# Assignment

## Velocity and Acceleration, Resultant and Component of Velocities

### Basic Level

**1.** The initial velocity of a particle is $u(\text{at } t=0)$, and the acceleration $f$ is given by $at$. Which of the following relation is valid

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

**2.** A particle is moving in a straight line such that the distance described $s$ and time taken $t$ are given by $t = as^2 + bs + c$, $a > 0$. If $v$ is the velocity of the particle at any time $t$, then its acceleration is

(a) $-2av$ (b) $-2av^2$ (c) $-2av^3$ (d) None of these

**3.** If a particle, moving in a straight line, covers a distance $s$ in time $t$, given by the relations $s^2 = at^2 + 2bt + c$, then its acceleration is

(a) $\frac{b^2 - ac}{s^3}$ (b) $\frac{ac - b^2}{s^3}$ (c) $\frac{ac - b^2}{s^2}$ (d) $\frac{ac - b^2}{s}$

**4.** The speed $v$ of a body moving on a straight track varies according to $v = \begin{cases} 2t + 13, & 0 \le t \le 5 \\ 3t + 8, & 5 < t \le 7 \\ 4t + 1, & t > 7 \end{cases}$.

The distances are measured in *metres* and time $t$ in *seconds*. The distance in *metres* moved by the particle at the end of 10 *seconds* is

(a) 127 (b) 247 (c) 186 (d) 313

**5.** If the velocity of a particle moving in a straight line is given by $v^2 = se^s$, then its acceleration is

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

**6.** The position at any time $t$, of a particle moving along $x$-axis is given by the relation $s = t^3 - 9t^2 + 24t + 6$, where $s$ denotes the distance in *metre* from the origin. The velocity $v$ of the particle at the instant when the acceleration becomes zero, is given by

(a) $v = 3$ (b) $v = -3$ (c) $v = 0$ (d) $v = -6$

**7.** For a particle moving in a straight line, if time $t$ be regarded as a function of velocity $v$, then the rate of change of the acceleration $a$ is given by

(a) $a^2 \frac{d^2t}{dv^2}$ (b) $a^3 \frac{d^2t}{dv^2}$ (c) $-a^3 \frac{d^2t}{dv^2}$ (d) None of these

**8.** If the law of motion of a particle moving in a straight line is given by $ks = \log\left(\frac{1}{v}\right)$, then its acceleration $a$ is given by

(a) $a = -kv$ (b) $a = -kv^3$ (c) $a = -kv^2$ (d) None of these

**9.** A point moves rectilinearly with deceleration whose modulus depends on the velocity of the particle as $a\sqrt{v}$, where *a* is a positive constant. At the initial moment its velocity is equal to $v_0$. The time it takes before it comes to rest is

(a) $2\frac{\sqrt{v_0}}{a}$ (b) $\frac{\sqrt{v_0}}{a}$ (c) $\frac{v_0}{a}$ (d) $\frac{a}{\sqrt{v_0}}$

**10.** The law of motion of a particle moving in a straight line is given by $s=\frac{1}{2}vt$, where *v* is the velocity at time *t* and *s* is the distance covered. Then acceleration is

(a) A function of *t* (b) a function of *s* (c) a function of *v* (d) constant

**11.** If the displacement of a particle varies with time as $\sqrt{x}=t+7$, then

(a) The velocity of the particle is inversely proportional to *t* (b) The velocity of the particle is proportional to *t*

(c) The velocity of the particle is proportional to $\sqrt{t}$ (d) The particle moves with a constant acceleration

**12.** The *x* and *y* displacement of a particle in the *xy*-plane at any instant are given by $x=at^2$ and $y=2at$, where *a* is a constant. The velocity of the particle at any instant is given by

(a) $4a\sqrt{t^2+4}$ (b) $2a\sqrt{t^2+1}$ (c) $4a\sqrt{t^2+1}$ (d) $\frac{a}{2}\sqrt{t^2+4}$

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

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

**14.** A particle moves along a straight line in such a way that its distance from a fixed point on the line, at any time *t* from the start, is given by the equation $s=6-2t+3t^3$. Its acceleration after 1 *second* of motion is

(a) 12 (b) 16 (c) 18 (d) None of these

**15.** A particle moves in a straight line with a velocity given by $\frac{dx}{dt}=x+1$. The time taken by the particle to traverse a distance of 99 *metres* is

(a) $\log_{10}e$ (b) $2\log_e 10$ (c) $2\log_{10}e$ (d) $\frac{1}{2}\log_{10}e$

**16.** A passenger travels along the straight road for half the distance with velocity $v_1$ and the remaining half distance with velocity $v_2$. The average velocity is given by

(a) $v_1+v_2$ (b) $\frac{v_1+v_2}{2}$ (c) $\frac{2v_1v_2}{v_1+v_2}$ (d) $\sqrt{v_1v_2}$

**17.** If a particle moves along a straight line according to the law $s^2=at^2+2bt+c$, then its acceleration is given by

(a) $\frac{a-v}{s}$ (b) $\frac{a-v^2}{s}$ (c) $\frac{a-v^2}{s^2}$ (d) $\frac{a-v}{s^2}$

**18.** If a particle has two velocities each equal to *u* in magnitude and their resultant is also of magnitude *u*, then the angle between the two velocities is

(a) $60^o$ (b) $30^o$ (c) $90^o$ (d) $120^o$

**19.** If two velocities *u* and *v* are inclined at such an angle that the resultant of 2*u* and *v* inclined at the same angle is at right angle to *v*, then the resultant of *u* and *v* is of magnitude

(a) 2*u* (b) *v* (c) 2*v* (d) *u*

**20.** If a particle having simultaneous velocities 3 *m/sec.*, 5 *m/sec.* and 7 *m/sec.* at rest, then the angle between the first two velocities is

(a) $120^o$ (b) $150^o$ (c) $60^o$ (d) $90^o$

**21.** The greatest and least magnitudes of the resultants of two velocities of constant magnitudes are $u$ and $v$ respectively. If a particle has these velocities inclined at an angle $2\alpha$, then the resultant velocity is of magnitude

(a) $\sqrt{u^2\cos^2\alpha + v^2\sin^2\alpha}$ (b) $\sqrt{u^2\sin^2\alpha + v^2\cos^2\alpha}$ (c) $\sqrt{u^2\cos\alpha + v^2\sin\alpha}$ (d) None of these

**22.** A particle possesses simultaneously two velocities 10 *m/sec*. and 15 *m/sec*. in directions inclined at an angle of $60^o$, then its resultant velocity is

(a) 15 *m/sec*. (b) $5\sqrt{19}\ m/\sec$ (c) 25 *m/sec* (d) None of these

**23.** A particle is moving with a velocity of 30 *m/sec*. The components of the velocity in *m/sec* at angle $30^o$ and $45^o$ in opposite sides to its direction are

(a) $\sqrt{3}-1, \sqrt{3}+1$ (b) $30(\sqrt{3}-1), 15(\sqrt{6}-\sqrt{3})$ (c) $30(\sqrt{3}+1), 30(\sqrt{3}-1)$ (d) None of these

