 + 2gh \Rightarrow v = \sqrt{u^2 + 2gh}$

So for both the cases velocity will be equal

686 **(c)**

Instantaeneous velocity $= v = \frac{\Delta x}{\Delta t}$

By using the data from the table

$v_1 = \frac{0 - (-2)}{1} = 2m/s,\quad v_2 = \frac{6 - 0}{1} = 6m/s$

$v_3 = \frac{16 - 6}{1} = 10m/s$

So, motion is non-uniform but accelerated

687 **(d)**

$\vec{r} = 3t\hat{\imath} - t^2\hat{\jmath} + 4\hat{k}$

Velocity, $\vec{v} = \frac{d\vec{r}}{dt} = \frac{d}{dt}(3t\hat{\imath} - t^2\hat{\jmath} + 4\hat{k}) = 3\hat{\imath} - 2t\hat{\jmath}$

At $t = 5s \Rightarrow \vec{v} = 3\hat{\imath} - 10\hat{\jmath}$

$|\vec{v}| = \sqrt{(3)^2 + (-10)^2} = \sqrt{9 + 100} = \sqrt{109}$

$= 10.44\ ms^{-1}$

688 **(c)**

Let the stone falls through a height h in t s

Here, $u = 0, a = g$

Using $D_n = u + \frac{a}{2}(2n - 1)$

Distance travelled by the stone in the last second is

$\frac{9h}{25} = \frac{g}{2}(2t - 1)$ $[\because u = 0]$ ...(i)

Distance travelled by the stone in t s is

$h = \frac{1}{2}gt^2$ $[\because u = 0]$ ...(ii)

Divide (i) by (ii), we get

$\frac{9}{25} = \frac{(2t - 1)}{t^2}$

$9t^2 = 50t - 25$

$9t^2 - 50t + 25 = 0$

On solving, we get

$t = 5s$ or $t = \frac{5}{9}s$

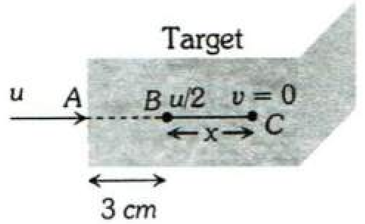
Substituting $t = 5s$ in (ii), we get

$h = \frac{1}{2} \times 9.8 \times (5)^2 = 122.5\, m$

689 **(b)**

Let initial velocity of the bullet $= u$

After penetrating 3 cm its velocity becomes $\frac{u}{2}$



From $v^2 = u^2 - 2as$

$\left(\frac{u}{2}\right)^2 = u^2 - 2a(3)$

$\Rightarrow 6a = \frac{3u^2}{4} \Rightarrow a = \frac{u^2}{8}$

Let further it will penetrate through distance x and stops at point C

For distance $BC, v = 0, u = u/2, s = x, a = u^2/8$

For $v^2 = u^2 - 2as \Rightarrow 0 = \left(\frac{u}{2}\right)^2 - 2\left(\frac{u^2}{8}\right).x \Rightarrow x =$ 1 cm

690 **(b)**

$S_{3^{rd}} = 10 + \frac{10}{2}(2 \times 3 - 1) = 35\, m$

$S_{2^{nd}} = 10 + \frac{10}{2}(2 \times 2 - 1) = 25\, m \Rightarrow \frac{S_{3^{rd}}}{S_{2^{nd}}} = \frac{7}{5}$

691 **(b)**

Relative velocity of one train $w.r.t.$ other

$= 10 + 10 = 20 m/s$

Relative acceleration$=0.3 + 0.2 = 0.5 m/s^2$

If train crosses each other then from $s = ut + \frac{1}{2}at^2$

$As, s = s_1 + s_2 = 100 + 125 = 225$

$\Rightarrow 225 = 20t + \frac{1}{2} \times 0.5 \times 0.5 \times t^2$

$\Rightarrow 0.5t^2 + 40t - 450 = 0$

$\Rightarrow t = \frac{-40 \pm \sqrt{1600 + 4.(005) \times 450}}{1}$

$= -40 \pm 50$

$\therefore t = 10 sec$ (Taking +ve value)

692 **(a)**

Time, $t = \sqrt{\frac{2h}{g}}$

Distance from the foot of the tower

$$d = vt = v\sqrt{\frac{2h}{g}}$$

$$= 250 \text{ m}$$

When velocity $= \frac{v}{2}$

And height of tower $= 4h$

Then, distance $x = \frac{v}{2}\sqrt{\frac{2(4h)}{g}}$

$$x = v\sqrt{\frac{2h}{g}} = 250 \text{ m}$$

693 **(c)**

$81 = -12t + \frac{1}{2} \times 10 \times t^2$

or $5t^2 - 12t - 81 = 0$

or $t = \frac{12 \pm \sqrt{144+4\times5\times81}}{2\times5}$

$= \frac{12 \pm \sqrt{1764}}{10} = \frac{12 \pm 42}{10} = \frac{54}{10} = 5.4s$

[negative sign has been ignored]

694 **(d)**

Given $a = 19.6 m/s^2 = 2g$

Resultant velocity of the rocket after 5 sec

$v = 2g \times 5 = 10g\ m/s$

Height achieved after 5 sec, $h_1 = \frac{1}{2} \times 2g \times 25 =$ $245m$

On switching off the engine it goes up to height h_2 where its velocity becomes zero

$0 = (10g)^2 - 2gh_2 \Rightarrow h_2 = 490m$

$\therefore$ Total height of rocket $= 245 + 490 = 735\, m$

695 **(d)**

Both trains will travel a distance of 1 km before to come in rest. In this case by using $v^2 = u^2 + 2as$

$\Rightarrow 0 = (40)^2 + 2a \times 1000 \Rightarrow a = -0.8\, m/s^2$

696 **(c)**

$h = \frac{1}{2}gt^2 \Rightarrow t = \sqrt{2h/g}$

$t_a = \sqrt{\frac{2a}{g}}$ and $t_b = \sqrt{\frac{2b}{g}} \Rightarrow \frac{t_a}{t_b} = \sqrt{\frac{a}{b}}$

697 **(d)**

As $v^2 = u^2 + 2as \Rightarrow (2y)^2 = u^2 + 2as \Rightarrow= 3u^2$

Now, after covering an additional distance s, if velocity becomes v,then,

$v^2 = u^2 + 2a(2s) = u^2 + 4as = u^2 + 6u^2 = 7u^2$

$\therefore v = \sqrt{7}u$

698 **(a)**

$S_n = u + \frac{g}{2}(2n-1)$; when $u = 0, S_1 : S_2 : S_3 = 1 : 3 : 5$

699 **(c)**

$\frac{dx}{dt} = 2at - 3bt^2 \Rightarrow \frac{d^2x}{dt^2} = 2a - 6bt = 0 \Rightarrow t = \frac{a}{3b}$

700 **(a)**

The velocity of the particle is

$\frac{dx}{dt} = \frac{d}{dt}(2 - 5t + 6t^2) = (0 - 5 + 12t)$

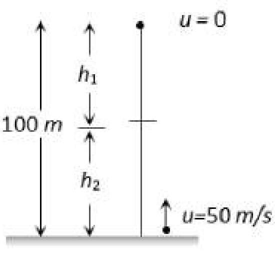
For initial velocity $t = 0$, hence $v = -5\ m/s$

701 **(b)**

Time of flight $= \frac{2u}{g} = \frac{2 \times 100}{10} = 20$ sec

702 **(b)**

$h_1 = \frac{1}{2}gt^2, h_2 = 50t - \frac{1}{2}gt^2$



Given $h_1 + h_2 = 100\ m$

$\Rightarrow 50t = 100 \Rightarrow t = 2\ sec$

703 **(a)**

The distance covered by the ball during the last t *seconds* of its upward motion = Distance covered by it in first t seconds of its downward motion

From $h == ut + \frac{1}{2}gt^2$

$h = \frac{1}{2}g\,t^2$ [As $u = 0$ for it downward motion]

704 **(c)**

Let the velocity of the bullet when it strikes the target is v cm s^{-1}.

After penetrating 30 cm, velocity becomes half ie, $\frac{v}{2}$.

From equation $v^2 = u^2 + 2as$

$\therefore \quad \left(\frac{v}{2}\right)^2 = v^2 + 2a \times 30$

Or $\quad -60a = v^2 - \frac{v^2}{4}$

Or $\quad -60a = \frac{3v^2}{4}$

$\therefore \quad a = -\frac{v^2}{80}\text{cm s}^{-2}$

Let the bullet further penetrates x cm before coming to rest, therefore

$$v'^2 = u'^2 + 2\,as'$$

$$0 = \left(\frac{v}{2}\right)^2 + 2\left(-\frac{v^2}{80}\right)x$$

$$\frac{v^2x}{40} = \frac{v^2}{4}$$

$$x = 10\text{ cm}$$

705 **(d)**

$h = ut - \frac{1}{2}gt^2$

$= 10 \times 1 - \frac{1}{2} \times 10 \times 1$

$= 10 - 5 = 5m$

706 **(a)**

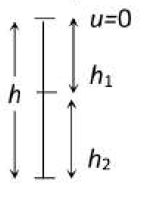
For first stone $u = 0$ and

For second stone $\frac{u^2}{2g}4h \Rightarrow u^2 = 8gh$

$\therefore u = \sqrt{8gh}$

Now, $h_1 = \frac{1}{2}gt^2$

$h_2 = \sqrt{8ght - \frac{1}{2}gt^2}$



$u = \sqrt{8gh}$

Where,t =time cross each other

$\therefore h_1 + h_2 = h$

$\Rightarrow \frac{1}{2}gt^2 + \sqrt{8ght} - \frac{1}{2}gt^2 = h \Rightarrow t = \frac{h}{\sqrt{8gh}} = \sqrt{\frac{h}{8g}}$

707 **(d)**

$x \propto t^3 \therefore x = Kt^3$

$\Rightarrow v = \frac{dx}{dt} = 3Kt^2$ and $a = \frac{dv}{dt} = 6Kt$

i.e. $a \propto t$

708 **(b)**

The distance traveled in last second

$S_{\text{Last}} = u + \frac{g}{2}(2t-1) = \frac{1}{2} \times 9.8(2t-1)$

$= 4.9(2t-1)$

and distance traveled in first three second,

$S_{\text{Three}} = 0 + \frac{1}{2} \times 9.8 \times 9 = 44.1\ m$

According to problem $S_{\text{Last}} = S_{\text{Three}}$

$\Rightarrow 4.9(2t - 1) = 44.1 \Rightarrow 2t - 1 = 9$

$\Rightarrow t = 5\ sec$

709 **(a)**

Here, $u = 10\ ms^{-1}, t = 2s, S = 20\ m$

Using $S = ut + \frac{1}{2}at^2$

$\therefore\ 20 = 10 \times 2 + \frac{1}{2} \times a \times 2^2$

$0 = 2a \Rightarrow a = 0$

710 **(b)**

Using $t = \sqrt{\frac{2h}{a}}, t \propto \sqrt{l}, \frac{t_2}{t_1} = \sqrt{\frac{l/4}{l}} = \frac{1}{2}$

or $t_2 = \frac{t_1}{2} = \frac{4}{2} = 2\text{s}$

711 **(c)**

Average velocity $= \frac{\text{Displacement}}{\text{Time interval}}$

A particle moving in a given direction with non-zero velocity cannot have zero speed.

