Practice Problems

Problems based on distance and displacement

▶ Basic level

1. A body moves 6 m north. 8 m east and 10m vertically upwards, what is its resultant displacement from initial position **[DCE 2000]**

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

2. An athlete completes one round of a circular track of radius R in 40 seconds. What will be his displacement at the end of 2 minutes 20 seconds **[NCERT 1990]**

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

3. A boy stops after travelling 3 km towards east and then goes 4 km towards north along a plane road. The resultant displacement of the boy is

(a) 7 km (b) 4 km (c) 5 km (d) 15 km

4. If the displacement of a particle is zero, then what can we say about its distance covered

(a) It must be zero (b) It cannot be zero (c) It is negative (d) It may or may not be zero

5. The location of a particle has changed. What can we say about the displacement and the distance covered by the particle

(a) Both cannot be zero (b) One of the two may be zero

(c) Both must be zero (d) If one is positive, the other is negative and vice versa

▶▶ Advance level

6. A particle moves along a circular arc of radius R making an angle of θ at centre. The magnitude of displacement is

(a) $2R\sin\theta/2$ (b) $2R\sin\theta$ (c) $R\sin\theta/2$ (d) $R\sin\theta$

Problems based on speed and velocity

▶ Basic level

7. The ratio of the numerical values of the average velocity and average speed of a body is always **[MP PET 2002]**

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

8. A particle moves along a semicircle of radius 10m in 5 seconds. The velocity of the particle is **[Kerala (Engg.) 2001]**

(a) $2\pi\ ms^{-1}$ (b) $4\pi\ ms^{-1}$ (c) $2\ ms^{-1}$ (d) $4\ ms^{-1}$

9. 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 *meters* is **[CBSE PMT 2001]**

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

10. A car moves for half of its time at 80 km/h and for rest half of time at 40 km/h. Total distance covered is 60 km. What is the average speed of the car **[RPET 1996]**

(a) 60 km/h (b) 80 km/h (c) 120 km/h (d) 180 km/h

11. 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 **[MNR 1987; MP PET 1996]**

(a) $-5\ m/s$ (b) $6\ m/s$ (c) $-3\ m/s$ (d) $3\ m/s$

12. A car travels a distance of 2000 m. If the first half distance is covered at 40 $km/hour$ and the second half with speed v and the average speed is 48 $km/hour$, then the value of v is **[CBSE PMT 1989]**

(a) 56 $km/hour$ (b) 60 $km/hour$ (c) 50 $km/hour$ (d) 48 $km/hour$

13. A car travels a distance S on a straight road in two hours and then returns to the starting point in the next three hours. Its average velocity is

(a) $S/5$ (b) $2S/5$ (c) $S/2 + S/3$ (d) None of the above

14. When a particle moves with uniform velocity, which of the following relations are correct

(I) Average speed = average velocity

(II) Instantaneous speed = instantaneous velocity

(III) Distance covered = magnitude of displacement

(a) I, II, III (b) I, II (c) II, III (d) I, III

15. When a particle moves with variable velocity, which of the following statements are not correct

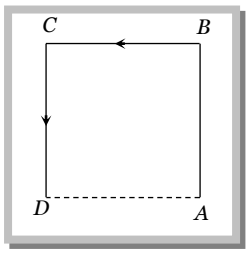
(I) Average speed = average velocity

(II) Instantaneous speed = instantaneous velocity

(III) Distance covered = magnitude of displacement

(a) I, II,III (b) I, II (c) II, III (d) I, III

16. A particle moves along the sides AB, BC, CD of a square of side 25 m with a velocity of 15 ms^{-1}. Its average velocity is



(a) $15\ ms^{-1}$ (b) $10\ ms^{-1}$ (c) $7.5\ ms^{-1}$ (d) $5\ ms^{-1}$

17. A body has speed 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) $\frac{11}{18}V$

▶▶ *Advance level*

18. 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 this motion is **[IIT-JEE 199**

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

19. If the body covers one-third distance at speed v_1, next one third at speed v_2 and last one third at speed v_3, then average speed will be

(a) $\frac{v_1 v_2 + v_2 v_3 + v_3 v_1}{v_1 + v_2 + v_3}$ (b) $\frac{v_1 + v_2 + v_3}{3}$ (c) $\frac{v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$ (d) $\frac{3v_1 v_2 v_3}{v_1 v_2 + v_2 v_3 + v_3 v_1}$

20. 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

21. The displacement of a particle is given by $\sqrt{x} = t + 1$. Which of the following statements about its velocity is true

(a) It is zero (b) It is constant but not zero (c) It increases with time (d) It decreases with time

Problems based on acceleration

▶ *Basic level*

22. 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 **[CBSE PMT 1994; JIPMER 2001, 02]**