**24.** If *OP* makes 4 revolutions in one *second*, the angular velocity in radians per second is

(a) $\pi$ (b) $2\pi$ (c) $4\pi$ (d) $8\pi$

**25.** A velocity $\frac{1}{4}m/s$ is resolved into two components along *OA* and *OB* making angles $30^o$ and $45^o$ respectively with the given velocity, then the component along *OB* is **[AIEEE 2004]**

(a) $\frac{1}{8}(\sqrt{6}-\sqrt{2})m/s$ (b) $\frac{1}{4}(\sqrt{3}-1)m/s$ (c) $\frac{1}{4}m/s$ (d) $\frac{1}{8}m/s$

## Advance Level

**26.** Two straight railways converge to a level crossing at an angle $\alpha$ and two trains are moving towards the crossing with velocities $u$ and $v$. If $a$ and $b$ are the initial distances of the trains from the crossing, the least distance between them will be after time $t$ given by

(a) $\frac{(au+bv)+(av+bu)\cos\alpha}{u^2+v^2+2uv\cos\alpha}$ (b) $\frac{(au+bv)-(av+bu)\cos\alpha}{u^2+v^2-2uv\cos\alpha}$ (c) $\frac{(au+bv)-(av+bu)\cos\alpha}{u^2+v^2+2uv\cos\alpha}$ (d) None of these

**27.** A particles moves from rest, away from a fixed point $O$, with an acceleration $\frac{\mu}{x^2}$, where $x$ is the distance of the particle from $O$. If it is at rest, then its distance from $O$ is $b$. The velocity when it is at a distance $2b$ from $O$ is

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

**28.** The velocity $v$ of a particle is at any time related to the distance travelled by the particle by the relation $v = as + b$, where $a > 0$ and $b \le a/2$. Which of the following statements will be true for this motion (Given $s = 0$ when $t = 0$)

(a) The displacement of the particle at time $t$ is $s = \frac{b}{a}(e^{at}-1)$ (b) The particle will experience a retardation if $b > 0$

(c) The particle will be at rest at $t = 0$ (d) The motion of the particle is under constant acceleration

**29.** A particle moving in a straight line is subject to a resistance which produces a retardation $kv^3$, where $v$ is the velocity and $k$ is a constant. If $u$ is the initial velocity of the particle, then

(a) $v = \frac{u}{1+kxu}$ (b) $v = \frac{u}{1+xu}$ (c) $v = \frac{ku}{1+kxu}$ (d) $v = \frac{u}{1-kxu}$

**30.** A man rows directly across a flowing river in time $t_1$ and rows an equal distance down the stream in time $t_2$. If $u$ be the speed of the man in still water and $v$ be that of the stream, then $t_1 : t_2 =$

(a) $u+v : u-v$ (b) $u-v : u+v$ (c) $\sqrt{u+v} : \sqrt{u-v}$ (d) $\sqrt{u-v} : \sqrt{u+v}$

## *Relative velocity*

### Basic Level

**31.** Two trains, each 250 *m* long, are moving towards each other on parallel lines with velocities of 20 *km/hr* and 30 *km/hr* respectively. The time that elapses from the instant when they first meet until they have cleared each other is

(a) 20 *sec.* (b) 36 *sec.* (c) 30 *sec.* (d) None of these

**32.** A train *A* is moving towards east with a velocity of 30 *km/hr* and another train *B* is moving on parallel lines towards west with a velocity of 40 *km/hr*. The relative velocity of train *A* with respect to train *B* is

(a) 10 *km/hr* (b) 70 *km/hr* towards east (c) 70 *km/hr* towards west (d) None of these

**33.** Two scooterists *P* and *Q* are moving due north at 48 *km/hr* and 36 *km/hr* respectively. The velocity of *P* relative to *Q* is

(a) 12 *km/hr* due south (b) 12 *km/hr* due north (c) 84 *km/hr* due south (d) 84 *km/hr* due north

**34.** If two particles, *A* and *B*, moves with speed *u* and 2*u* respectively in two straight lines inclined at an angle $\alpha$, then the relative velocity of *B* with respect to *A* is

(a) $u\sqrt{5+4\cos\alpha}$ (b) $u\sqrt{5-4\cos\alpha}$ (c) $u\sqrt{4-5\cos\alpha}$ (d) $u\sqrt{4+5\cos\alpha}$

**35.** A railway train, moving at the rate of 44 *m/sec*, is struck by a stone, moving horizontally and at right angles to the train with velocity of 33 *m/sec*. The magnitude and direction of the velocity with which the stone appears to meet the train is

(a) $50, \tan^{-1}\frac{3}{4}$ (b) $55, \tan^{-1}\left(\frac{-3}{4}\right)$ (c) $40, \cos^{-1}\frac{3}{4}$ (d) None of these

**36.** To a boy cycling at the rate of 4 *km/hr* eastward, the wind seems to blow directly, from the north. But when he cycles at the rate of 7 *km/hr*, it seems to blow from north-east. The magnitude of the actual velocity of the wind is

(a) $5/\sqrt{2} km/hr$ (b) $5\sqrt{2}\ km/hr$ (c) $5 km/hr$ (d) $5\frac{1}{2} km/hr$

**37.** If a particle *A* is moving along a straight line with velocity 3 *m/sec* and another particle *B* has a velocity 5 *m/sec.* at an angle of 60° to the path of *A*, then the velocity *B* relative to *A*

(a) $\sqrt{39}\ m/\sec$ (b) $\sqrt{19}\ m/\sec$ (c) $19\ m/\sec$ (d) None of these

**38.** A train *A* is moving towards east with a velocity of 30 *km/h* and another train *B* is moving on parallel lines towards west with a speed of 40 *km/h*. The velocity of train *A* relative to train *B* is

(a) 10 *km/h* (b) 70 *km/h* towards east (c) 70 *km/h* towards west (d) None of these

**39.** A car is travelling at a velocity of 10 *km/h* on a straight road. The driver of the car throws a parcel with a velocity of $10\sqrt{2}\ km/hr$ when the car is passing by a man standing on the side of the road. If the parcel is to reach the man, the direction of throw makes the following angle with the direction of the car

(a) $135^{\circ}$ (b) $45^{\circ}$ (c) $\tan^{-1}(\sqrt{2})$ (d) $\tan^{-1}(1/\sqrt{2})$

**40.** A man wishes to cross a river to an exactly opposite point on the other bank, if he can swim with twice the velocity of the current, then the inclination to the current of the direction in which he should swim is

(a) $90^{\circ}$ (b) $120^{\circ}$ (c) $150^{\circ}$ (d) None of these

**41.** A ship is moving with velocity 12 *km/hr* in east direction and another ship is moving with velocity 16 *km/hr* in north direction. The relative velocity of second ship with respect to first ship will be

(a) 20 *km/hr* (b) 22 *km/hr* (c) 18 *km/h* (d) $20\sqrt{2}$ *km/h*

**42.** A particle moves towards east from a point *A* to a point *B* at the rate of 4 *km/h* and then towards north from *B* to *C* at the rate of 5 *km/h*. If *AB* = 12 *km* and *BC* = 5 *km*, then its average speed for its journey from *A* to *C* and resultant average velocity direct from *A* to *C* are respectively