In general, average speed is not equal to magnitude of average velocity. However, it can be so if the motion is along a straight line without change in direction

712 **(b)**

Let us solve the problem in terms initial velocity, relative acceleration and relative displacement of the coin with respect to floor of the lift.

$u = 10 - 10 = \text{ms}^{-1}, a = 9.8\text{ms}^{-2}, S = 4.9\text{m}, t = ?$

$4.9 = 0 \times t + \frac{1}{2} \times 9.8 \times t^2$ or $4.9t^2 = 4.9$ or $t = 1\text{s}$

$15 = 30 - 10t$ or $10t = 15$ or $t = 1.5\text{s}$

713 **(a)**

Given, $s = 1.2\text{ m}, v = 640\text{ ms}^{-1},\ a = ?,\ u = 0; t = ?$

We have the third equation of motion

$$2as = v^2 - u^2$$

$$2a \times 1.2 = 640 \times 640$$

Or $$a = \frac{8 \times 64 \times 10^3}{3}$$

And by first equation of motion

$$v = u + at$$

Or $$t = \frac{v}{a} = \frac{15}{4} \times 10^{-3}$$

$$= 3.75 \times 10^{-3}\text{s} \approx 4\text{ ms}$$

714 **(c)**

We know that,

$$s_t = u + \frac{1}{2}a(2t - 1)$$

$\therefore$ $$65 = u + \frac{1}{2}a[10 - 1]$$

$\Rightarrow$ $$65 = u + \frac{9}{2}a \quad \text{...(i)}$$

Again, $t = 9s$ and $s = 105$ m

$\therefore$ $$105 = u + \frac{1}{2}a[18 - 1]$$

Or $$105 = u + \frac{17}{2}a \quad \text{...(ii)}$$

On substracting Eq. (i) from Eq. (ii)

$$105 - 65 = \frac{17}{2}a - \frac{9}{2}a$$

Or $$40 = \frac{8}{2}a$$

Or $$40 = 4a$$

Or $$a = 10\text{ ms}^{-2}$$

On putting the value of a in Eq. (i),

Or $$65 = u + \frac{9}{2} \times 10$$

Or $$65 = u + 45$$

Or $$u = 20\text{ ms}^{-1}$$

Now we know that from second equation of motion

$$s = ut + \frac{1}{2}at^2$$

$\therefore$ $$s = 20 \times 20 + \frac{1}{2} \times 10 \times (20)^2$$

Or $$s = 400 + 5 \times 400$$

Or $$s = 2400\text{ m}$$

715 **(a)**

When the stone is released from the balloon. Its height

$h = \frac{1}{2}at^2 = \frac{1}{2} \times 1.25 \times (8)^2 = 40\ m$ and velocity

$v = at = 1.25 \times 8 = 10\ m/s$

Time taken by the stone to reach the ground

$$t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right]$$

$$= \frac{10}{10}\left[1 + \sqrt{1 + \frac{2 \times 10 \times 40}{(10)^2}}\right]$$

$$= 4sec$$

716 **(c)**

(i) A body having constant speed can have varying velocity as direction may change.

(ii) Position-time graphs for two objects with zero relative velocity are parallel.

(iii) For a given time interval,

Distance $\geq$ | displacement |

$\therefore$ Average speed $\geq$ | average velocity |

Therefore, all the options are true.

717 **(d)**

Distance is defined as length of the path between two points.

In this case

Disance $=$ Area of $v - t$ graph in 4 s

$= \text{Area of trangle} = \frac{1}{2}\text{base } \times \text{height}$

$= \frac{1}{2} \times 4 \times 8 = 16$ m

718 **(b)**

Acceleration, $a = \frac{dv}{dt}$

As $\quad a = \text{constant}$

Then $\quad \frac{dv}{dt} = \text{constant or } v = kt$

Hence, the correct graph is (b).

719 **(c)**

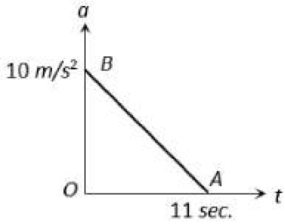
From given figure, it is clear that the net displacement is zero. So average velocity will be zero

720 **(c)**

$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 20} = 20m/s$

721 **(b)**

The area under acceleration time graph gives change in velocity. As acceleration is zero at the end of 11 *sec*



i.e. $v_{\max}$ =Area of ΔOAB

$= \frac{1}{2} \times 11 \times 10 = 55\ m/s$

722 **(a)**

The slope of distance-time graphs speed.

The change in velocity in 1 s

$= \tan 60° - \tan 45° = \sqrt{3} - 1$

$\therefore$ Acceleration $= \frac{\Delta v}{\Delta t} = \frac{\sqrt{3}-1}{1} = (\sqrt{3} - 1)$unit

723 **(d)**

Interval of ball throw $= 2sec$

If we want that minimum three (more than two) ball remain in air then time of flight of first ball must be greater than 4 *sec*

$T > 4\ sec$

$\frac{2u}{g} > 4 \text{ sec} \Rightarrow u > 19.6\ m/s$

For $u = 19.6$, first ball will just about to strike the ground (in air)

Second ball will be at highest point (in air)

Third ball will be at point of projection or at ground (not in air)

724 **(c)**

Let the man starts crossing the road at an angle θ with the roadside. For safe crossing, the condition is that the man must cross the road by the time truck describes the distance(4+2 cot θ),

So, $\frac{4+2\cot\theta}{8} = \frac{2l\sin\theta}{v}$

or $v = \frac{8}{2\sin\theta=2\cos\theta}$

For minimum $v = \frac{dv}{d\theta} = 0$

or $\frac{-8(2\cos\theta-\sin\theta)}{(2\sin\theta+\cos\theta)^2} = 0$

or $2\cos\theta - \sin\theta = 0$

or $\tan\theta = 2$, so, $\sin\theta = \frac{2}{\sqrt{5}}$, $\cos\theta=\frac{1}{\sqrt{5}}$

$\therefore v_{\min} = \frac{6}{2\left(\frac{2}{\sqrt{5}}\right) + \frac{1}{\sqrt{5}}}$

$= \frac{8}{\sqrt{5}} = 3.57\text{ms}^{-1}$

725 **(c)**

Let man will catch the bus after 't'sec. So he will cover distance ut

Similarly distance travelled by the bus will be $\frac{1}{2}at^2$

For the given condition

$$u\,t = 45 + \frac{1}{2}a\,t^2 = 45 + 1.25t^2 \quad [\text{As } a = 2.5\ m/s^2]$$

$$\Rightarrow u = \frac{45}{t} + 1.25t$$

To find the minimum value of u

$\frac{du}{dt} = 0$ sp we get $t = 6\ sec$ then,

$$u = \frac{45}{6} + 1.25 \times 6 = 7.5 + 7.5 = 15\ m/s$$

726 **(b)**

From the give graph. From 0s to 8s, particle is accelerated, then from 8 to 12 s, particle moves with constant acceleration. The form 12 to 16s, the particle is in the condition of deceleration. Hence, maximum velocity will be during 8s to 12s. During 0 to 4s, the acceleration will be function of time. The equation of straight lines is

$$a = \frac{5}{4}t$$

$$\therefore \frac{dv}{dt} = \frac{5}{4}t$$

$$\therefore v = \int_0^t \frac{5}{4}t\,dt = \frac{5}{4}\frac{t^2}{2} = \frac{5}{8}t^2$$

The velocity at $t = 4$s is $u = 10\text{ms}^{-1}$

The distance travelled during 4 to 8s is

$$s_2 = ut + \frac{1}{2}at^2$$

$$= 10 \times 4 + \frac{1}{2} \times 5 \times 4^2$$

$$= 40 + 40 = 80\text{m}$$

The velocity at $t = 8$s is

$$v = 10 + 5 \times 4 = 30\text{ms}^{-1}$$

This is the maximum velocity.

Tricky approach: The area of $a - t$ graph gives change in velocity. The area of the graph from 0 to 8s

$$= v - u = \frac{1}{2} \times 4 \times 5 + 4 \times 5 = 30$$

But $u = 0$

$v = 30\text{ms}^{-1}$

727 **(d)**

Average velocity $= \frac{Total\ Displacement}{Time\ taken} = \frac{25}{75/15} = 5m/s$

728 **(d)**

Let the body after time $t/2$ be at x from the top, then

$$x = \frac{1}{2}g\frac{t^2}{4} = \frac{gt^2}{8} \quad \text{... (i)}$$

$$h = \frac{1}{2}gt^2 \quad \text{... (ii)}$$

Eliminate t from (i) and (ii), we get $x = \frac{h}{4}$

$\therefore$ Height of the body from the ground $= h - \frac{h}{4} = \frac{3h}{4}$

730 **(b)**

Let v be the velocity of the train after time t_1.