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

23. 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 **[BHU 2000]**

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

24. The displacement is given by $x = 2t^2 + t + 5$, the acceleration at $t = 2s$ is **[EAMCET (Engg.)1995]**

(a) $4\ m/s^2$ (b) $8\ m/s^2$ (c) $10\ m/s^2$ (d) $15\ m/s^2$

25. The velocity of a body depends on time according to the equation $v = 20 + 0.1t^2$. The body is undergoing **[MNR 1995; UPSEAT 2000]**

(a) Uniform acceleration (b) Uniform retardation (c) Non-uniform acceleration (d) Zero acceleration

26. The displacement of a body is given to be proportional to the cube of time elapsed. The magnitude of the acceleration of the body is **[NCERT 1990]**

(a) Increasing with time (b) Decreasing with time (c) Constant but not zero (d) Zero

27. The correct statement from the following is **[MP PET 1993]**

(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

28. A particle moves along a straight line such that its displacement at any time t is given by $s = t^3 - 3t^2 + 2\ meter$. The displacement when the acceleration becomes zero is **[MP PMT 2001]**

(a) 0 *meter* (b) 2 *meter* (c) 3 *meter* (d) -2 *meter*

29. What is the angle between instantaneous displacement and acceleration during the retarded motion

(a) Zero (b) $\frac{\pi}{4}$ (c) $\frac{\pi}{2}$ (d) π

▶▶ *Advance level*

30. The acceleration of a particle starting from rest, varies with time according to the relation $A = -a\omega^2 \sin\omega t$. The displacement of this particle at a time t will be

(a) $-\frac{1}{2}\left(a\omega^2 \sin\omega t\right)t^2$ (b) $a\omega \sin\omega t$ (c) $a\omega \cos\omega t$ (d) $a \sin\omega t$

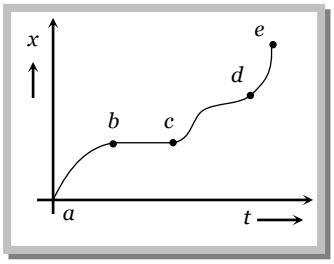
31. If the velocity of a particle is $(10 + 2t^2)\ m/s$, then the average acceleration of the particle between $2s$ and $5s$ is

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

Problems based on position time graph

▶ *Basic level*

32. The displacement versus time graph for a body moving in a straight line in shown in figure. Which of the following regions represents the motion when no force is acting on the body **[NCERT 1971]**



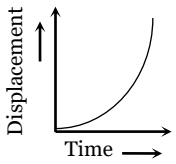
(a) *ab*

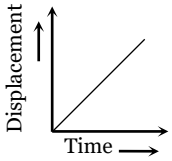
(b) *bc*

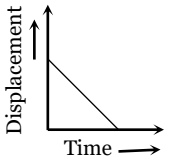
(c) *cd*

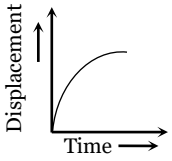
(d) *de*

33. A car dealcelerates at a constant rate during a period commencing at $t = 0$. Which of the displacement time graphs represents the displacement of the car

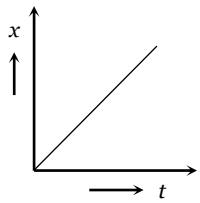
(a) 

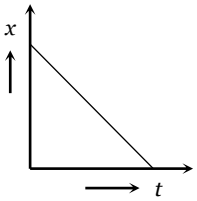
(b) 

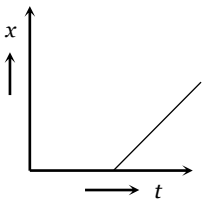
(c) 

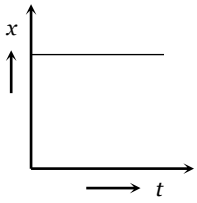
(d) 

34. Which of the following can not be the distance time graph

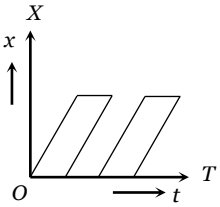
(a) 

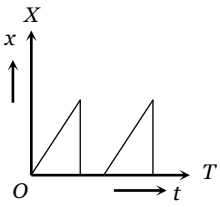
(b) 

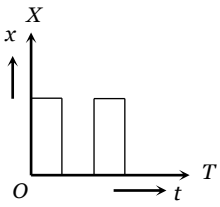
(c) 

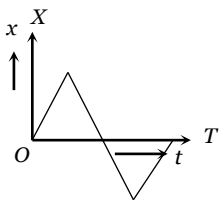
(d) 

35. Which of the following displacement time graphs is not possible

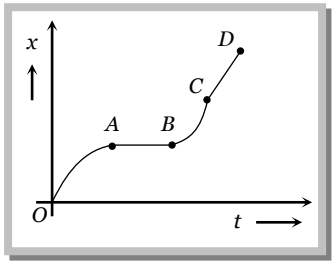
(a) 

(b) 

(c) 

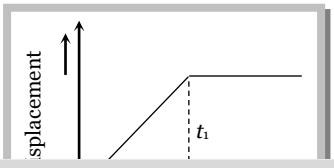
(d) 