(a) $\frac{13}{9}$ *km/h* and $\frac{17}{9}$ *km/h* (b) $\frac{13}{4}$ *km/h* and $\frac{17}{4}$ *km/h* (c) $\frac{17}{9} km/h$ and $\frac{17}{9}$ *km/h*(d)

## Advance Level

**43.** A person travelling towards the north-east, finds that the wind appears to blow from north, but when he doubles his speed it seems to come from a direction inclined at an angle $\tan^{-1}\frac{1}{2}$ on the east of north. The true direction of the wind is towards

(a) North-east (b) North (c) East (d) None of these

**44.** A man is walking towards north with speed 4.5 *km/hr* . Another man is running towards west with speed 6 *km/hr*. The magnitude and direction of the relative velocity of the second with respect to first is

(a) 7.5 *km/hr* at an angle $\tan^{-1}\left(\frac{3}{4}\right)$ south of west (b) 7.5 *km/hr* at an angle $\tan^{-1}\left(\frac{3}{4}\right)$ west of south

(c) 7.5 *km/hr* south-west (d) None of these

**45.** A man is swimming in a lake in a direction $30^o$ east of north with a speed of 5 *km/hr* and a cyclist is going on the road along the lake shore towards east at a speed of 10 *km/hr*. The direction of the swimmer relative to the cyclist is

(a) $30^o$ west of north (b) West-north (c) $60^o$ west of north (d) None of these

**46.** Two cars *A* and *B* are moving uniformly on two straight roads at right angles to one another at 40 and 20 *km/hr* respectively. A passes the intersection of the road when *B* has still to move 50 *km* to reach it. The shortest distance between the two cars and the time when they are closest are

(a) $20\sqrt{5}\ km$, 30 minutes (b) 20 *km*, 10 *minutes* (c) 20 *km*, 20 *minutes* (d) None of these

**47.** A man is tavelling in a train moving at the rate of $60\sqrt{3}$ *km/hr* and the rain is falling vertically at the rate of 60 *km/hr*. The magnitude and direction of the apparent velocity of the rain to the man sitting in the train

(a) 120 *km/hr*, making an angle of $60^o$ with the motion of the train

(b) 120 *km/hr* making an angle of $30^o$ with the motion of the train

(c) 120 *km/hr* making an angle of $45^o$ with the motion of the train

(d) None of these

**48.** A person travelling towards eastwards at the rate of 4 *km/hr*. finds that the wind seems to blow directly from the north. On doubling his speed it appears to come from north-east. The velocity and direction of the wind are

(a) $4\sqrt{2}\ km/hr, 90^o$ (b) $5\sqrt{2}\ km/hr, 60^o$ (c) $4\sqrt{2}\ km/hr, 135^o$ (d) None of these

**49.** A boat takes 10 *minutes* to cross a river in a straight line from a point *A* on the bank to a point *B* on the other bank and 20 *minutes* to do the return journey. The current flows at the rate of 3 *km/hr* and the speed of the boat relative to the water is 6 *km/hr*. The width of the river and the down stream distance from *A* to *B* are

(a) $\frac{\sqrt{15}}{4}, \frac{3}{4}$ (b) $\frac{\sqrt{10}}{4}, \frac{1}{3}$ (c) $\sqrt{6}, \frac{1}{2}$ (d) None of these

**50.** If a moving particle has two equal velocities inclined at an angle $2\alpha$ such that their resultant velocity is twice as great as when they are inclined at an angle $2\beta$, then

(a) $\cos\alpha = 2\cos\beta$ (b) $\cos\beta = 2\cos\alpha$ (c) $\cos\alpha = 3\cos\beta$ (d) $\cos\beta = 3\cos\alpha$

**51.** The speed of a boat in a river is *u m/sec* and that of the current is $v\ m/\text{sec}$. The boat traverse a distance of *d metres* down the stream and then comes back to its original position. The average speed of the boat for to and fro journey is

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

**52.** A thief, when detected, jumps out of a running train at right angles to its direction with a velocity of 5 *m/min*. If the velocity of the train is 36 *km/hr*, then the angle $\theta$ between the direction in which the thief falls and the direction of motion of the train is given by

(a) $\tan^{-1}\left(\frac{5}{36}\right)$ (b) $\tan^{-1}\left(\frac{1}{20}\right)$ (c) $\tan^{-1}\left(\frac{5}{120}\right)$ (d) None of these

**53.** A 30 *m* wide canal is flowing at the rate of 20 *m/min*. A man can swim at the rate of 25 *m/min*. in still water. The time taken by him to cross the canal perpendicular to the flow is

(a) 1.0 *min* (b) 1.5 *min.* (c) 2.0 *min.* (d) 2.5 *min.*

**54.** A man crosses a 320 *m* wide river perpendicular to the current in 4 *minutes*. If in still water he can swim with a speed 5/3 times that of the current, then the speed of the current in *m/min* is

(a) 30 (b) 40 (c) 50 (d) 6

## *Rectilinear motion with acceleration*

### *Basic Level*

**55.** A body starts from rest with a uniform acceleration of $8 m/\sec^2$ . Then the time it will take in traversing the second *metre* of its journey is

(a) $\sqrt{2}$ *sec* (b) $\frac{1}{2}$ *sec* (c) $\left(\frac{\sqrt{2}-1}{2}\right)$ *sec* (d) $\left(\frac{\sqrt{2}+1}{\sqrt{2}}\right)$ *sec*

**56.** A body starts from rest and moves with a uniform acceleration. The ratio of the distance covered in $n^{th}$ *sec* to the distance covered in *n seconds* 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) $\frac{2}{n}+\frac{1}{n^2}$

**57.** If a particle moves in a straight line with uniform acceleration, the distance traversed by it in consecutive seconds are in

(a) A.P. (b) G.P. (c) H.P. (d) None of these

**58.** If a point moves with constant acceleration from *A* to *B* in the straight line *AB* has velocities *u* and *v* at *A* and *B* respectively, then the velocity at *C*, the mid-point of *AB* is

(a) $\frac{u+v}{2}$ (b) $\sqrt{u^2+v^2}$ (c) $\sqrt{\frac{u^2+v^2}{2}}$ (d) None of these

**59.** A point is moving with uniform acceleration ; in the eleventh and fifteenth seconds from the commencement it moves through 720 and 960 *cm* respectively. Its initial velocity, and the acceleration with which it moves are

(a) 60, 40 (b) 70, 30 (c) 90, 60 (d) None of these

**60.** A particle is moving in a straight line with initial velocity *u* and uniform acceleration *f*. If the sum of the distances travelled in $t^{th}$ and $(t+1)^{th}$ seconds is 100 *cm*, then its velocity after *t* seconds, in *cm/sec*. is

(a) 20 (b) 30 (c) 50 (d) 80

**61.** If the coordinates of a point moving with the constant acceleration be $x_1, x_2, x_3$ at the instants $t_1, t_2, t_3$ respectively, then