Then $v = \alpha t_1 = \beta t_2; x_1 = \frac{1}{2}\alpha t_1^2$

and $x_2 = \frac{1}{2}\beta t_2^2$

$$\therefore \frac{\beta}{\alpha} = \frac{t_1}{t_2} \text{ and } \frac{x_1}{x_2} = \frac{\alpha t_1^2}{\beta t_2^2} = \frac{\alpha}{\beta} \times \frac{\beta^2}{\alpha^2} = \frac{\beta}{\alpha}$$

$$\therefore \frac{x_1}{x_2} = \frac{\beta}{\alpha} = \frac{t_1}{t_2}$$

731 **(b)**

Speed of stone in a vertically upward direction is $4.9\ m/s$. So for vertical downward motion we will consider $u = -4.9\ m/s$

$$h = ut + \frac{1}{2}gt^2 = -4.9 \times 2 + \frac{1}{2} \times 9.8 \times (2)^2$$

$$= 9.8\ m$$

732 **(d)**

The separation between the two bodies, two seconds after the release of second body

$$= \frac{1}{2} \times 9.8[(3)^2 - (2)^2] = 24.5\ m$$

734 **(b)**

(i) $\frac{\frac{1}{2}\times OA \times AC}{OA} + \frac{\frac{1}{2}\times AB \times AC}{AB} = 1$

(ii) $\tan 60° = \frac{CA}{OA}$ and $\tan 30° = \frac{CA}{AB}$

$OA \tan 60° = AB \tan 30°$

or $\frac{OA}{AB} = \frac{\tan 30°}{\tan 60°} = \frac{1}{\sqrt{3}} \times \frac{1}{\sqrt{3}} = \frac{1}{3}$

735 **(b)**

Velocity of graph = Area of a-t graph

$= (4 \times 1.5) - (2 \times 1) = 4m/s$

736 **(b)**

Given, $x = 2t^2 + 6t + 25$ and $y = t^2 + 2t + 1$

$$\therefore \frac{dx}{dt} = 4t + 6 \text{ and } \frac{dy}{dx} = 2 + 2$$

At $t = 10$ s

$$\frac{dx}{dt} = 4(10) + 6 = 46 \text{ and } \frac{dy}{dt} = 2\,(10) + 2 = 22$$

$$v = \sqrt{\left(\frac{dx}{dt}\right)^2 + \left(\frac{dy}{dt}\right)^2}$$

$$= \sqrt{(46)^2 + (22)^2} \simeq 51\text{m/s}$$

737 **(a)**

$h = -4.9 \times 3 + \frac{1}{2} \times 9.8 \times 3 \times 3 = 5.9 \times 3 \times 2\text{m} = 29.4\text{m}$

738 **(a)**

Total time of motion $= t$

Duration of acceleration $= t'$

Duration of deceleration $= t - t'$

Given $u = 0$, $a =$ constant acceleration and

$b =$ constant deceleration

$v = 0 + at'$

Also $0 = v - b(t - t')$

$\therefore v = at'$

From (ii), $-v = -bt + bt'$

$\Rightarrow -at' = -bt + bt'$

$\Rightarrow (a + b)t' = bt \Rightarrow t' = \frac{b}{(a+b)}t$

But $v = at'$

$\therefore$ Maximum velocity attained $= at'$

$\Rightarrow v = \frac{ab}{(a+b)}t\ m/s$

739 **(a)**

Effective speed of bullet

= speed of bullet + speed of police jeep

$= 180\ m/s + 45\ km/h = (180 + 12.5)\ m/s$

$= 192.5\ m/s$

Speed of thief's jeep $= 153\ km/h = 42.5\ m/s$

Velocity of bullet $w.r.t.$ thief's car $= 192.5 - 42.5 = 150\ m/s$

740 **(b)**

According to given relation acceleration $a = \alpha t + \beta$

As $a = \frac{dv}{dt} \Rightarrow \alpha t + \beta = \frac{dv}{dt}$

Since particle starts from rest, its initial velocity is zero

$i.e.$, At time $t = 0$, velocity $= 0$

$$\Rightarrow \int_0^v dv = \int_0^t (\alpha t + \beta)dt \Rightarrow v = \frac{\alpha t^2}{2} + \beta t$$

741 **(d)**

$u = 200\ m/s, v = 100\ m/s, s = 0.1\ m$

$$a = \frac{u^2 - v^2}{2s} = \frac{(200)^2 - (100)^2}{2 \times 0.1} = 15 \times 10^4\ m/s^2$$

742 **(c)**

For first part,

$u = 0, t = T$ and acceleration $= a$

$\therefore v = 0 + aT = aT$ and $S_1 = 0 + \frac{1}{2}aT^2 = \frac{1}{2}aT^2$

For Second part,

$u = aT$, retardation $= a_1, v = 0$ and time taken $= T_1$ (let)

$\therefore 0 = u - a_1T_1 \Rightarrow aT = a_1T_1$

And from $v^2 = u^2 - 2aS_2 \Rightarrow S_2 = \frac{u^2}{2a_1} = \frac{1}{2}\frac{a^2T^2}{a_1}$

$$S_2 = \frac{1}{2}aT \times T_1 \quad \left(\text{As } a_1 = \frac{aT}{T_1}\right)$$

$$\therefore v_{av} = \frac{S_1 + S_2}{T + T_1} = \frac{\frac{1}{2}aT^2 + \frac{1}{2}aT \times T_1}{T + T_1}$$

$$= \frac{\frac{1}{2}aT(T + T_1)}{T + T_1} = \frac{1}{2}aT$$

743 **(a)**

Velocity $v = \alpha\sqrt{x}$

$$\frac{dx}{dt} = \alpha\sqrt{x} \qquad \left(\because v = \frac{dx}{dt}\right)$$

Or $\frac{dx}{\sqrt{x}} = \alpha\ dt$

Integrating

$$\int_0^x \frac{dx}{\sqrt{x}} = \int_0^t \alpha\ dt$$

[$\because$ at $t = 0, x$

$= 0$ ad let at any time t, paricle is at x]

Or $\frac{x^{1/2}}{1/2} = \alpha t$

Or $x^{1/2} = \frac{\alpha}{2}t$

Or $x = \frac{\alpha^2}{4} \times t^2 \Rightarrow x \propto t^2$

744 **(c)**

From acceleration time graph, acceleration is constant for first part of motion so, for this part velocity of body increases uniformly with time and as $a = 0$ then the velocity becomes constant. Then again increased because of acceleration

745 **(a)**

$0^2 - v^2 = -2aS$ or $v^2 \propto S; \left(v + \frac{20v}{100}\right)^2 \propto S'$

or $\frac{S'}{S} = \left(1 + \frac{20}{100}\right)^2 = \frac{36}{25}$

$\therefore \left(\frac{S'}{S} - 1\right) \times 100 = \left(\frac{36}{25} - 1\right) \times 100 = 44\%$

746 **(c)**

$v = (180 - 16x)^{1/2}$

As $a = \frac{dv}{dt} = \frac{dv}{dx} \cdot \frac{dx}{dt}$

$$\therefore a = \frac{1}{2}(180-16x)^{-1/2} \times (-16)\left(\frac{dx}{dt}\right)$$
$$= -8(180-16x)^{-1/2} \times v$$
$$= -8(180-16x)^{-1/2} \times (180-16x)^{1/2}$$
$$= -8\ m/s^2$$

747 **(b)**

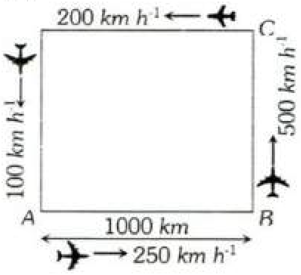
Area under the velocity–time curve over a given time interval gives the displacement of the particle

748 **(a)**

$$\frac{dt}{dx} = 2\alpha x + \beta \Rightarrow v = \frac{1}{2\alpha x + \beta}$$
$$\because a = \frac{dv}{dt} = \frac{dv}{dx}.\frac{dx}{dt}$$
$$a = v\frac{dv}{dx} = \frac{-v.2\alpha}{(2\alpha x+\beta)^2} = -2\alpha.v.v^2 = -2\alpha v^3$$

$\therefore$ Retardation $= 2\alpha v^3$

749 **(d)**



Let t_{AB}, t_{BC}, t_{CD} and t_{DA} be the time taken by the aeroplane to go from A to B, B to C, C to D and D to A respectively

$$\therefore t_{AB} = \frac{1000\ km}{250\ km\ h^{-1}} = 4h$$
$$\therefore t_{BC} = \frac{1000\ km}{500\ km\ h^{-1}} = 2h$$
$$\therefore t_{CD} = \frac{1000\ km}{200\ km\ h^{-1}} = 5h$$
$$\therefore t_{DA} = \frac{1000\ km}{100\ km\ h^{-1}} = 10h$$

Average speed$=\frac{\text{Total distance covered}}{\text{Total time taken}}$

$$= \frac{1000km + 1000km + 1000km + 1000km}{t_{AB} + t_{BC} + t_{CD} + t_{DA}}$$
$$= 190.5\ km\ h^{-1}$$

750 **(b)**

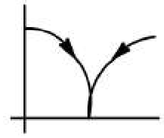
When a ball is dropped on a floor then

$$y = \frac{1}{2}\ gt^2 \qquad \text{...(i)}$$

So, the graph between $y$and t is a parabola. Here y decrease as time decrease. When the ball is bounces back then

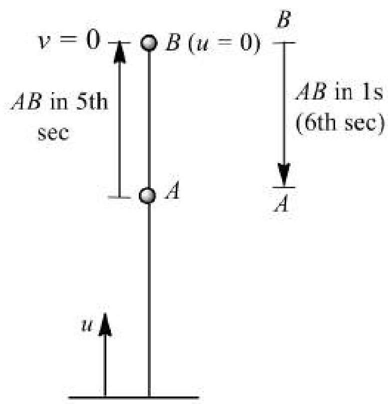
$$y = ut - \frac{1}{2}gt^2 \qquad \text{... (ii)}$$

Eq. (ii) is also the form of a general equation of parabola so the graph between y and t will be a parabola. Here y increases when the time increases. Hence, the required graph between y and $t$is shown in the figure.