36. The graph between the displacement x and time 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 **[CPMT 1986]**



	OA	AB	BC	CD
(a)	+	0	+	+
(b)	–	0	+	0
(c)	+	0	–	+
(d)	–	0	–	0

37. The x–t graph in figure represents



(a) Constant velocity

(b) Velocity of the body continuously changing

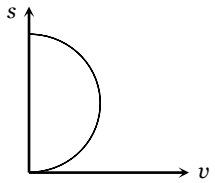
(c) Instantaneous velocity

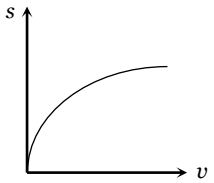
(d) The body travels with constant speed upto time t_1 and then stops

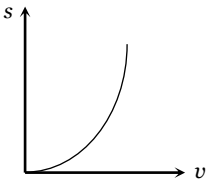
Problems based on velocity time graph

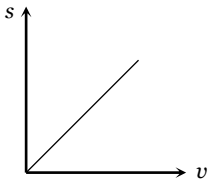
▶ *Basic level*

38. 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 **[SCRA 1998; DCE 2000]**

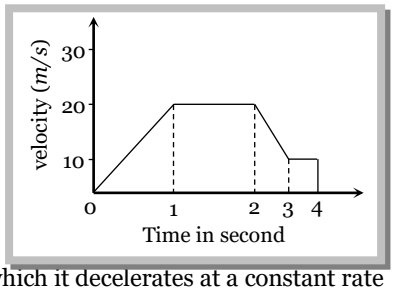
(a) 

(b) 

(c) 

(d) 

39. 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

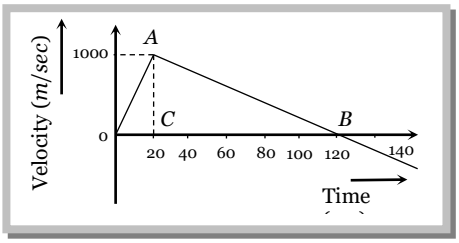
(c) 25 m

(d) 30 m

40. 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 in t, then the maximum velocity acquired by the car is

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

41. A rocket is projected vertically upwards, whose velocity-time graph is shown in fig. The maximum height reached by the rocket is



(a) 1 km

(b) 10 km

(c) 20 km

(d) 60 km

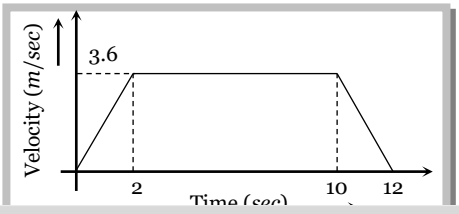
42. In the above problem the mean velocity of rocket in reaching the maximum height will be

(a) 100 m/s (b) 50 m/s (c) 500 m/s (d) 25/3 m/s

43. In the above problem the acceleration of rocket will be

(a) 50 m/s^2 (b) 100 m/s^2 (c) 500 m/s^2 (d) 250 m/s^2

44. A lift is going up. The variation in the speed of the lift is as given in the graph. What is height to which the lift takes the passenger **[IIT-JEE 1970]**



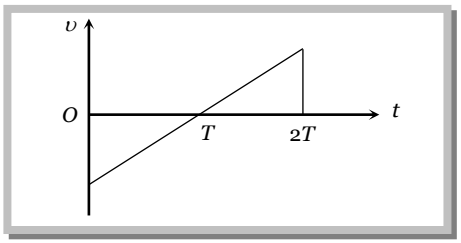
(a) 3.6 m

(b) 28.8 m

(c) 36.0 m

(d) Cannot be calculated from the above graph

45. The figure shows the velocity of a particle plotted against time t



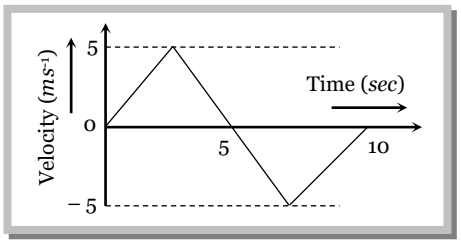
(a) The displacement of the particle is zero

(b) The particle changes its direction of motion at some point

(c) The initial and final speeds of the particle are same

(d) All of the above statements are correct

46. The $\upsilon - t$ plot of a moving object is shown in the figure. The average velocity of the object during the first 10 seconds is



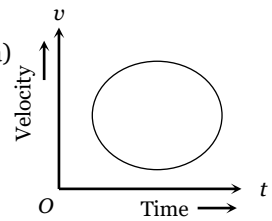
(a) 0

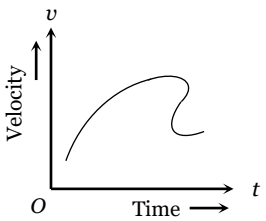
(b) 2.5 ms^{-1}

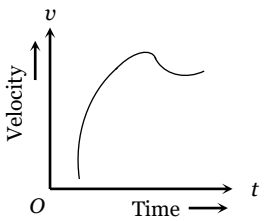
(c) 5 ms^{-1}

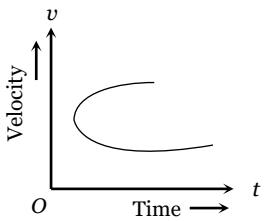
(d) 2 ms^{-1}

47. Which of the following velocity time graphs is possible.

(a) 