$x_1(t_2-t_3)+x_2(t_3-t_1)+x_3(t_1-t_2)=$

(a) $f(t_1-t_2)(t_2-t_3)(t_3-t_1)$ (b) $2f(t_1-t_2)(t_2-t_3)(t_3-t_1)$ (c) $\frac{f}{2}(t_1-t_2)(t_2-t_3)(t_3-t_1)$ (d) None of these

**62.** A body is in motion along a straight line. As it crosses a fixed point, a stop watch is started. The body travels a distance of 180 *cm* in the first three seconds and 220 *cm* in the next five *seconds*. The velocity of the body after 9 *seconds* is

(a) 66 *cm/sec* (b) 30 *cm/sec* (c) 36 *cm/sec* (d) 45 *cm/sec*

**63.** A body starts from rest and moves in a straight line with uniform acceleration *F*, the distances covered by it in second, fourth and eighth seconds are

(a) In arithmetic progression (b) In geometrical progression (c) In the ratio 1 : 3 : 7

**64.** A bullet of mass 0.006 *kg* travelling at 120 *metres/sec* penetrates deeply into a fixed target and is brought to rest in 0.01 *sec*. The distance through which it penetrates the target is

(a) 3 *cm* (b) 6 *cm* (c) 30 *cm* (d) 60 *cm*

**65.** A person travelling on a straight line moves with uniform velocity $v_1$ for some time and with uniform velocity $v_2$ for the next equal time. The average velocity '*v*' is given by

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

**66.** A particle starts with a velocity of 200 *cm/sec* and moves in a straight line with a retardation of 10 *cm*/sec$^2$. Then the time it takes to describe 1500 *cm* is

(a) 10 *sec*, 30 *sec* (b) 5 *sec*, 15 *sec*. (c) 10 *sec* (d) 30 *sec*

## Advance Level

**67.** For $\frac{1}{m}$ of the distance between two stations a train is uniformly accelerated and $\frac{1}{n}$ of the distance it is uniformly retarded, it starts from rest at one station and comes to rest at the other. Then the ratio of its greatest velocity to its average velocity is

(a) $m + n + 1 : 1$ (b) $\left(\frac{1}{m} + \frac{1}{n}\right) : 1$ (c) $\frac{1}{m} + \frac{1}{n} + 1 : 1$ (d) $m + n + 1 : mn$

**68.** A train starts from station *A* with uniform acceleration $f_1$ for some distance and then goes with uniform retardation $f_2$ for some more distance to come to rest at *B*. If the distance between stations *A* and *B* is 4 *km* and the train takes 4 *minutes* to complete this journey, then $\frac{1}{f_1} + \frac{1}{f_2} =$

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

**69.** A bullet moving at 100 *m/sec* is fired into a wood-block in which it penetrates 50 *cm*. If the same bullet moving with the same velocity were fired into a similar piece of wood but only 12.5 *cm* thick, then the velocity with which it emerges is

(a) 500 *m/sec* (b) $\frac{500}{\sqrt{3}} m/\text{sec}$ (c) $500\sqrt{3} m/\text{sec}$ (d) None of these

**70.** A body traversed half the distance with velocity $v_0$. The remaining part of the distance was covered with velocity $v_1$ for half the time and with velocity $v_2$ for the other half of the time. The mean velocity of the body averaged over the whole time of motion is

(a) $\frac{v_0 + v_1 + v_2}{3}$ (b) $\frac{2v_0 + v_1 + v_2}{4}$ (c) $\frac{2v_0(v_1 + v_2)}{2v_0 + v_1 + v_2}$ (d) $\frac{v_0(v_1 + v_2)}{v_0 + v_1 + v_2}$

**71.** Two points move in the same straight line starting at the same moment from the same point in the same direction. The first moves with constant velocity *u* and the second starts from rest with constant acceleration *f*. The distance between the two points will be maximum at time

(a) $t = \frac{2u}{f}$ (b) $t = \frac{u}{f}$ (c) $t = \frac{u}{2f}$ (d) $t = \frac{u^2}{f}$

**72.** A train starts from rest from a station with constant acceleration for 2 *minutes* and attains a constant speed. It then runs for 11 *minutes* at this speed and retards uniformly during the next 3 *minutes* and stops at the next station which is 9 *km* off. The maximum speed (in *km/hr*) attained by the train is

(a) 30 (b) 35 (c) 40 (d) 45

**73.** A point moves from rest with constant acceleration. If it covered $\frac{9}{25}$ part of its total distance in its last second of motion, then upto what time it travelled

(a) 5 *second* (b) $\frac{5}{9}$ *second* (c) (a) and (b) both are true (d) $6\frac{1}{3}$ *second*

## Motion under gravity

### Basic Level

**74.** If a particle is thrown vertically upwards with a velocity of $u$ *cm/sec* under gravity, then the time for the particle to come to earth again is

**[MNR 1995]**

(a) $\frac{u}{g}\sec$ (b) $\frac{2u}{g}\sec$ (c) $\frac{u}{2g}\sec$ (d) None of these

**75.** Two balls are projected at the same instant, from the same point with the same velocity, one vertically upwards and other vertically downwards. If first takes $t_1$ *sec* and second takes $t_2$ *sec* to reach the ground, then $t_1 t_2 =$

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

**76.** If a particle is projected vertically upwards and is at a height $h$ after $t_1$ seconds and again after $t_2$ seconds, then $h =$ **[UPSEAT 1993, 1999]**

(a) $gt_1t_2$ (b) $\sqrt{gt_1t_2}$ (c) $2gt_1t_2$ (d) $\frac{1}{2}gt_1t_2$

**77.** From the top of a tower, 98 *m* high, a body is projected vertically upwards with a velocity of 39.2 *m/sec*. The velocity with which it strikes the ground is

(a) 58 *m/sec* (b) 60 *m/sec* (c) 58.8 *m/sec* (d) 55 *m/sec*

**78.** If the acceleration of falling bodies on the moon is 1.6 $m/sec^2$ and $t_1$ and $t_2$ seconds are timings of free fall from equal altitude above the moon's and earth's surface, then $t_1 : t_2 =$

(a) $7 : 2\sqrt{2}$ (b) $2\sqrt{2} : 7$ (c) $\sqrt{2} : 7$ (d) $2 : 7$

**79.** A house has multi-storeys. The lowest storey is 20 *ft* high. A stone which is dropped from the top of the house passes the lowest storey in $\frac{1}{4}\sec$. The height of the house is

(a) 100 *ft* (b) 110 *ft* (c) 110.25 *ft* (d) None of these

**80.** Two bodies of different masses $m_1$ and $m_2$ are dropped from different heights $h_1$ and $h_2$. The ratio of the times taken by the two bodies to fall through these distances is

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

**81.** The time to slide down the chord through the highest point of a vertical circle is

(a) Variable (b) Constant

(c) Dependent on the position of the chord (d) None of these

**82.** Two particles *A* and *B* are dropped from the height of 5 *m* and 20 *m* respectively. Then the ratio of time taken by *A* to that taken by *B*, to reach the ground is

(a) 1 : 4 (b) 2 : 1 (c) 1 : 2 (d) 1 : 1

**83.** A body is projected upwards with a certain velocity , and it is found that when in its ascent, it is 29430 *cm* from the ground it takes 4 *seconds* to return to the same point, again. The velocity of projection of the body is