751 **(b)**

The distance travelled in t sec in upward motion is



$$s = u - \frac{1}{2}\ g(2t-1)$$
$$\therefore \qquad AB = u - \frac{1}{2}g(2\times 5 - 1)$$
$$AB = u - \frac{1}{2}\ 9g$$

Distance travelled in 1 s in the downward direction is

$$BA = 0 + \frac{1}{2}\ g(1)^2$$

It is given that these distance are equal. Therefore,

$$u - \frac{9g}{2} = \frac{1}{2}g$$
$$\Rightarrow \qquad u = 5 \times 9.8 = 49\ ms^{-1}$$

752 **(d)**

Let the car accelerate at rate α for time t_1 then maximum velocity attained,

$v = 0 + at_1 = at_1$

Now, the car decelerates at a rate β for time $(t - t_1)$ and finally comes to rest. Then,

$0 = v - \beta(t - t_1) \Rightarrow 0 = \alpha t_1 - \beta t + \beta t_1$

$\Rightarrow t_1 = \dfrac{\beta}{\alpha + \beta} t$

$\therefore v = \dfrac{\alpha\beta}{\alpha + \beta} t$

753 **(d)**

Up to time t_1 slope of the graph is constant and after t_1 slope is zero *i.e.* the body travel with constant speed up to time t_1 and then stops

754 **(a)**

$\frac{dv}{dt} = bt$ or $dv = bt\, dt$

$\int_{v_0}^{v} dv = \int_0^t bt\, dt$ or $v - v_0 = \frac{bt^2}{2}$

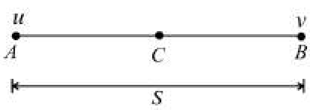
or $v = v_0 = + \frac{bt^2}{2}$

or $dx = v_0 dt + \frac{bt^2}{2} dt$

$\int_0^x dx = \int_0^t v_0 dt + \frac{b}{2}\int_0^t t^2 dt$

or $x = v_0 t + \frac{1}{2}\frac{bt^3}{3} = v_0 t + \frac{bt^3}{6}$

755 **(d)**



Let S be the distance between AB and a be constant acceleration of a particle. Then

$v^2 - u^2 = 2aS$

Or $aS = \frac{v^2 - u^2}{2}$ ... (i)

Let v_c be velocity of a particle at midpoint C

$\therefore v_c^2 - u^2 = 2a\left(\frac{S}{2}\right)$

$v_c^2 = u^2 + aS = u^2 + \frac{v^2 - u^2}{2}$ [Using (i)]

$v_c = \sqrt{\dfrac{u^2 + v^2}{2}}$

756 **(c)**

Displacement of the particle will be zero because it comes back to its starting point

Average speed $= \dfrac{\text{Total distance}}{\text{Total time}} = \dfrac{30m}{10sec}$
$= 3\ m/s$

757 **(a)**

$v = u - gt$

At max height $v^2 = u^2 - 2gh$

$t = \dfrac{u}{g}$ $h = \dfrac{u^2}{2g}$

$\dfrac{t_1}{t_2} = \dfrac{2}{3}$ $\dfrac{h_1}{h_2} = \left(\dfrac{2}{3}\right)^2 = \dfrac{4}{9}$

758 **(b)**

$S_2 = \frac{1}{2} g t_2^2 = \frac{10}{2} \times (3)^2 = 45\ m$

$S_1 = \frac{1}{2} g t_1^2 = \frac{10}{2} \times (5)^2 = 125\ m$

$\therefore S_1 - S_2 = 125 - 45 = 80\ m$

759 **(b)**

The displacement equation is given by

$$x = a_0 + \frac{a_1 t}{2} - \frac{a_2 t^2}{3}$$

Velocity = rate of change of displacement

ie, $v = \dfrac{dx}{dt}$

$= \dfrac{d}{dt}\left(a_0 + \dfrac{a_1 t}{2} - \dfrac{a_2 t^2}{3}\right)$

$= 0 + \dfrac{a_1}{2} - \dfrac{2a_2 t}{3}$

$= \dfrac{a_1}{2} - \dfrac{2a_2 t}{3}$

Acceleration = rate of change of velocity

ie, $a = \dfrac{dv}{dt}$

$= \dfrac{d}{dt}\left(\dfrac{a_1}{2} - \dfrac{2a_2}{3} t\right)$

$= 0 - \dfrac{2a_2}{3}$

$= -\dfrac{2a_2}{3}$

760 **(a)**

$s = 1.2\ m$

$v = 640\ ms^{-1}$

$a = ?;\ u = 0;\ t = ?$

$2\ as = v^2 - u^2$

$\Rightarrow 2a \times 1.2 = 640 \times 640 \Rightarrow a = \dfrac{8 \times 64 \times 10^3}{3}$

$v = u + at \Rightarrow t = \dfrac{v}{a} = \dfrac{15}{4} \times 10^{-3} = 3.75 \times 10^{-3}\ s$

$\approx 4\ ms$

761 **(d)**

$h = \dfrac{1}{2} g t^2 \Rightarrow t = \sqrt{\dfrac{2 \times 1960}{9.8}} = 20\ \text{s}$

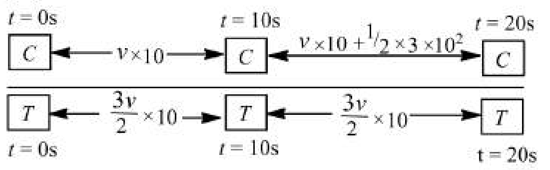
$\therefore \quad s = AB = ut = 600 \times \frac{20}{60 \times 60}$

$= 3.33$ km

762 **(d)**

The area under acceleration-time graph gives change in velocity.

764 **(b)**



The diagram is showing the position of car and truck at various instants.

$$v \times 20 + \frac{1}{2} \times 3 \times 10^2 = \frac{3v}{2} \times 20$$

$$\frac{3}{2} \times 100 = \frac{v}{2} \times 20$$

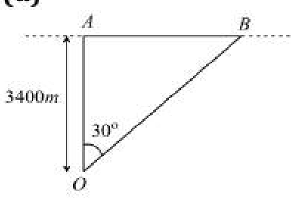
$$v = 15 \text{ ms}^{-1}$$

765 **(b)**

Distance average speed $= \frac{2v_1v_2}{v_1+v_2} = \frac{2\times2.5\times4}{2.5+4}$

$= \frac{200}{65} = \frac{40}{13} km/hr$

766 **(d)**



O is the observation point at the ground. A and B are the positions of aircraft for which $\angle AOB = 30°$. Time taken by aircraft from A to B is 10s

ΔAOB

$\tan 30° = \frac{AB}{3400}$

$AB = 3400 \tan 30° = \frac{3400}{\sqrt{3}} m$

$\therefore$ Speed of aircraft,

$v = \frac{AB}{10} = \frac{3400}{10\sqrt{3}} = 196.3 \; ms^{-1}$

767 **(a)**

Distance = Area covered between velocity and time axis

$= \frac{1}{2}(30+10)10 = 200 \; meter$

768 **(a)**

If a body starts from rest with acceleration α and then retards with retardation β and comes to rest. The total time taken for this journey is t and distance covered is S

Then $S = \frac{1}{2}\frac{\alpha\beta t^2}{(\alpha+\beta)} = \frac{1}{2}\frac{5\times10}{(5+10)} \times t^2$

$\Rightarrow 1500 = \frac{1}{2}\frac{5\times10}{(5+10)} \times t^2 \Rightarrow t = 30 \; sec$

769 **(a)**

According to problem

Distance travelled by body A in 5^{th} sec and distance travelled by body B in 3^{rd} $sec.$ of its motion are equal.

$0 + \frac{a_1}{2}(2\times5-1) = 0 + \frac{a_2}{2}[2\times3-1]$

$9a_1 = 5a_2 \Rightarrow \frac{a_1}{a_2} = \frac{5}{9}$

770 **(b)**

$v = v_0 + gt + ft^2$

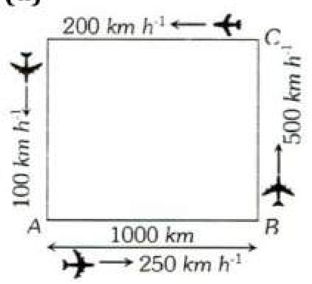
Or $\quad \frac{dx}{dt} = v_0 + gt + ft^2$

Or $\quad dx = (v_0 + gt + ft^2)\, dt$

So, $\quad \int_0^x dx = \int_0^1 (v_0 + gt + ft^2)\, dt$

Or $\quad x = v_0 + \frac{g}{2} + \frac{f}{3}$

771 **(d)**



Let t_{AB}, t_{BC}, t_{CD} and t_{DA} be the time taken by the aeroplane to go from A to B, B to C, C to D and D to A respectively

$\therefore t_{AB} = \frac{1000 \; km}{250 \; km \; h^{-1}} = 4h$

$\therefore t_{BC} = \frac{1000 \; km}{500 \; km \; h^{-1}} = 2h$

$\therefore t_{CD} = \frac{1000 \; km}{200 \; km \; h^{-1}} = 5h$

$\therefore t_{DA} = \frac{1000 \; km}{100 \; km \; h^{-1}} = 10h$

Average speed$= \frac{\text{Total distance covered}}{\text{Total time taken}}$

$= \frac{1000km + 1000km + 1000km + 1000km}{t_{AB} + t_{BC} + t_{CD} + t_{DA}}$

$= 190.5\ km\ h^{-1}$

772 **(b)**

For stone to be dropped from rising balloon of velocity 29 m/s

$u = -29\ m/s, t = 10 sec$

$\therefore h = -29 \times 10 + \frac{1}{2} \times 9.8 \times 100$

$= -290 + 490 = 200\ m$

773 **(d)**

Using, $v = u + at$ or $v - u = at$, we find that if $|\vec{a}|$ is, it t is the time for acceleration, then $\frac{t}{2}$ is the time for retardation

Now, $t + \frac{t}{2} = 3$ or $\frac{3t}{2} = 3$ or $t = 2s$

$S = \frac{1}{2} \times 2 \times 2 \times 2 + \frac{1}{2} \times 4 \times 1 \times 1 = (4 + 2)$m=6m

774 **(c)**

$h = ut + \frac{1}{2}gt^2 \Rightarrow 1 = 0 \times t_1 + \frac{1}{2}gt_1^2 \Rightarrow t_1$

$= \sqrt{2/g}$

Velocity after travelling 1 m distance

$v^2 = u^2 + 2gh \Rightarrow v^2 = (0)^2 + 2g \times 1 \Rightarrow v = \sqrt{2g}$

For second 1 m distance

$1 = \sqrt{2g} \times t_2 + \frac{1}{2}gt_2^2 \Rightarrow gt_2^2 + 2\sqrt{2g}t_2 - 2 = 0$

$t_2 = \frac{-2\sqrt{2g} \pm \sqrt{8g + 8g}}{2g} = \frac{-\sqrt{2} \pm 2}{\sqrt{g}}$

Taking +ve sign $t_2 = (2 - \sqrt{2})/\sqrt{g}$

$\therefore \frac{t_1}{t_2} = \frac{\sqrt{2/g}}{(2-\sqrt{2})/\sqrt{g}} = \frac{1}{\sqrt{2}-1}$ and so on

775 **(a)**

Average speed for other half of distance

$= \frac{4.5 + 7.5}{2} \text{ms}^{-1} = 6\text{ms}^{-1}$

Average speed during whole motion

$= \frac{2 \times 3 \times 6}{3 + 6} \text{ms}^{-1} = 4\text{ms}^{-1}$

776 **(c)**

Given : Initial velocity of a body $u = 0$ ... (i)