(b) 

(c) 

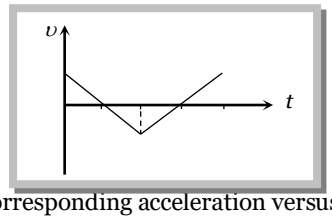
(d) 

▶▶ *Advance level*

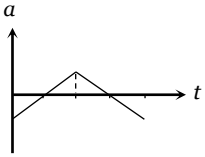
48. A particle starts from rest, accelerates at 2 m/s^2 for 10s and then goes for constant speed for 30s and then decelerates at 4 m/s^2 till it stops. What is the distance travelled by it **[DCE 2001; AIIMS 2002]**

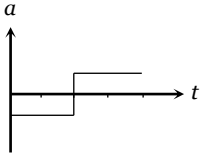
(a) 750 m (b) 800 m (c) 700 m (d) 850 m

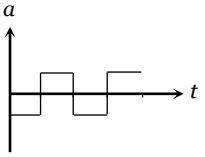
49. The graph below shows the velocity versus time graph for a body

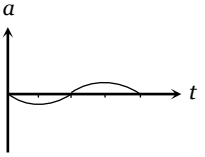


Which of the following graphs represents the corresponding acceleration versus time graphs

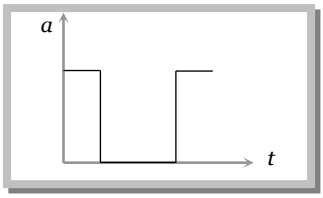
(a) 

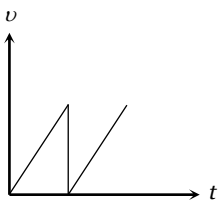
(b) 

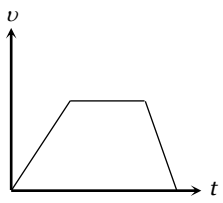
(c) 

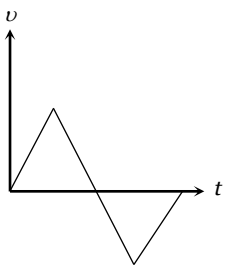
(d) 

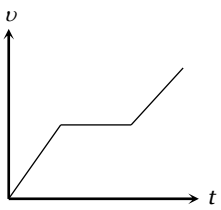
50. The acceleration-time graph for a body is shown in the following graph. Which of the following graphs would probably represent the velocity of the body plotted against time



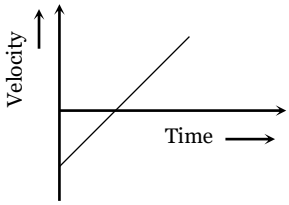
(a) 

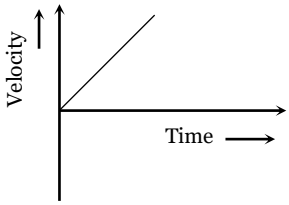
(b) 

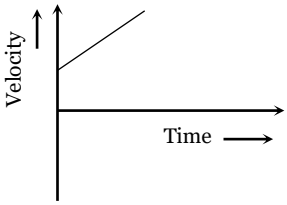
(c) 

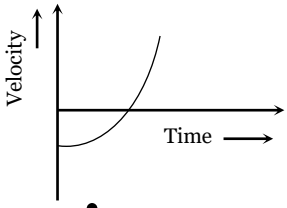
(d) 

51. A particle is moving in such a way that its displacement is related with time by the equation $x = (10 - 4t + 6t^2)\ m$. The diagram showing variation of velocity of particle with time is

(a) 

(b) 

(c) 

(d) 

Problems based on equation of kinematics (Uniform acceleration)

▶ *Basic level*

52. A body of 5 *kg* is moving with a velocity of 20 *m/s*. If a force of 100 *N* is applied on it for 10*s* in the same direction as its velocity, what will now be the velocity of the body **[MP PMT 2000; RPET 2001]**

(a) 200 *m/s* (b) 220 *m/s* (c) 240 *m/s* (d) 260 *m/s*

53. 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 statements about the motion of the particle is false **[CBSE PMT 2000; AFMC 2001]**

(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)

54. A constant force acts on a body of mass 0.9 *kg* at rest for 10*s*. If the body moves a distance of 250 *m*, the magnitude of the force is **[EAMCET (Engg.) 2000]**

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

55. Two cars *A* and *B* are 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 $4\ m/s^2$, then *B* will catch *A* after how much time **[RPET 1999]**

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

56. If a train travelling at 72 *kmph* to be brought to rest in distance of 200 *metres,* then its retardation should be **[SCRA 1998]**