(a) 7000 *cm/sec* (b) 7848 *cm/sec* (c) 8000 *cm/sec* (d) None of these

**84.** A particle is projected from the top of tower 5 *m* high and at the same moment another particle is projected upward from the bottom of the tower with a speed of 10 *m/s*, meet at distance '*h*' from the top of tower, then *h*

(a) 1.25 *m* (b) 2.5 *m* (c) 3 *m* (d) None of these

### Advance Level

**85.** If a body is projected vertically upwards with velocity $u$ and $t$ seconds after words another body is similarly projected with the same velocity, then the two bodies will meet after $T$ *seconds* of the projection of the second body, where $T$ =

(a) $\frac{u-gt}{2g}$ (b) $\frac{u-2gt}{2g}$ (c) $\frac{2u-gt}{g}$ (d) $\frac{2u-gt}{2g}$

**86.** A stone falling from the top of a vertical tower described $m$ *metres*, when another is let fall from a point $n$ *metres* below the top. If the two stones fall from rest and reach the ground together, then the time taken by them to reach the ground is

(a) $\frac{n+m}{\sqrt{2gm}}$ (b) $\frac{n+m}{\sqrt{2gn}}$ (c) $\frac{n-m}{\sqrt{2gm}}$ (d) $\frac{m-n}{\sqrt{2gn}}$

**87.** Let $g_1\, m/\sec^2$, $g_2\, m/\sec^2$ be the accelerations due to gravity at two places $P$ and $Q$. If a particle occupies $n$ *seconds* less and acquires a velocity of $m$ *metre/sec* more at place $P$ than place $Q$ in falling through the same distance, then $m/n$ equals

(a) $g_1 g_2$ (b) $\sqrt{\frac{g_1}{g_2}}$ (c) $\sqrt{\frac{g_2}{g_1}}$ (d) $\sqrt{g_1 g_2}$

**88.** After a ball has been falling under gravity for 5 *seconds* it passes through a pane of glass and loses half of its velocity and now reaches the ground in one second. The height of the glass above the ground is

(a) 2000 *m* (b) 2500 *m* (c) 2943 *m* (d) None of these

**89.** A tower is 61.25 *m* high. A rigid body is dropped from its top and at the same instant another body is thrown upwards from the bottom of the tower with such a velocity that they meet in the middle of the tower. The velocity of the projection of the second body is

(a) 20 *m/sec* (b) 25 *m/sec* (c) 24.5 *m/sec* (d) None of these

**90.** A particle is dropped from the top of a tower $h$ *metres* high and at the same moment another particle is projected upwards from the bottom of the tower. If the two particles meet when the upper one has described $\left(\frac{1}{n}\right)^{th}$ of the distance, then the velocities when they meet are in the ratio

(a) $2:n-2$ (b) $(n-2):2$ (c) $(n+2):2$ (d) $2:n+2$

**91.** A particle was dropped from the top of the tower of height $h$ and at the same time another particle is thrown vertically upwards form the bottom of the tower with such a velocity that it can just reach the top of the tower. The two particles meet at a height

**[UPSEAT 1998]**

(a) $\frac{h}{2}$ (b) $\frac{3}{5}h$ (c) $\frac{3h}{4}$ (d) $\frac{h}{4}$

**92.** A stone is dropped from an aeroplane which is rising with acceleration $f$ and $t$ *seconds* after this another stone is dropped. The distance between the two stones at time $T$ after the *second* stone is dropped is

(a) $\frac{1}{2}(g+f)(t+T)$ (b) $\frac{1}{2}(g+f)(t+2T)$ (c) $\frac{1}{2}(g+f)(2t+T)$ (d) $\frac{1}{2}(g-f)(t+2T)$

**93.** A stone is dropped slowly from the top of the wall and it reaches the surface of the water with the velocity 3924 *cm/sec,* if sound of splash is heard after $4\frac{109}{475}$ *seconds*, then the velocity of sound will be

(a) 312 *metre/sec* (b) 302 *metre/sec.* (c) 321 *metre/sec* (d) 342 *metre/sec*

## *Laws of motion, Apparent weight of a body on lift*

### *Basic Level*

**94.** A man on a lift ascending with an acceleration $f\,m/\sec^2$ throws a ball vertically upwards with a velocity of $v\,m/\sec$ relative to the lift and catches it again in *t seconds*. The value of *t* is

(a) $\frac{2v}{f-g}$ (b) $\frac{v}{f-g}$ (c) $\frac{v}{f+g}$ (d) $\frac{2v}{f+g}$

**95.** A body weighs most **[Roorkee 1994]**

(a) At the earth's surface (b) Above the earth's surface (c) Inside the earth (d) At the centre of the earth

**96.** A dyne is the force which produces an acceleration of $1 cm/\sec^2$ when acted on a mass of

(a) $1 mg$ (b) $10 gm$ (c) $1 gm$ (d) $1 kg$

**97.** A balloon of mass *M* ascends with a uniform acceleration *f*. If a certain part of the balloon is detached in such a way that the acceleration is doubled, then the mass of the detached portion is

(a) $\frac{fM}{f+g}$ (b) $\frac{fM}{f+2g}$ (c) $\frac{fM}{2f+g}$ (d) $\frac{gM}{2f+g}$

**98.** In a rectilinear motion a particle of mass *m* changes its velocity from *u* to *v* in describing a distance *x*. If *F* is the constant force which produces the changes, then $F =$

(a) $\frac{1}{2}m(v^2-u^2)$ (b) $\frac{1}{2x}m(v^2-u^2)$ (c) $\frac{1}{2x}m(v^2+u^2)$ (d) None of these

**99.** A cricket ball of mass 200 *gm* moving with a velocity of 20 *m/sec* is brought to rest by a player in 0.1 *sec*. The average force applied by the player is

(a) $4\times10^3$ *dynes* (b) $4\times10^4$ *dynes* (c) $4\times10^5$ *dynes* (d) $4\times10^6$ *dynes*

**100.** A train whose mass is 16 metric tons, moves at the rate of 72 *km/hr*. After applying breaks it stops in 500 *metre*. What is the force exerted by breaks obtaining it to be uniform

(a) 800 *N* (b) 1600 *N* (c) 3200 *N* (d) 6400 *N*

**101.** A mass of 8 *kg* is rolled a grass with a velocity of 28 *m/sec*. If the resistance be $\left(\frac{1}{10}\right)^{th}$ of the weight, then the body comes to rest after travelling

(a) 200 *m* (b) 400 *m* (c) 600 *m* (d) 800 *m*

**102.** If a force $F_1$ acts on a mass of 10 *kg* and in one-fifth of a second produces in it a velocity of 2 *m/sec* and the other force $F_2$ acting on a mass of 625 *kg* in a minute produces in it a velocity of 18 *km/hr*, then $F_1 : F_2$

(a) 24 : 25 (b) 48 : 25 (c) 24 : 5 (d) 48 : 125

**103.** In a diving competition, the boards fixed at a height of 10 *m* above the water level. A competitor jumps from the board and dives to a depth of 5 *m*. If the mass of the competitor is 60 *kg*, then the resistance offered by the water is