Let s be the distance covered by a body in time t

$\therefore s = ut + \frac{1}{2}at^2$ or $s = \frac{1}{2}at^2$ [Using (i)]

$\Rightarrow s \propto t^2$

777 **(b)**

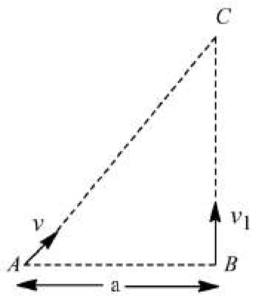
Let two boys meet at point C after time t from the starting. Then,

$$AC = vt, BC = v_1 t$$

$$(AC)^2 = (AB)^2 + (BC)^2$$

$\Rightarrow \quad v^2t^2 = a^2 + v_1^2t^2$

By showing, we get $t = \sqrt{\frac{a^2}{v^2 - v_1^2}}$



778 **(c)**

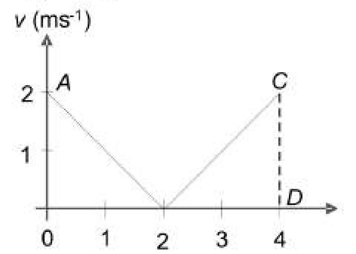
Speed of the object at reaching the ground $v = \sqrt{2gh}$

If heights are equal then velocity will also be equal

780 **(c)**

Since, $v = (t - 2)$, so $v \propto t$. On plotting a graph between v and t we get a straight line AB and BC as shown in figure. The distance covered in 4s is equal to the area under the velocity-time graph = Area of ΔOAB ∓Area of ΔBCD

$= \frac{2 \times 2}{2} + \frac{2 \times 2}{2} = 2 + 2 = 4$m



781 **(b)**

According to problem, when

$s = a, t = p$

$\because s = ut + \frac{1}{2}ft^2$ (here, f =acceleration)

$\therefore a = up + \frac{fp^2}{2}$ (i)

For $s = b, t = q$

$b = uq + \frac{fq^2}{2}$ (ii)

After solving Eqs. (i) and (ii),

$f = \frac{2(aq - bp)}{pq(p - q)}$

782 **(d)**

$u = at, x = \int u\, dt = \int at\, dt = \frac{at^2}{2}$

For $t = 4$ sec, $x = 8a$

783 **(d)**

$s = 3t^3 + 7t^2 + 14t + 8m$

$a = \frac{d^2s}{dt^2} = 18t + 14$ at $t = 1$ sec $\Rightarrow a = 32\ m/s^2$

784 **(a)**

$s = ut + \frac{1}{2}at^2$

$s = \frac{1}{2}at^2$ $\quad [\because u = 0]$

It is an equation of parabola

785 **(c)**

Relativistic momentum $= \frac{m_0 v}{\sqrt{1-v^2/c^2}}$

If velocity is doubled then the relativistic mass also increases. Thus value of linear momentum will be more than double

786 **(a)**

Here, $u = 10\ ms^{-1}, t = 2s, S = 20\ m$

Using $S = ut + \frac{1}{2}at^2$

$\therefore\ 20 = 10 \times 2 + \frac{1}{2} \times a \times 2^2$

$0 = 2a \Rightarrow a = 0$

787 **(b)**

$u = 0, v = 180\ km\ h^{-1} = 50\ ms^{-1}$

Time taken $t = 10s$

$a = \frac{v-u}{t} = \frac{50}{10} = 5\ ms^{-2}$

$\therefore$ Distance covered $S = ut + \frac{1}{2}at^2$

$= 0 + \frac{1}{2} \times 5 \times (10)^2 = \frac{500}{2} = 250\ m$

788 **(d)**

Time of flight $T = \frac{2u}{g} 4$ sec $\Rightarrow u = 20\ m/s$

790 **(d)**

The nature of the path is decided by the direction of velocity, and the direction of acceleration. The trajectory can be a straight line, circle or a parabola depending on these factors

791 **(a)**

$4 = u + \frac{a}{2}(2 \times 3 - 1)$or $4 = u + \frac{5a}{2}$,

$5 = u + \frac{a}{2}(2 \times 4 - 1)$ or $5 = u + \frac{7a}{2}$

Subtracting, $1 = \frac{7a}{2} - \frac{5a}{2} = \frac{2a}{2} = a$

Again, $4 = u + \frac{5}{2}$ or $u = 4 - \frac{5}{2} = 1.5\text{ms}^{-1}$

So, the initial velocity is non-zero and acceleration is uniform.

792 **(b)**

$v = u + \int a dt = u + \int (3t^2 + 2t + 2)dt$

$= u + \frac{3t^3}{3} + \frac{2t^2}{2} + 2t = u + t^3 + t^2 + 2t$

$= 2 + 8 + 4 + 4 = 18\ m/s$ $\quad$ (As $t = 2\ sec$)

793 **(c)**

Total distance to be covered for crossing the bridge

= length of train + length of bridge

$= 150m + 850m = 1000m$

Time $= \frac{\text{Distance}}{\text{Velocity}} = \frac{1000}{45 \times \frac{5}{18}} = 80\ sec$

794 **(b)**

$$\frac{(S)_{(last\ 2s)}}{(S)_{7s}} = \frac{\frac{1}{2} \times 2 \times 10}{\frac{1}{2} \times 2 \times 10 + 2 \times 10 + \frac{1}{2} \times 2 \times 10}$$

$$= \frac{1}{4}$$

795 **(b)**

$v = u + at \Rightarrow -2 = 10 + a \times 4 \Rightarrow a$

$= -3m/\sec^2$

796 **(a)**

Distance covered in 5 s

$$s_1 = \frac{1}{2}at^2$$

$$= \frac{1}{2}a(5)^2 = \frac{25a}{2}$$

Distance covered in 5th second

$$s_2 = \frac{1}{2} \times a(2 \times 5 - 1) = \frac{9}{2}a$$

$$\therefore \quad \frac{s_2}{s_1} = \frac{9}{25}$$

798 **(b)**

Constant velocity means constant speed as well as same direction throughout

799 **(d)**

Average speed $= \frac{\text{Total distance travelled}}{\text{Total time taken}}$

$= \frac{x}{\frac{2x/5}{v_1} + \frac{3x/5}{v_2}} = \frac{5v_1v_2}{3v_1 + 2v_2}$

800 **(d)**

Relative velocity of police man w.r.t. the time$10 - 9 = 1\text{ms}^{-1}$. Since the relative separation between them is 100 m, hence, the time taken will be = relative separation/relative velocity =100/1=100s

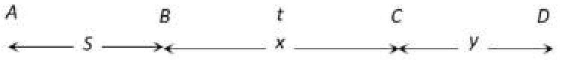
801 **(b)**

Area under the velocity–time curve over a given time interval gives the displacement of the particle

802 **(b)**

Constant velocity means constant speed as well as same direction throughout

803 **(c)**



Let car starts from point A from rest moves up to point B with acceleration f

Velocity of car at point B, $v = \sqrt{2fS}$

[As $v^2 = u^2 + 2as$]

Car moves distance BC with this constant velocity in time t

$x = \sqrt{2fS}.t$ [As $s = ut$] ... (i)

So the velocity of car at point C also will be $\sqrt{2fS}$ and finally car stops after covering distance y

Distance $CD \Rightarrow y = \frac{(\sqrt{2fS})^2}{2(f/2)} = \frac{2fS}{f} = 2S$ ...(ii)

So, the total distance $AD = AB + BC + CD = 15S$ [Given]

$\Rightarrow S + x + 2S = 15\,S \Rightarrow x = 12S$

Substituting the value of x in equation (i) we get

$x = \sqrt{2fS}.t \Rightarrow 12S = \sqrt{2fS}.t \Rightarrow 144S^2 = 2fS.t^2$

$\Rightarrow S = \frac{1}{72}ft^2$

804 **(a)**

According to kinematics equation,

$v = v_0 - g\,t$

Upward direction is taken a positive and downward direction is taken as negative. Hence, $v - t$ graphs is straight line having negative slope.

805 **(c)**

Since acceleration due to gravity is independent of mass, hence time is also independent of mass (or density) of object

806 **(c)**

Given, $t = ax^2 + bx$

Differentiating w.r.t. t

$$\frac{dx}{dt} = 2\,ax\frac{dx}{dt} + b\frac{dx}{dt}$$

$$v = \frac{dx}{dt} = \frac{1}{(2ax + b)}$$

Again differentiating w.r.t. t

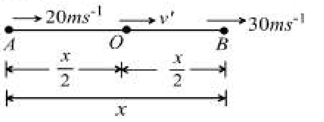
$$\frac{d^2x}{dt^2} = \frac{-2a}{(2\,ax + b)^2}\frac{dx}{dt}$$

$$\therefore f = \frac{d^2x}{dt^2} = \frac{-1}{(2\,ax + b)^2}\cdot\frac{2a}{(2ax + b)}$$

Or $f = \frac{-2a}{(2ax + b)^3}$

$\therefore f = -2av^3$

807 **(a)**



$$\because v'' = \sqrt{\frac{(v_1)^2 + (v_2)^2}{2}} = \sqrt{\frac{900 + 400}{2}} = \sqrt{650}$$

$$= 25.5\,ms^{-1}$$

808 **(a)**

When two particles moves towards each other then

$v_1 - v_2 = 6$ ...(i)

When these particles moves in the same direction then

$v_1 - v_2 = 4$ ...(ii)

By solving $v_1 = 5$ and $v_2 = 1\,m/s$

809 **(c)**

Acceleration of the body along AB is $g\cos\theta$

Distance travelled in time $t\,sec = AB = \frac{1}{2}(g\cos\theta)t^2$

From $\Delta\,ABC, AB = 2R\cos\theta\,; 2R\cos\theta = \frac{1}{2}g\cos\theta t^2$

$\Rightarrow t^2 = \frac{4R}{g}$ or $t = 2\sqrt{\frac{R}{g}}$

810 **(a)**

$v = 3t^2 = 12t + 3; a = 6t - 12$

When $a = 0, 6t - 12 = 0$

or $6t = 12$ or $t = 2$ s When $t = 2$ s,

$v = 3 \times 2 \times 2 - 12 \times 2 + 3 = -9\text{ms}^{-1}$

811 **(c)**

We know that gravity is a universal force with which all bodies are attracted towards the earth. Hence, g is same for both the balls. Also, if t is the time taken by the balls to reach the ground, then from equation of motion.

$$s = ut + \frac{1}{2}gt^2$$

$$\Rightarrow \quad t = \sqrt{\frac{2(s - ut)}{g}}$$

Since s, u and g are same for both, hence time taken by both the balls is same.