(a) $20\ ms^{-2}$ (b) $10\ ms^{-2}$ (c) $2\ ms^{-2}$ (d) $1\ ms^{-2}$

57. If a body starts from rest and travels 120 *cm* in the 6th second, then what is the acceleration **[AFMC 1997]**

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

58. A car moving with a speed of 40 km/h can be stopped by applying brakes after at least 2 *m*. If the same car is moving with a speed of 80 km/h, what is the minimum stopping distance **[CBSE PMT 1998, 99; AFMC 2000; JIPMER 2001, 02]**

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

59. 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 **[MP PET 1995]**

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

60. A particle moves along a straight line path. After some time it comes to rest. The motion is with constant acceleration whose direction with respect to the direction of velocity is

(a) Positive throughout motion (b) Negative throughout motion

(c) First positive then negative (d) First negative then positive

61. A bus is moving with a velocity $10\ ms^{-1}$ on a straight road. A scooterist wishes to overtake the bus in 100 s. If, the bus is at a distance of 1 km from the scooterist, with what velocity should the scooterist chase the bus

(a) $50\ ms^{-1}$ (b) $40\ ms^{-1}$ (c) $30\ ms^{-1}$ (d) $20\ ms^{-1}$

62. The velocity acquired by a body moving with uniform acceleration is $30\ ms^{-1}$ in 2 seconds and $60\ ms^{-1}$ in four seconds. The initial velocity is

(a) $4\ ms^{-1}$ (b) $0\ ms^{-1}$ (c) $2\ ms^{-1}$ (d) $10\ ms^{-1}$

63. An engine of a train moving with uniform acceleration passes an electric pole with velocity u and the last compartment with velocity v. The middle point of the train passes past the same pole with a velocity of

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

64. A uniformly accelerated body passes two points P and Q with speeds of 10 m/s and 20 m/s respectively. If O is mid-point of P and Q then speed of O will be

(a) 15.0 m/s (b) 15.8 m/s (c) 16.5 m/s (d) 14.2 m/s

65. A particle starts from rest and moving with constant acceleration covers a distance x_1 in the 3rd second and x_2 in the 5th second. The ratio $x_1/x_2 =$

(a) 3/5 (b) 5/9 (c) 9/25 (d) 25/81

66. A particle starts moving along a straight line path with a velocity $10\ ms^{-1}$. After 5 seconds, the distance of the particle from the starting point is 50 m. Which of the following statements about the nature of motion of the particle are correct?

I. The motion may be with constant acceleration.

II. The motion is continuously with constant velocity.

III. The motion is continuously retarded

IV. The motion may be first accelerated and then retarded

(a) I, III (b) II, IV (c) I, II (d) III, IV

67. A bullet moving with a velocity of 200 cm/s penetrates a wooden block and comes to rest after traversing 4 cm inside it. What velocity is needed for travelling distance of 9 cm in same block

(a) 100 cm/s (b) 136.2 cm/s (c) 300 cm/s (d) 250 cm/s

▶▶ *Advance level*

68. A point moves with uniform acceleration and v_1, v_2 and v_3 denote the average velocities in the three successive intervals of time t_1, t_2 and t_3. Which of the following relations is correct **[NCERT 1982]**

(a) $(v_1-v_2):(v_2-v_3)=(t_1-t_2):(t_2+t_3)$ (b) $(v_1-v_2):(v_2-v_3)=(t_1+t_2):(t_2+t_3)$

(c) $(v_1-v_2):(v_2-v_3)=(t_1-t_2):(t_1-t_3)$ (d) $(v_1-v_2):(v_2-v_3)=(t_1-t_2):(t_2-t_3)$

69. 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 $(p^2-p+1)^{th}$ sec will be

(a) S_1+S_2 (b) S_1S_2 (c) S_1-S_2 (d) S_1/S_2

70. A thief is running away on a straight road in jeep moving with a speed of $9\ ms^{-1}$. A police man chases him on a motor cycle moving at a speed of $10\ ms^{-1}$. If the instantaneous separation of the jeep from the motorcycle is 100 m, how long will it take for the police to catch the thief

(a) $1\ s$ (b) $19\ s$ (c) $90\ s$ (d) $100\ s$

71. 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) $1/2\ hr$ (c) $1/4\ hr$ (d) $1/8\ hr$

72. 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 ahead of the car B, the driver of the car A applies the brake producing a uniform retardation a there will be no collision when

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

73. The displacement x of a particle in time t is given by $10t^2 - 4t - x = 0$. Where x is in *metre* and t in second. The distance covered by the body in 4^{th} second of motion

(a) $31\ m$ (b) $39.5\ m$ (c) $66\ m$ (d) $75\ m$

74. The speed of a body moving with uniform acceleration is u. This speed is doubled while covering a distance S. When it covers an additional distance S, its speed would become