(a) 588 *N* (b) 1176 *N* (c) 1764 *N* (d) None of these

**104.** A man weighing 60 *kg* jumps off a railway train running on horizontal rails at 20 *km/h* with a packet weighing 10 *kg* in his hand. The thrust of the packet on his hand is

(a) 0 (b) 10 *kg wt.* (c) 50 *kg wt.* (d) 70 *kg wt.*

**105.** A hockey stick pushes a ball at rest for 0.01 *sec* with an average force of 50 *N*. If the ball weighs 0.2 *kg*, then the velocity of the ball just after being pushed is

(a) 3.5 *m/sec* (b) 2.5 *m/sec* (c) 1.5 *m/sec* (d) 4.5 *m/sec*

**106.** A bullet of mass 10 *gram* fired into a wall with a velocity of 10 *m/sec* loses its velocity in penetrating through 5 *cm* into the wall. The average force exerted by the wall is

(a) $10^4$ *gm wt* (b) $10^6$ *dynes* (c) $10^5$ *dynes* (d) None of these

**107.** If body of mass *M kg* and at rest is acted upon by a constant force of *W kg* weight, then in seconds it moves through a distance of

(a) $\frac{gTW}{2M}$ *metre* (b) $\frac{gTW^2}{2M}$ *metre* (c) $\frac{g^2TW}{2M}$ *metre* (d) $\frac{gT^2W}{2M}$ *metre*

**108.** A train is moving with constant velocity. If the resistance of its motion is 10 *lbs per ton* (of mass) and the force exerted by the engine is 200 *lbs wt*, then the mass of engine is

(a) 20 *tons* (b) 200 *tons* (c) 2000 *tons* (d) 2 *tons*

**109.** If the barrel of the gun is cut down 50 *cm*, then a bullet of 49 *kilogram* fire out with velocity 361 *m/sec* instead of 441 *m/sec*. The approximate thrust of gas on the bullet will be

(a) 317.6 metric ton weight (b) 318.4 metric ton weight (c) 319.3 metric ton weight (d) 320.8 metric ton weight

**110.** A cart of 100 *kg* is free to move on smooth rails and a block of 20 *kg* is resting on it. Surface of contact between the cart and the block is smooth. A force of 60 *Newton* is applied to the cart. Acceleration of 20 *kg*, block in *metres per second*$^2$ is **[UPSEAT 1993]**

(a) 3 (b) 0.6 (c) 0.5 (d) 0

**111.** A man having mass 70 *kilogram* is standing in a lift which is moving with uniform acceleration of 25 *cm/sec*$^2$. What will be the reaction of floor when lift coming down

(a) $\frac{70\times 956}{981}\,kg\text{-}wt$ (b) $\frac{70\times 1006}{981}\,kg\text{-}wt$ (c) $\frac{70\times 25}{981}\,kg\text{-}wt$ (d) $\frac{70\times 981}{25}\,kg\text{-}wt$

## Advance Level

**112.** From the gun cartage of mass *M*, a fire arm of mass *m* with velocity *u* relative to gun cartage is fired. The real velocities of fire arms and gun cartage will be respectively

(a) $\frac{Mu}{M+m}, \frac{Mu}{M-u}$ (b) $\frac{Mu}{M+m}, \frac{mu}{M+m}$ (c) $\frac{M+m}{Mu}, \frac{M+m}{mu}$ (d) $\frac{M+m}{M-m}, \frac{M+m}{Mm}$

**113.** The shortest time from rest to rest in which a steady load of *P* tons can lift a weight of *W* tons through a vertical distance *h* feet is

(a) $\sqrt{\left(\frac{2h}{g}.\frac{P}{P-W}\right)}$ (b) $\sqrt{\left(\frac{2h}{g}.\frac{P}{P+W}\right)}$ (c) $\sqrt{\left(\frac{2h}{g}.\frac{P+W}{P-W}\right)}$ (d) None of these

**114.** A shot, whose mass is 400 *kg*, is discharged from a 80 metric ton gun with a velocity of 490 *m/sec*. The necessary force required to stop the gun after a recoil of 1.6 *m* is

(a) 245/16 metric ton (b) 15 metric ton (c) 20 metric ton (d) None of these

**115.** A rough plane is 100 *ft* long and is inclined to the horizon at an angle $\sin^{-1}(3/5)$, the coefficient of friction being 1/2, and a body slides down it from rest at the highest point, the velocity on reaching the bottom would be

(a) $16/\sqrt{5}$ *ft/sec* (b) $16\ ft/\sec$ (c) $16\sqrt{5}\ ft/\sec$ (d) $16/\sqrt{7}\ ft/\sec$.

**116.** A particle slide down a rough inclined plane whose inclination to the horizontal is $45^o$ and whose coefficient of friction is 3/4. The time of descending the distance $4\sqrt{8/5}$ *m* down the plane is

(a) 0.8 *sec* (b) 1.2 *sec* (c) 1.4 *sec* (d) 1.62 *sec*

**117.** The times of ascent and descent of a particle projected along an inclined plane of inclination $\alpha$ are $t_1$ and $t_2$ respectively, the coefficient of friction is

(a) $\frac{t_2-t_1}{t_2+t_1}\tan\alpha$ (b) $\frac{t_2+t_1}{t_2-t_1}\tan\alpha$ (c) $\frac{t_2^2-t_1^2}{t_2^2+t_1^2}\tan\alpha$ (d) $\frac{t_2^2+t_1^2}{t_2^2-t_1^2}\tan\alpha$

## *Motion of two particles connected by a string*

## Basic Level

**118.** A pulley carrying a total load *W* hangs in a loop of a chord which passes over two fixed pulleys and has unequal weights *P* and *Q* freely suspended from the ends, each segment of the chord vertical. If *W* remains at rest, then *W* =

(a) $\frac{PQ}{P+Q}$ (b) $\frac{2PQ}{P+Q}$ (c) $\frac{3PQ}{P+Q}$ (d) $\frac{4PQ}{P+Q}$

**119.** Two particles of masses $m_1$ and $m_2$ are connected by a light inextensible string $m_2$ is placed on a smooth horizontal table and the string passes over a light pulley at the edge of the table and $m_1$ is hanging freely. If $m_1$ is replaced by $m_2$ and $m_2$ is replaced by $m_3$, then the acceleration of the system remains unaltered if $m_1, m_2, m_3$ are in

(a) A.P. (b) G.P. (c) H.P. (d) None of these

**120.** A light string passing over a light smooth pulley carries masses of 3 *kg* and 5 *kg* at its ends. If the string breaks after the masses have moved 9 *m*, then the 3 *kg* mass will farther rise $(g = 10 m/\sec^2)$

(a) 1.75 *m* (b) 1.95 *m* (c) 2.05 *m* (d) 2.25 *m*

**121.** A body of mass 90 *gm* is placed on a smooth table from the distance 2.45 *metre* from end and is attached to a rope which is hanging from the end of table, then time taken by body to reach to end of table will be