812 **(d)**

If t_1 and t_2 are time of ascent and descent respectively then time of flight $T = t_1 + t_2 = \frac{2u}{g}$

$\Rightarrow u = \frac{g(t_1 + t_2)}{2}$

813 **(b)**

Let 'a' be the retardation of boggy then distance covered by it be S. If u is the initial velocity of boggy after detaching from train ($i.e.$ uniform speed of train)

$v^2 = u^2 + 2as \Rightarrow 0 = u^2 - 2as \Rightarrow s_b = \frac{u^2}{2a}$

Time taken by boggy to stop

$v = u + at \Rightarrow 0 = u - at \Rightarrow t = \frac{u}{a}$

In this time t distance travelled by train $= s_t = ut = \frac{u^2}{a}$

Hence ratio $\frac{s_b}{s_1} = \frac{1}{2}$

814 **(b)**

$x = 4(t-2) + a(t-2)^2$

At $t = 0, x = -8 + 4a = 4a - 8$

$v = \frac{dx}{dt} = 4 + 2a(t-2)$

At $t = 0, v = 4 - 4a = 4(1-a)$

But acceleration, $a = \frac{d^2x}{dt^2} = 2a$

815 **(c)**

For upward motion

Effective acceleration $= -(g+a)$

And for downward motion

Effective acceleration $= (g-a)$

But both are constants. So the slope of speed-time graph will be constant

816 **(a)**

Total time of motion $= t$

Duration of acceleration $= t'$

Duration of deceleration $= t - t'$

Given $u = 0$, $a =$ constant acceleration and $b =$ constant deceleration

$v = 0 + at'$

Also $0 = v - b(t - t')$

$\therefore v = at'$

From (ii), $-v = -bt + bt'$

$\Rightarrow -at' = -bt + bt'$

$\Rightarrow (a+b)t' = bt \Rightarrow t' = \frac{b}{(a+b)}t$

But $v = at'$

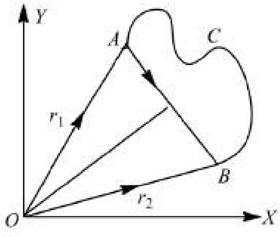
$\therefore$ Maximum velocity attained $= at'$

$\Rightarrow v = \frac{ab}{(a+b)}t\ m/s$

817 **(d)**

The average speed

$$v_{av} = \frac{\text{length of path } ACB}{\text{time interval } (t_2 - t_1)} \quad \text{... (i)}$$



And average velocity,

$$\mathbf{v}_{av} = \frac{\text{displacement}}{\text{time interval}} = \frac{\mathbf{r}_2 - \mathbf{r}_1}{t_2 - t_1} \quad \text{... (ii)}$$

But we know that distance is always be greater than or equal to magnitude of displacement. So the average speed will always be greater than or equal to the magnitude of average velocity.

From Eqs. (i) and (ii)

$$\frac{\mathbf{v}_{av}}{v_{av}} = \frac{\text{displacement}}{\text{length of path (distance)}} \leq 1$$

818 **(d)**

Let the thickness of each plank is d.

From equation of motion

$$v^2 = u^2 + 2as \quad \text{... (i)}$$

Ist case

$$s = 2d, u = 100\ \text{ms}^{-1}, v = 0$$

$\therefore \quad 0 = (100)^2 + 2a \times 2d$

Or $\quad 4ad = -100 \times 100$

Or $\quad a = -\frac{100 \times 100}{4d}$

$\therefore \quad a = -\frac{2500}{d} \quad \text{... (ii)}$

IInd case Let the bullet with double the previous speed will penetrate n planks of equal thickness d.

Now, $v = 0, u = 200\ \text{ms}^{-1}, a = -\frac{2500}{d}, s = nd$

$$0 = (200)^2 - 2 \times \frac{2500}{d} \times nd$$

Or $n = \frac{200 \times 200}{2 \times 2500} = 8$

819 **(b)**

Velocity at 3s = total algebraic sum of area under the curve

$$v = 4 \times 2 - 4 \times 1 = 4\ \text{m/s}$$

820 **(b)**

Let car B catches, car A after 't'sec, then

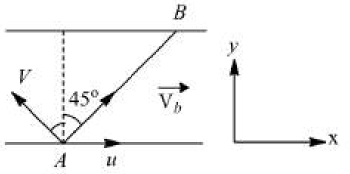
$60t + 2.5 = 70t - \frac{1}{2} \times 20 \times t^2$

$\Rightarrow 10t^2 - 10t + 2.5 = 0 \Rightarrow t^2 - t + 0.25 = 0$

$\therefore t = \frac{\sqrt{1 - 4 \times (0.25)}}{2} = \frac{1}{2} hr$

821 **(b)**

Let v be the speed of boatman is still water.



Resultant of v and u should be along AB. Components of $\vec{v}_b$ (absolute velocity of boatman)along x and y direction are,

$v_x = u - v \sin\theta$

Further, $\tan 45° = \frac{v_y}{v_x}$

or $1 = \frac{v \cos\theta}{u - v \sin\theta}$

$v = \frac{u}{\sin\theta + \cos\theta} = \frac{u}{\sqrt{2}\sin(\theta + 45°)}$

v is minimum at,

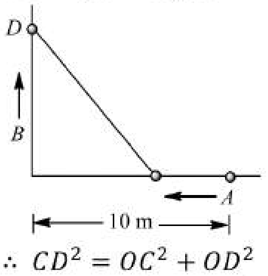
$\theta + 45° = 90°$ or $\theta = 45°$

and $v_{min} = \frac{u}{\sqrt{2}}$

822 **(c)**

At D then the distance CD is least. Therefore,

$OC = (10 - 3t)$m



$\therefore CD^2 = OC^2 + OD^2$

$= (10 - 3t)^2 + (4t)^2$

$= 25t^2 - 60t + 100$

or $CD = [(5t - 6)^2 + 64]^{1/2}$

CD is least if $(5t - 6)^2 = 0$ or $5t - 6 = 0$

or $5t = 6$ or $6 = t/5 = 1.2$s

So, $AC = 3 \times 1.2 = 3.6$m: $CD = (64)^{1/2}$=8m.

823 **(a)**

$s = 1.2\ m$

$v = 640\ ms^{-1}$

$a = ?; u = 0;\ t = ?$

$2\ as = v^2 - u^2$

$\Rightarrow 2a \times 1.2 = 640 \times 640 \Rightarrow a = \frac{8 \times 64 \times 10^3}{3}$

$v = u + at \Rightarrow t = \frac{v}{a} = \frac{15}{4} \times 10^{-3} = 3.75 \times 10^{-3}\ s$

$\approx 4\ ms$

824 **(b)**

Time of ascent $= \frac{u}{g} = 6$ sec $\Rightarrow u = 60 m/s$

Distance in first second $h_{\text{first}} = 60 - \frac{g}{2}(2 \times 1 - 1) = 55m$

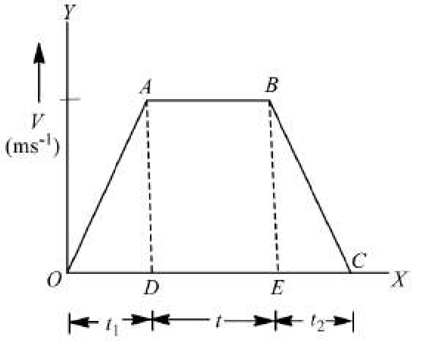
Distance in seventh second will be equal to the distance in first second of vertical downward motion

$h_{\text{seventh}} = \frac{g}{2}(2 \times 1 - 1) = 5\ m \Rightarrow h_{\text{first}}/h_{\text{seventh}}$

$= 11:1$

825 **(d)**

The velocity-time graph for the given situation can be drawn as below. Magnitudes of slope of $OA = f$



And slope of $BC = \frac{f}{2}$

$$v = f\ t_1 = \frac{f}{2} t_2$$

$t_2 = 2t_1$

In graph area of ΔOAD gives

Distance, $S = \frac{1}{2}\ f\ t_1^2$ .... (i)

Area of rectangle $ABED$ gives distance travelled in time t.

$S_2 = (f\, t_1)t$

Distance travelled in time t_2 =

$S_3 = \frac{1}{2}\frac{f}{2}(2t_1)^2$

Thus, $S_1 + S_2 + S_3 = 15\, S$

$S + (ft_1)t + ft_1^2 = 15\, S$

$S + (ft_1)t + 2S = 15\, S \qquad \left(S = \frac{1}{2}\, ft_1^2\right)$

$(ft_1)t = 12\, S \qquad$ ... (ii)

From Eqs. (i) and (ii), we have

$\frac{12\, S}{S} = \frac{(ft_1)t}{\frac{1}{2}(ft_1)t_1}$

$\therefore t_1 = \frac{t}{6}$

From Eq. (i), we get

$\therefore S = \frac{1}{2}\, f(t_1)^2$

$\therefore S = \frac{1}{2}\, f\left(\frac{t}{6}\right)^2 = \frac{1}{72}\, ft^2$

826 **(d)**

The straight vertical line in the graph represents change in the direction of velocity.

827 **(b)**

Given, $a = \frac{dv}{dt} = 6t + 5$

Integrating it $\int_0^v dv = \int_0^t (6t + 5)dt$

$v = \frac{6t^2}{2} + 5t$

As $v = \frac{ds}{dt}$, so $ds = \left(\frac{6t^2}{2} + 5t\right)dt$

$s = 3\frac{t^3}{3} + \frac{5t^2}{2}$

Where $t = 2$s, $s = 3 \times \frac{2^3}{3} + \frac{5\times 2^2}{2} = 18$m

828 **(b)**

$2 = \sqrt{\frac{2\times 19.6}{g}}$ or $g = \frac{2\times 19.6}{4} = 9.8\text{ms}^{-2}$

829 **(d)**

Man walks from his home to market with a speed of 5 km/h. Distance= 2.5 km and time $= \frac{d}{v} = \frac{2.5}{5} = \frac{1}{2}\, hr$ and he returns back with speed of 7.5 km/h in rest of time of 10 $minutes$

Distance $= 7.5 \times \frac{10}{60} = 1.25\, km$

So, Average speed $= \frac{\text{Total distance}}{\text{TOtal time}}$

$= \frac{(2.5 + 1.25)km}{(40/60)hr} = \frac{45}{8}\, km/hr$

830 **(a)**

When the body is projected vertically upward then at the highest point its velocity is zero but acceleration is not equal to zero ($g = 9.8\text{m/s}^2$)

831 **(d)**

By the time 5th water drop starts falling, the first water drop reaches the ground.