(a) $\sqrt{3}\,u$ (b) $\sqrt{5}\,u$ (c) $\sqrt{11}\,u$ (d) $\sqrt{7}\,u$

75. Two trains one of length $100\ m$ and another of length $125\ m$, are moving in mutually opposite directions along parallel lines, meet each other, each with speed $10\ m/s$. If their acceleration are $0.3\ m/s^2$ and $0.2\ m/s^2$ respectively, then the time they take to pass each other will be

(a) $5\ s$ (b) $10\ s$ (c) $15\ s$ (d) $20\ s$

76. If the distances covered by an accelerated body during the l^{th}, m^{th} and n^{th} seconds are a, b and c respectively, then the correct relation is

(a) $a(m-n)+b(n-l)+c(l-m)=0$ (b) $l(b+c)+m(c+a)+n(a+b)=0$

(c) $al+bm+cn=0$ (d) None of these is true

77. Two trains, one travelling at 90 m/s and the other travelling at 120 m/s, are moving towards each other on the same track. When they are 11 km apart, both drivers simultaneously apply brakes. If the brakes decelerate each train at the rate of $3\ m/s^2$, then the distance travelled by the first train is.

(a) $1350\ m$ (b) $2400\ m$ (c) $4740\ m$ (d) $8870\ m$

78. In the above problem, the distance travelled by the second train is

(a) $1350\ m$ (b) $2400\ m$ (c) $3740\ m$ (d) $8870\ m$

79. In the above problem whether a collision will take place or not

(a) Collision will take place (b) There shall be no collision

(c) Collision may not take place (d) None of these

80. A body starts from rest with uniform acceleration. If its velocity after n second 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) $\frac{2v(n-1)}{n}$

81. Two particles move in a straight line towards each other with initial velocities v_1 and v_2 and retardation a_1 and a_2 towards each other. The maximum initial separation between the two particles so that they may meet must be

(a) $\frac{(v_1+v_2)}{2(a_1+a_2)}$ (b) $\frac{(v_1+v_2)^2}{2(a_1+a_2)}$ (c) $\frac{(v_1+v_2)}{2a_1\ a_2}$ (d) $\frac{(v_1+v_2)}{2(a_1+a_2)^2}$

82. 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

83. A particle is moving in a straight line and passes through a point O with a velocity of $6\ ms^{-1}$. The particle moves with a constant retardation of $2\ ms^{-2}$ for 4 s and there after moves with constant velocity. How long after leaving O does the particle return to O

(a) $3s$ (b) $8s$ (c) Never (d) $4s$

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

(a) $2\ m$ (b) $4\ m$ (c) $6\ m$ (d) $8\ m$

Problems based on equation of kinematics (variable acceleration)

▶ *Basic level*

85. A particle, initially at rest, starts moving in a straight line with an acceleration $a = 6t + 4\ m/s^2$. The distance covered by it in 3 s is

(a) $30\ m$ (b) $60\ m$ (c) $45\ m$ (d) $15\ m$

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

▶▶ *Advance level*

87. The velocity of a particle is dependent on the time as $\upsilon = k(t-1)$ where $k = 2\ \text{m/s}^2$. the distance covered in first three seconds will be

(a) $18\ m$ (b) $5\ m$ (c) $3\ m$ (d) $6\ m$

88. A particle is projected with velocity υ_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) $\sqrt{\frac{3\upsilon_0}{2\alpha}}$ (b) $\left(\frac{3v_o}{2\alpha}\right)^{\frac{1}{3}}$ (c) $\sqrt{\frac{3\upsilon_0^2}{2\alpha}}$ (d) $\left(\frac{3\upsilon_0^2}{2\alpha}\right)^{\frac{1}{3}}$

Problems based on motion under gravity

▶ *Basic level*

89. The acceleration due to gravity on the planet A is 9 times the acceleration due to gravity on 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 **[CBSE PMT 2003]**

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

90. Two balls are dropped from heights h and $2h$ respectively from the earth surface. The ratio of time of these balls to reach the earth is

[CPMT 2003]

(a) $1:\sqrt{2}$ (b) $\sqrt{2}:1$ (c) $2:1$ (d) $1:4$

91. A body falling from a high Minaret travels 40 meters in the last 2 seconds of its fall to ground. Height of Minaret in meters is (take $g = 10\,m/s^2$) **[MP PMT 2002]**

(a) 60 (b) 45 (c) 80 (d) 50

92. A cricket ball is thrown up with a speed of 19.6 ms^{-1}. The maximum height it can reach is **[Kerala PMT 2002]**

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

93. 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

94. From the top of a tower, a particle is thrown vertically down wards with a velocity of 10 m/s. The ratio of the distances covered by it in the 3rd and 2nd seconds of the motion is (Take g = 10 m/s^2) **[AIIMS 2000; CBSE PMT 2002]**

(a) 5: 7 (b) 7 : 5 (c) 3 : 6 (d) 6 : 3

95. 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 **[AIIMS 2002]**

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

96. A particle when thrown, moves such that it passes from same height at 2 and 10s, the height is **[UPSEAT 2001]**

(a) g (b) 2g (c) 5 g (d) 8 g

97. 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 remains in the air $[g = 10\,m/s^2]$