(a) $\sqrt{2}$ sec (b) $\sqrt{3}$ sec (c) 2 sec (d) $\sqrt{5}$ sec

**122.** Two bodies of mass 8 and 10 *gm* is attached to a light rope which is passing over a smooth pulley. If this system is given to a velocity $\frac{3}{16} g\, cm/\sec$. then small body will move downwards and heavy body will move upwards, then after what time they will move in opposite directions

(a) $\frac{25}{16}$ sec (b) $\frac{23}{14}$ sec (c) $\frac{27}{16}$ sec (d) $\frac{81}{512}$ sec

**123.** Two masses $m_1$ and $m_2$ are connected by a light inextensible string and suspended over a smooth fixed pulley. Then **[Roorkee 1994]**

(a) Pressure on the pulley = $m_1 g$ (b) Pressure on the pulley = $m_2 g$

(c) Pressure $< (m_1 + m_2)g$ (d) Pressure > $(m_1 + m_2)g$

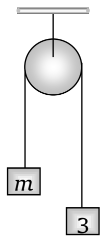
**124.** Two strings pass over a smooth pulley, on one side they are attached to masses of 3 and 4 *kg* respectively, and on the other to a mass of 5 *kg*. Then the tensions of the strings are

(a) 2, 3 *kg wt*. (b) 5/2, 10/3 *kg wt*. (c) 3, 4 *kg wt*. (d) None of these

**125.** A body of mass 5 *gram* is placed on a smooth table and is connected by a string passing over a light smooth pulley at the edge with a body of mass 10 *gram*. The common acceleration is

(a) 2*g*/3 (b) 3 *g*/2 (c) 2.5 *g* (d) 0.5 *g*

**126.** Two masses are attached to the pulley as shown in fig., find acceleration of centre of mass




(a) $\frac{g}{4}$ (b) $\frac{-g}{4}$ (c) $\frac{g}{2}$ (d) $\frac{-g}{2}$

## Advance Level

**127.** A light string passing over a light smooth pulley carries masses of 3 *kg* and 5 *kg* at its ends. If the string breaks after the masses have moved 9 *m*, how much further the 3 *kg* mass will rise (Take *g* = 10 $m/sec^2$)

(a) 1.75 *m* (b) 1.95 *m* (c) 2.05 *m* (d) 2.25 *m*

**128.** A mass 2*Q* on a horizontal table, whose coefficient of friction is $\sqrt{3}$ is connected by a string with a mass 6*Q* which hangs over the edge of the table. Eight seconds after the commencement of the motion, the string breaks. The distance of the new position of equilibrium of 2*Q* from its initial position is

(a) 117.6 *m* (b) 120.4 *m* (c) 130.4 *m* (d) None of these

**129.** A mass of 6 *kg* slides down a smooth inclined plane whose height is half its length, and draws another mass from rest over a distance 3 *m* in 5 *sec* along a smooth horizontal table which is level with the top of the plane over which the string passes, the mass on the table is

(a) 86.5 *kg* (b) 96.5 *kg* (c) 106.5 *kg* (d) 116.5 *kg*

**130.** Masses of 5 *kg* and 3 *kg* rest on two inclined planes each inclined at $30^o$ to the horizontal and are connected by a string passing over the common vertex. After 2 *second* the mass of 5 *kg*. is removed. How far up the plane will the 3 *kg*. mass continue to move

(a) 1.9/8 *m* (b) 2.9/8 *m* (c) 3.9/8 *m* (d) 4.9/8 *m*

## *Impact of elastic ladies*

### *Basic Level*

**131.** Two equal perfectly elastic balls impinges directly, then after impact they

(a) Are at rest (b) Interchange their velocities

(c) Move with the same velocities (d) Move with twice velocities

**132.** A sphere impinges directly on an equal sphere at rest. If the coefficient of restitution is *e*, their velocities after the impact are as

**[UPSEAT 1999]**

(a) $1 : e$ (b) $e : 1$ (c) $1+e : 1-e$ (d) $1-e : 1+e$

**133.** A ball is dropped from a height of 22.5 *metre* on a fixed horizontal plane. If $e = 2/5$, then it will stop rebounding after

(a) 5 *sec*. (b) 6 *sec*. (c) 7 *sec*. (d) 8 *sec*.

**134.** An elastic ball with coefficient of elasticity 1/2 is dropped from rest at a height *h* on a smooth floor. The total distance covered by the ball is

(a) More than 2*h* (b) Less than 2*h* but more than (3/2)*h*

(c) Less than (3/2)*h* but more that (4/3)*h* (d) Less then (4/3)*h*

**135.** Hailstorm are observed to strike the surface of a frozen lake in a direction making an angle of $30^o$ to the vertical and to rebound at an angle of $60^o$ to the vertical. Assuming the contact to be smooth, the coefficient of restitution is **[MNR 1986]**

(a) 1/3 (b) 2/3 (c) $1/\sqrt{3}$ (d) None of these

**136.** Any heavy elastic ball falls from the ceiling of any room and after rebounding two times reaches the half of the height of ceiling. The coefficient of restitution is

(a) $(0.50)^{1/2}$ (b) $(0.50)^{1/3}$ (c) $(0.50)^{1/4}$ (d) $(0.25)^{1/2}$

**137.** A ball of 1 *kg* moving with velocity 7 *m/sec* overtakes and collides with a ball of mass 2 *kg* moving with velocity 1 *m/sec*. in the same direction. If $e = 3/4$, the velocity of the lighter ball after impact is

(a) 120 *m/sec* (b) $\frac{1}{2}$ *m/sec* (c) 1 *m/sec* (d) 0 *m/sec*

**138.** A ball is dropped from a height of 25 *dm* above a fixed horizontal plane. If it rebounds to a height of 16 *dm*, then the coefficient of restitution is

(a) 16/25 (b) 0.8 (c) 16 *g*/25 (d) 0.8 *g*

### *Advance Level*

**139.** A ball falls from a height *h* upon a fixed horizontal plane, *e* is the coefficient of restitution, the whole distance described by the ball before it comes to rest is

(a) $\frac{1+e^2}{1-e^2}h$ (b) $\frac{1-e^2}{1+e^2}h$ (c) $\frac{1+e^2}{(1-e^2)h}$ (d) $\frac{1-e^2}{(1+e^2)h}$

**140.** A ball is thrown from a point at a distance *c* from a smooth vertical wall and against the wall and returns to the point of projection. If *e* as the coefficient of restitution, $\alpha$ the angle of projection, the time of flight of the ball is

(a) $\left[\frac{2(1-e)c}{eg}\tan\alpha\right]^{1/2}$ (b) $\left[\frac{2(1+e)c}{eg}\tan\alpha\right]^{1/2}$ (c) $2(1+e)c\tan\alpha$ (d) None of these

**141.** A ball of mass 8 *kg* and moving with velocity 4 *m/sec* collides with another ball of mass 10 *kg* moving with velocity 2 *m/sec* in the same direction. If the coefficient of restitution is 1/2, the velocities (in *m/sec*) of the balls after impact are **[MNR 1983]**