As $u = 0$, $h = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times t^2$

or $5 = \frac{1}{2} \times 10 \times t^2$ or $t = 1$ s

Hence, the interval of each water drop $= \frac{1s}{4} =$ 0.25s.

When the 5th drop starts its journey towards ground, the third drop travels in air for

$t_1 = 0.25 + 0.25 = 0.5$s

$\therefore$ Height (distance) covered by 3rd drop in air is

$h_1 = \frac{1}{2}gt_1^2 = \frac{1}{2} \times 10 \times (0.5)^2$

$= 5 \times 0.25 = 1.25$m

So, third water drop will be at a height of

$= 5 - 1.25 = 3.75$m

832 **(a)**

$1900 = \frac{1}{2} \times 0.4[(120)^2 - (120 - t^2)]$

or $\frac{1900}{0.2} = (240 - t)t$ or $9500 = 240t - t^2$

or $t^2 - 240t + 9500 = 0$

or $t^2 - 190t - 50t + 9500 = 0$

or $t(t - 190) - 50(t - 190) = 0$

or $(t - 50)(t - 190) = 0 \Rightarrow t = 50\text{s}, 190\text{s}$

Rejecting $t = 190$ s, we get $t = 50$ s

833 **(b)**

Let the stone remains in air for t s. From $S = ut + \frac{1}{2}gt^2$

Here, $u = 0$, $S = \frac{1}{2}gt^2$

Total distance travelled by the stone in last second is

$D = S_t - S_{t-1} = \frac{1}{2}gt^2 - \frac{1}{2}g(t-1)^2$

Distance travelled by the stone in first three seconds is

$S_3 = \frac{1}{2} \times g \times 3^2 = \frac{9}{2}g$

According to given problem, $D = S_3$

$\therefore \frac{g}{2}(2t-1) = \frac{9}{2}g$ or $2t - 1 = 9 \Rightarrow t = 5s$

834 **(b)**

Time taken by first drop to reach the ground $t = \sqrt{\frac{2h}{g}} \Rightarrow t = \sqrt{\frac{2\times5}{10}} = 1$ sec

As the water drops fall at regular intervals from a tap therefore time difference between any two drops $= \frac{1}{2}$sec

In this given time, distance of second drop from the tap $= \frac{1}{2}g\left(\frac{1}{2}\right)^2 = \frac{10}{8} = 1.25\ m$

Its distance from the ground $= 5 - 1.25 = 3.75m$

835 **(c)**

$v = \sqrt{2gh} = \sqrt{2\times10\times20} = 20m/s$

836 **(c)**

Given : Initial velocity of a body $u = 0$ ... (i)

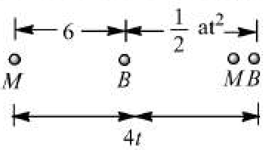
Let s be the distance covered by a body in time t

$\therefore s = ut + \frac{1}{2}at^2$ or $s = \frac{1}{2}at^2$ [Using (i)]

$\Rightarrow s \propto t^2$

837 **(a)**

As the clear from figure



$4t = 6 + \frac{1}{2}\times1.2\times t^2$

or $4t = 6 + 0.6t^2$

838 **(b)**

$v = u + at$ As $u = 0, v = at$

The graph (b) is correct as $v = 0$ at $t = 0$, and in the straight line graph $y = mx, y = v, m = a$ and $t = x$

839 **(c)**

Since, the object accelerates from rest, its initial velocity u is zero. $ie, u = 0$

From first equation of motion

$$v = u + at$$

$\therefore$ $27.5 = 0 + a\times10$

Or $a = 2.75\ \text{ms}^{-2}$

Hence, distance covered in first 10 s

$$s_1 = ut + \frac{1}{2}at^2$$

$$= 0 + \frac{1}{2}\times2.75\times(10)^2 = 137.5\text{ m}$$

Distance covered in next 10 s with uniform velocity of 27.5 ms^{-1}

$$s_2 = 27.5\times10 = 275\text{ m}$$

Total distance covered

$$s = 137.5 + 275 = 412.5\text{ m}$$

840 **(b)**

Distance covered =Area enclosed by $v - t$ graph

= Area of triangle $= \frac{1}{2}\times4\times8 = 16\ m$

MOTION IN A STRAIGHT LINE

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: The speedometer of an automobile measure the average speed of the automobile

Statement 2: Average velocity is equal to total displacement per total time taken

2

Statement 1: Rocket in flight is not an illustration of projectile

Statement 2: Rocket takes flight due to combustion of fuel and does not move under the gravity effect alone

3

Statement 1: A body, whatever its motion is always at rest in a frame of reference which is fixed to the body itself

Statement 2: The relative velocity of a body with respect to itself is zero

4

Statement 1: The equation of motion can be applied only if acceleration is along the direction of velocity and is constant

Statement 2: If the acceleration of a body is constant then its motion is known as uniform motion

5

Statement 1: A bus moving due north takes a turn and starts moving towards east with same speed. There will be no change in the velocity of bus

Statement 2: Velocity is a vector-quantity

6

Statement 1: A negative acceleration of a body can be associated with a '*speeding up*' of the body

Statement 2: Increase in speed of a moving body is independent of its direction of motion

7

Statement 1: Position-time graph of a stationary object is a straight line parallel to time axis

Statement 2: For a stationary object, position does not change with time

8

Statement 1: A positive acceleration of a body can be associated with a '*slowing down*' of the body

Statement 2: Acceleration is vector quantity

9

Statement 1: For an observer looking out through the window of a fast moving train, the nearby objects appear to move in the opposite direction to the train, while the distant objects appear to be stationary

Statement 2: If the observer and the object are moving at velocities $\vec{V}_1$ and $\vec{V}_2$ respectively with reference to a laboratory frame, the velocity of the object with respect to the observer is $\vec{V}_2 - \vec{V}_1$

10

Statement 1: A positive acceleration of a body can be associated with a '*slowing down*' of the body

Statement 2: Acceleration is vector quantity

11

Statement 1: The position-time graph of a uniform motion in one dimension of a body can have negative slope

Statement 2: When the speed of body decreases with time, the position-time graph of the moving body can have negative slope

12

Statement 1: A body may be accelerated even when it is moving uniformly

Statement 2: When direction of motion of the body is changing then body may have acceleration

13

Statement 1: Rocket in flight is not an illustration of projectile

Statement 2: Rocket takes flight due to combustion of fuel and does not move under the gravity effect alone

14

Statement 1: The speedometer of an automobile measure the average speed of the automobile

Statement 2: Average velocity is equal to total displacement per total time taken

15

Statement 1: The average and instantaneous velocities have same value in a uniform motion

Statement 2: In uniform motion, the velocity of an object increases uniformly

16

Statement 1: A body is dropped from a height of 40.0m. After it falls by half the distance, the acceleration due to gravity ceases to act. The velocity with which it hits the ground is $20ms^{-1}$(Take $g = 10ms^{-2}$)

Statement 2: $v^2 = u^2 + 2as$

17

Statement 1: An object can have constant speed is a scalar quantity

Statement 2: Speed is a scalar but velocity is a vector quantity

18

Statement 1: A body falling freely may do so with constant velocity

Statement 2: The body falls freely, when acceleration of a body is equal to acceleration due to gravity

19

Statement 1: Velocity-time graph for an object in uniform motion along a straight path is a straight line parallel to the time axis

Statement 2: In uniform motion of an object velocity increases as the square of time elapsed

20

Statement 1: A body having non-zero acceleration can have a constant velocity

Statement 2: Acceleration is the rate of change of velocity

21

Statement 1: The relative velocity between any two bodies moving in opposite direction is equal to sum of the velocities of two bodies

Statement 2: Sometimes relative velocity between two bodies is equal to difference in velocities of the two

22

Statement 1: The position-time graph of a body moving uniformly is a straight line parallel to position axis

Statement 2: The slope of position-time graph in a uniform motion gives the velocity of an object

23

Statement 1: A bus moving due north takes a turn and starts moving towards east with same speed. There will be no change in the velocity of bus

Statement 2: Velocity is a vector-quantity

24

Statement 1: Position-time graph of a stationary object is a straight line parallel to time axis

Statement 2: For a stationary object, position does not change with time

25

Statement 1: A body moving with a uniform velocity is in equilibrium.

Statement 2: A boy can move with a uniform velocity if a constant force is acting on it.

26

Statement 1: For an observer looking out through the window of a fast moving train, the nearby objects appear to move in the opposite direction to the train, while the distant objects appear to be stationary

Statement 2: If the observer and the object are moving at velocities $\vec{V}_1$ and $\vec{V}_2$ respectively with reference to a laboratory frame, the velocity of the object with respect to the observer is $\vec{V}_2 - \vec{V}_1$

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Statement 1: The relative velocity between any two bodies moving in opposite direction is equal to sum of the velocities of two bodies

Statement 2: Sometimes relative velocity between two bodies is equal to difference in velocities of the two

29

Statement 1: Distance-time graph of the motion of a body having uniformly accelerated motion is a straight line inclined to the time axis

Statement 2: Distance travelled by a body having uniformly accelerated motion is directly proportional to the square of the time taken

30

Statement 1: The average velocity of the object over an interval of time is either smaller than or equal to the average speed of the object over the same interval

Statement 2: Velocity is vector quantity and speed is a scalar quantity

31

Statement 1: The position-time graph of a uniform motion in one dimension of a body can have negative slope

Statement 2: When the speed of body decreases with time, the position-time graph of the moving body can have negative slope

32

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Statement 2: The slope of position-time graph in a uniform motion gives the velocity of an object

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Statement 1: Displacement of a body is vector sum of the area under velocity-time graph

Statement 2: Displacement is a vector quantity

34

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Statement 2: The body falls freely, when acceleration of a body is equal to acceleration due to gravity

37

Statement 1: A body, whatever its motion is always at rest in a frame of reference which is fixed to the body itself

Statement 2: The relative velocity of a body with respect to itself is zero

38

Statement 1: Displacement of a body may be zero when distance travelled by it is not zero

Statement 2: The displacement is the longest distance between initial and final position

39

Statement 1: The slope of displacement-time graph of a body moving with high velocity is steeper than the slope of displacement-time graph of a body with low velocity

Statement 2: Slope of displacement-time graph = Velocity of the body

40

Statement 1: The relative velocity between any two bodies may be equal to sum of the velocities of two bodies.