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

98. 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) **[KCET (Engg.) 2001]**

(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

99. 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 **[EAMCET (Engg.) 2000]**

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

100. Time taken by an object to reach 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 **[RPMT 1999]**

(a) $h_1 : h_2$ (b) $\sqrt{h_1} : \sqrt{h_2}$ (c) $h_1 : 2h_2$ (d) $2h_1 : h_2$

101. 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^o) is

[JIPMER 1999]

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

102. 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 **[AFMC 1999]**

(a) 4.9 m (b) 9.8 m (c) 19.8 m (d) 24.7 m

103. 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

104. 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 $-u' = 4\,km/h$. Find the final velocity of second body with which it strikes the ground **[CBSE PMT 1996; KCET 2002]**

(a) $3\,km/h$ (b) $4\,km/h$ (c) $5\,km/h$ (d) $12\,km/h$

105. 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

[EAMCET (Engg.) 1995]

(a) It reaches $H/2$ in $T/2$ *sec* (b) It acquires velocity $u/2$ in $T/2$ sec

(c) Its velocity is $u/2$ at $H/2$ (d) Same velocity at $2T$

106. P, Q and R are three balloons ascending with velocities U, $4U$ and $8U$ respectively. If stones of the same mass be dropped from each, when they are at the same height, then **[ISM Dhanbad 1994]**

(a) They reach the ground at the same time (b) Stone from P reaches the ground first

(c) Stone from R reaches the ground first (d) Stone from Q reaches the ground first

107. A particle is dropped vertically from rest from a height. The time taken by it to fall through successive distances of $1m$ each will then be

(a) All equal, being equal to $\sqrt{2/g}$ second

(b) In the ratio of 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.* $\frac{1}{\sqrt{1}},\frac{1}{\sqrt{2}},\frac{1}{\sqrt{3}},\frac{1}{\sqrt{4}}$

108. 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) $735\,m$

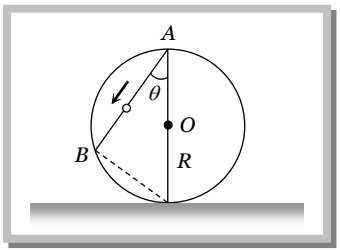
109. A man in a balloon rising vertically with an acceleration of $4.9\ m/\sec^2$ releases a ball 2 *sec* after the balloon is let go from the ground. The greatest height above the ground reached by the ball is $(g = 9.8\,m/\sec^2)$ **[MNR 1986]**

(a) $14.7\,m$ (b) $19.6\,m$ (c) $9.8\,m$ (d) $24.5\,m$

110. A body is slipping from an inclined plane of height h and length l. If the angle of inclination is θ, the time taken by the body to come from the top to the bottom of this inclined plane is

(a) $\sqrt{\frac{2h}{g}}$ (b) $\sqrt{\frac{2l}{g}}$ (c) $\frac{1}{\sin\theta}\sqrt{\frac{2h}{g}}$ (d) $\sin\theta\sqrt{\frac{2h}{g}}$

111. 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) $\frac{gR}{\sqrt{g\cos\theta}}$

112. 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

[NCERT 1981]

(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

113. A body is thrown vertically upwards. If air resistance is to be taken into account, then the time during which the body rises is **[RPET 2000; KCET (Engg./Med.) 2001; DPMT 2001]**

(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

114. A body falls freely from rest. It covers as much distance in the last second of its motion as covered in the first three seconds. The body has fallen for a time of **[MNR 1998]**

(a) 3 s (b) 5 s (c) 7 s (d) 9 s

115. A ball is dropped on the floor from a height of 10 m. It rebounds to a height 2.5 m. If the ball is in contact with the floor for 0.01 sec, the average acceleration during contact is **[BHU 1997; CPMT 1997]**

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

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

116. Two particles one 0.98 m vertically above the other are released simultaneously. They fall under gravity $(g = 9.8\, m/s^2)$. The separation between the two particles after 2 s will be

(a) 0.49 m (b) 4.9 m (c) 0.98 m (d) 19.6 m

117. Two balls are dropped from different heights. One ball is dropped 2 sec after the other ball. If both balls reach the ground simultaneously after 5 sec of dropping the first ball the difference of initial heights of the two balls will be $(g = 9.8\, m/s^2)$

(a) 58.8 v (b) 78.4 m (c) 98 m (d) 117.6 m

118. A balloon is moving upwards with a constant velocity of 5 m/s. A stone is dropped from it. If at the moment of dropping the stone the balloon is at height of 50 m, then when the stone will hit the ground, at that time the height of the balloon will be $(g = 10\, m/s^2)$

(a) 68.3 m (b) 63.5 m (c) 75.5 m (d) 88.7 m

119. A stone thrown upwards with a velocity u reaches upto a height h. If the initial velocity is $2u$ the height attained would be