Statement 2: Some times, relative velocity between two bodies may be equal to difference in velocities of the two.

41

Statement 1: The average velocity of the object over an interval of time is either smaller than or equal to the average speed of the object over the same interval

Statement 2: Velocity is vector quantity and speed is a scalar quantity

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Statement 1: The equation of motion can be applied only if acceleration is along the direction of velocity and is constant

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46

Statement 1: The average and instantaneous velocities have same value in a uniform motion

Statement 2: In uniform motion, the velocity of an object increases uniformly

47

Statement 1: A car moving with a speed of 25ms^{-1} takes U turn in 5 s, without changing its speed. The average acceleration during these 5 s is 5ms^{-2}.

Statement 2: Acceleration$= \frac{\text{change in velocity}}{\text{time taken}}$.

48

Statement 1: A negative acceleration of a body can be associated with a '*speeding up*' of the body

Statement 2: Increase in speed of a moving body is independent of its direction of motion

49

Statement 1: Velocity-time graph for an object in uniform motion along a straight path is a straight line parallel to the time axis

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Statement 2: When the speed of body decreases with time, the position-time graph of the moving body has negative slope.

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Statement 1: A body may be accelerated even when it is moving uniformly

Statement 2: When direction of motion of the body is changing then body may have acceleration

MOTION IN A STRAIGHT LINE

: ANSWER KEY :

1)	d	2)	a	3)	a	4)	d	29)	d	30)	a	31)	c	32)	d
5)	d	6)	b	7)	a	8)	b	33)	a	34)	a	35)	d	36)	d
9)	b	10)	b	11)	c	12)	d	37)	a	38)	c	39)	a	40)	b
13)	a	14)	d	15)	c	16)	a	41)	a	42)	d	43)	a	44)	a
17)	a	18)	d	19)	c	20)	d	45)	c	46)	c	47)	d	48)	b
21)	b	22)	d	23)	d	24)	a	49)	c	50)	c	51)	d		
25)	c	26)	b	27)	d	28)	b								

MOTION IN A STRAIGHT LINE

: HINTS AND SOLUTIONS :

1 **(d)**

Speedometer measures instantaneous speed of automobile

2 **(a)**

Motion of rocket is based on action reaction phenomena and is governed by rate of fuel burning causing the change in momentum of ejected gas

3 **(a)**

A body has no relative motion with respect to itself. Hence if a frame of reference of the body is fixed, then the body will be always at relative rest in this frame of reference

4 **(d)**

Equation of motion can be applied if the acceleration is in opposite direction to that of velocity and uniform motion mean the acceleration is zero

5 **(d)**

As velocity is a vector quantity, its value changes with change in direction. Therefore when a bus takes a turn from north to east its velocity will also change

6 **(b)**

A body having negative acceleration can be associated with a speeding up, if object moves along negative X-direction with increasing speed

7 **(a)**

Position- time graph for a stationary object is a straight line parallel to time axis showing that no change in position with time

8 **(b)**

A body having positive acceleration can be associated with slowing down, as time rate of change of velocity decreases, but velocity increases with time, from graph it is clear that slope with time axis decreases in speed *i. e.* retardation in motion

9 **(b)**

Statement 1 is based on visual experience. Statement 2 is formula of relative velocity. But it does not explains Statement 1. The correct explanation of Statement 1 is due to visual perception of motion (due angular velocity). The object appears to be faster when its angular velocity is greater w.r.t. observer

10 **(b)**

A body having positive acceleration can be associated with slowing down, as time rate of change of velocity decreases, but velocity increases with time, from graph it is clear that slope with time axis decreases in speed *i. e.* retardation in motion

11 **(c)**

Negative slope of position time graph represents that the body is moving towards the negative direction and if the slope of the graph decrease with time then it represents the decrease in speed *i. e.* retardation in motion

12 **(d)**

The uniform motion of a body means that the body is moving with constant velocity, but if the direction of motion is changing (such as in uniform circular motion), its velocity changes and thus acceleration is produced in uniform motion

13 **(a)**

Motion of rocket is based on action reaction phenomena and is governed by rate of fuel burning causing the change in momentum of ejected gas

14 **(d)**

Speedometer measures instantaneous speed of automobile

15 **(c)**

An object is said to be in uniform motion if it undergoes equal displacement in equal intervals if time

$$\therefore v_{av} = \frac{s_1 + s_2 + s_3 + \cdots}{t_1 + t_2 + t_3 + \cdots} = \frac{s + s + s + \cdots}{t + t + t + \cdots} = \frac{ns}{nt} = \frac{s}{t}$$

and $v_{ins} = \frac{s}{t}$

thus, in uniform motion average and instantaneous velocities have same value and body moves with constant velocity

16 **(a)**

Here, $u = 0, a = 10\text{ms}^{-2}, s = 40/2 = 20\text{m}$

Using the relation $v^2 = u^2 + 2as = 0 + 2 \times 10 \times 20 = 400$ or $v = 20\text{ms}^{-1}$. Thus both the Assertion and Reason are correct and Reason is the correct explanation of Assertion.

17 **(a)**

Since velocity is a vector quantity, hence as its direction changes keeping magnitude constant, velocity is said to be changed. But for constant speed in equal time interval distance travelled should be equal

18 **(d)**

When a body falling freely, only gravitational force acts on it in vertically downward direction. Due to this downward acceleration the velocity of a body increases and will be maximum when the body touches the ground

19 **(c)**

In uniform motion the object moves with uniform velocity, the magnitude of its velocity at different instant $i.e.$ at $t = 0, t = 1sec, t = 2\ sec$, ...will always be constant. Thus velocity-time graph for an object in uniform motion along a straight path is a straight line parallel to time axis

20 **(d)**

As per definition, acceleration is the rate of change of velocity, $i.e.\ \vec{a} = \frac{d\vec{v}}{dt}$.

If velocity is constant $d\vec{v}/dt = 0, \therefore \vec{a} = 0$

Therefore, if a body has constant velocity it cannot have non zero acceleration

21 **(b)**

When two bodies are moving in opposite direction, relative velocity between them is equal to sum of the velocity of bodies. But if the bodies are moving in same direction their relative velocity is equal to difference in velocity of the bodies

22 **(d)**

If the position-time graph of a body moving uniformly is a straight line parallel to position axis, it means that the position of body is changing at constant time. The statement is abrupt and shows that the velocity of body is infinite

23 **(d)**

As velocity is a vector quantity, its value changes with change in direction. Therefore when a bus takes a turn from north to east its velocity will also change

24 **(a)**

Position- time graph for a stationary object is a straight line parallel to time axis showing that no change in position with time

25 **(c)**

Here Assertion is correct but Reason is wrong because a constant force on body will produce a constant acceleration in the body.

26 **(b)**

Statement 1 is based on visual experience. Statement 2 is formula of relative velocity. But it does not explains Statement 1. The correct explanation of Statement 1 is due to visual perception of motion (due angular velocity). The object appears to be faster when its angular velocity is greater w.r.t. observer

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Therefore, if a body has constant velocity it cannot have non zero acceleration

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When two bodies are moving in opposite direction, relative velocity between them is equal to sum of the velocity of bodies. But if the bodies are moving in same direction their relative velocity is equal to difference in velocity of the bodies

29 **(d)**

For distance-time graph, a straight line inclined to tome axis measures uniform speed for which acceleration is zero and for uniformly accelerated motion $S \propto t^2$

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Negative slope of position time graph represents that the body is moving towards the negative direction and if the slope of the graph decrease with time then it represents the decrease in speed $i.e.$ retardation in motion

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If the position-time graph of a body moving uniformly is a straight line parallel to position axis, it means that the position of body is changing at constant time. The statement is abrupt and shows that the velocity of body is infinite

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According to definition, displacement= velocity × time

Since displacement is a vector quantity so its value is equal to the vector sum of the area under velocity-time graph

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38 **(c)**

The displacement is the shortest distance between initial and final position. When final position of a body coincides with its initial position, displacement is zero, but the distance travelled is not zero

39 **(a)**

Since slope of displacement-time graph measures velocity of an object

40 **(b)**

When two bodies are moving in opposite directions, relative velocity between them is equal to sum of the velocities of two bodies.

42 **(d)**

Equation of motion can be applied if the acceleration is in opposite direction to that of velocity and uniform motion mean the acceleration is zero

43 **(a)**

Since slope of displacement-time graph measures velocity of an object

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Since velocity is a vector quantity, hence as its direction changes keeping magnitude constant, velocity is said to be changed. But for constant speed in equal time interval distance travelled should be equal

45 **(c)**

The displacement is the shortest distance between initial and final position. When final position of a body coincides with its initial position, displacement is zero, but the distance travelled is not zero

46 **(c)**

An object is said to be in uniform motion if it undergoes equal displacement in equal intervals if time

$$\therefore v_{av} = \frac{s_1 + s_2 + s_3 + \cdots}{t_1 + t_2 + t_3 + \cdots} = \frac{s + s + s + \cdots}{t + t + t + \cdots} = \frac{ns}{nt} = \frac{s}{t}$$

and $v_{ins} = \frac{s}{t}$

thus, in uniform motion average and instantaneous velocities have same value and body moves with constant velocity

47 **(d)**

$$\text{Acceleration} = \frac{\text{change in velocity}}{\text{time taken}}$$

$$= \frac{25 - (-25)}{5} = 10\text{ms}^{-2}.$$

Hence assertion is wrong but Reason is correct.

48 **(b)**

A body having negative acceleration can be associated with a speeding up, if object moves along negative X-direction with increasing speed

49 **(c)**

In uniform motion the object moves with uniform velocity, the magnitude of its velocity at different instant $i.e.$ at $t = 0, t = 1sec, t = 2\ sec$, ...will always be constant. Thus velocity-time graph for an object in uniform motion along a straight path is a straight line parallel to time axis

50 **(c)**

The position-time graph of a moving body in one dimension can have negative slope if its velocity in negative

51 **(d)**

The uniform motion of a body means that the body is moving with constant velocity, but if the direction of motion is changing (such as in uniform circular motion), its velocity changes and thus acceleration is produced in uniform motion