(a) 2 h (b) 4 h (c) 8 h (d) 16 h

120. A person throws balls into the air one after the other at an interval of one second. The next ball is thrown when the velocity of the ball thrown earlier is zero. To what height the ball rise (Take $g = 10\, m/s^{-2}$)

(a) 5 m (b) 10 m (c) 25 m (d) 40 m

121. A body is projected vertically up 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

122. Two balls A and B are simultaneously thrown. A is thrown from ground level with a velocity of 20 ms^{-1} in the upward direction and B is thrown from a height of 40 m in the downward direction with same velocity. Where will the two balls meet

(a) 15 m (b) 25 m (c) 35 m (d) 45 m

123. 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 each other after time

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

124. A body is released from a height towards the ground level. Just after one second another body is released from same height. The distance between two bodies just after two seconds after the release of second body will be

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

125. A stone falls from the top of the tower in 8 sec. How much time will it take to cover the first quarter of the distance starting from the top

(a) 4 sec (b) 2 sec (c) 1 sec (d) None of these

126. Three particles A, B and C are thrown from the top of a tower with the same speed. A is thrown straight up, B is thrown straight down and C is thrown horizontally. They hit the ground with speeds v_A, v_B and v_C respectively, then

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

▶▶ *Advance level*

127. 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 after 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

128. A ball is dropped from the top of the tower of height h. It covers a distance of $h/2$ in the last second of its motion. How long does the ball remain in air (Take $g = 10\ ms^{-2}$)

(a) $\sqrt{2}\ s$ (b) $(2+\sqrt{2})s$ (c) $2\ s$ (d) None of the above

129. A body is dropped form height h. If t_1 and t_2 be the times in covering first half and next half distances respectively, then the correct relation is

(a) $t_1 = t_2$ (b) $t_1 = 2t_2$ (c) $t_1 = \frac{t_2}{\sqrt{2}-1}$ (d) $t_1 = 4t_2$

130. 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) $\sqrt{\frac{g}{h}}$

131. 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) $\frac{v}{g}\left[1+\sqrt{v^2+\frac{2g}{h}}\right]$

132. 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) $2v_0 t + \frac{1}{2}g t^2$ (b) $2v_0 t$ (c) $v_0 t + \frac{1}{2}g t^2$ (d) $v_0 t$

133. 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) 100 m (d) 125 m

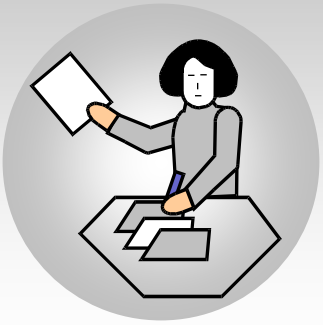
134. A particle is projected upwards. The times corresponding to height h while ascending and while descending are t_1 and t_2 respectively. The velocity of projection will be

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

135. 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 u.

(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



Answer Sheet (Practice problems)

1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
a	b	c	d	a	a	b	d	c	a
11.	**12.**	**13.**	**14.**	**15.**	**16.**	**17.**	**18.**	**19.**	**20.**
a	b	d	a	d	d	c	a	d	a
21.	**22.**	**23.**	**24.**	**25.**	**26.**	**27.**	**28.**	**29.**	**30.**
c	d	c	a	c	a	a	a	d	d
31.	**32.**	**33.**	**34.**	**35.**	**36.**	**37.**	**38.**	**39.**	**40.**
d	b	d	b	a	b	d	c	b	d
41.	**42.**	**43.**	**44.**	**45.**	**46.**	**47.**	**48.**	**49.**	**50.**
d	c	a	c	d	a	c	a	b	d
51.	**52.**	**53.**	**54.**	**55.**	**56.**	**57.**	**58.**	**59.**	**60.**
a	b	c	d	b	d	c	a	a	b
61.	**62.**	**63.**	**64.**	**65.**	**66.**	**67.**	**68.**	**69.**	**70.**
d	b	b	b	b	b	c	b	a	d
71.	**72.**	**73.**	**74.**	**75.**	**76.**	**77.**	**78.**	**79.**	**80.**
b	c	c	d	b	a	a	b	b	d
81.	**82.**	**83.**	**84.**	**85.**	**86.**	**87.**	**88.**	**89.**	**90.**
b	b	b	b	c	b	c	d	d	a
91.	**92.**	**93.**	**94.**	**95.**	**96.**	**97.**	**98.**	**99.**	**100.**
b	b	b	b	c	d	d	a	b	b
101.	**102.**	**103.**	**104.**	**105.**	**106.**	**107.**	**108.**	**109.**	**110.**
b	b	a	c	b	b	c	a	a	c
111.	**112.**	**113.**	**114.**	**115.**	**116.**	**117.**	**118.**	**119.**	**120.**
c	d	b	b	b	c	b	a	b	a
121.	**122.**	**123.**	**124.**	**125.**	**126.**	**127.**	**128.**	**129.**	**130.**
b	a	a	d	b	c	a	b	c	b
131.	**132.**	**133.**	**134.**	**135.**					
c	b	d	d	c					