(a) 0, 0 (b) 7/3, 10/3 (c) 2/3, 5/3 (d) 2, 2

**142.** Three balls of masses $m_1$, $m_2$, $m_3$ are lying in straight line. The first ball is moved with a certain velocity so that it strikes the second ball directly, then the second ball collides with the third. If the coefficient of elasticity for each ball is $e$ and after impact first ball comes to rest, while after second impact the second ball comes to rest. Then $m_1, m_2, m_3$ are in

(a) A.P., (b) G.P. (c) H.P. (d) None of these

**143.** A sphere impings directly on an equal sphere which is at rest. Then the original kinetic energy lost is equal

(a) $\frac{1+e^2}{2}$ times the initial K.E.(b) $\frac{1-e^2}{2}$ (c) $\frac{1-e^2}{2}$ times the initial K.E. (d) None of these

## Projectile motion

### Basic Level

**144.** A particle is projected with velocity $2\sqrt{(2g)}$ so that it just clears two walls of equal height 2 *metre*, which are at a distance of 4 *metre* from each other. What is the time of passing from one wall to another

(a) $\sqrt{(2/g)}$ (b) $\sqrt{(2g)}$ (c) $2\sqrt{(2/g)}$ (d) $\sqrt{(g/2)}$

**145.** A particle is thrown over a triangle from one end of horizontal base. If $\alpha, \beta$ are the base angles and $\theta$ the angle of projection, then

(a) $\tan\theta = \tan\alpha - \tan\beta$ (b) $\tan\theta = \tan\beta - \tan\alpha$ (c) $\tan\theta = \tan\alpha + \tan\beta$ (d) None of these

**146.** A particle is projected down an inclined plane with a velocity of 21 *m/sec* at an angle of $60^o$ with the horizontal. Its range on the inclined plane, inclined at an angle of $30^o$ with the horizontal is

(a) 21 *dm* (b) 2.1 *dm* (c) 30 *dm* (d) 6 *dm*

**147.** If you want to kick a football to the maximum distance the angle at which it should be kicked is (assuming no resistance) **[MNR 1981, 95]**

(a) $45^o$ (b) $90^o$ (c) $30^o$ (d) $60^o$

**148.** The path of projectile in vacuum is a **[MNR 1971; UPSEAT 1998]**

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

**149.** A particle is projected under gravity $(g = 9.81 m/\sec^2)$ with a velocity of $29.43\, m/\sec$ at an elevation of 30°. The time of flight in seconds to a height of 9.81 *m* are

(a) 5, 1, 5 (b) 1, 2 (c) 1, 5, 2 (d) 2, 3

**150.** From the top of a tower of height 100 *m*, a ball is projected with a velocity of 10 *m/sec*. It takes 5 *seconds* to reach the ground. If $g = 10 m/\sec^2$, then the angle of projection is

(a) $30^o$ (b) $45^o$ (c) $60^o$ (d) $90^o$

**151.** A particle is projected with initial velocity *u* making an angle $\alpha$ with the horizontal, its time of flight will be given by

**[MNR 1979; UPSEAT 1998]**

(a) $\frac{2u\sin\alpha}{g}$ (b) $\frac{2u^2\sin\alpha}{g}$ (c) $\frac{u\sin\alpha}{g}$ (d) $\frac{u^2\sin\alpha}{g}$

**152.** The escape velocity for a body projected vertically upwards is 11.2 *km/sec*. If the body is projected in a direction making an angle of $60^o$ with the vertical, then the escape velocity will be

(a) 11.2 *km/sec* (b) $5.6\sqrt{3} km/\sec$ (c) 5.6 *km/sec* (d) None of these

**153.** A particle is projected with the speed of $10\sqrt{5} m/\sec$ at an angle of $60^o$ from the horizontal. The velocity of the projectile when it reaches the height of 10 *m* is ( $g = 9.8\, m/\sec^2$ )

(a) $4\sqrt{(19)}\, m/\sec$ (b) $\sqrt{(179)}\, m/\sec$ (c) $15\, m/\sec$ (d) $5\sqrt{(15)}\, m/\sec$

**154.** From the top of a hill of height 150 *m*, a ball is projected with a velocity of 10 *m/sec*. It takes 6 *second* to reach the ground. The angle of projection of the ball is

(a) $15^o$ (b) $30^o$ (c) $45^o$ (d) $60^o$

**155.** A cricket ball is thrown from the top of a cliff 200 *m* high with a velocity of 80 *m/sec*. at an elevation of $30^o$ above the horizon, the horizontal distance from the foot of the cliff to the point where it hits the ground is (take $g = 10 m/\sec^2$ )

(a) 595.3 *m* (b) 695.3 *m* (c) 795.3 *m* (d) 895.3 *m*

**156.** A particle is projected with a velocity of 39.2 *m/sec* at an angle of $30^o$ to the horizontal. It will move at right angle to the direction of projection after the time

(a) 8 *sec* (b) 5 *sec* (c) 6 *sec* (d) 10 *sec*

**157.** Let $R_1$ and $R_2$ respectively be the maximum ranges up and down an inclined plane and *R* be the maximum range on the horizontal plane. Then $R_1, R, R_2$ are in

(a) Arithmetic-Geometric progression (A.G.P.) (b) A.P.
(c) G.P. (d) H.P.

**158.** If $t_1$ and $t_2$ are the times of flight of two particles having the same initial velocity *u* and range *R* on the horizontal, then $t_1^2 + t_2^2$ is equal to

(a) 1 (b) $4u^2/g^2$ (c) $u^2/2g$ (d) $u^2/g$

**159.** A particle is projected at an angle of $45^o$ with a velocity of 9.8 *metre per second*. The horizontal range will be

(a) 9.8 *metre* (b) 4.9 *metre* (c) $9.8/\sqrt{2}$ *metre* (d) $9.8\sqrt{2}$ *metre*

**160.** Two balls are projected respectively from the same point in directions inclined at $60^o$ and $30^o$ to the horizontal. If they attain the same height, the ratio of their velocities of projection is

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

**161.** If a projectile having horizontal range of 24 acquires a maximum height of 8, then its initial velocity and the angle of projection are

**[Roorkee Screeninig 1990]**

(a) $24\sqrt{g}, \sin^{-1}(0.6)$ (b) $8\sqrt{g}, \sin^{-1}(0.8)$ (c) $5\sqrt{g}, \sin^{-1}(0.8)$ (d) $5\sqrt{g}, \sin^{-1}(0.6)$

**162.** The range of a projectile fixed at an angle of $15^o$ is 50 *m*, if it is fixed with the same speed at an angle of $45^o$, then the range will be

**[UPSEAT 2002]**

(a) 50 *m* (b) 100 *m* (c) 150 *m* (d) None of these

**163.** A particle is thrown with velocity *u* at an angle of $30^o$ from horizontal line when it becomes perpendicular to its original position

**[UPSEAT 2002]**

(a) $\frac{2u}{g}$ (b) $2ug$ (c) $\frac{u\sqrt{3}}{g}$ (d) None of these

**164.** *AB* is the vertical diameter of a circle in a vertical plane. Another diameter *CD* makes an angle of $60^o$ with *AB*, then the ratio of the time taken by a particle to slide along *AB* to the time taken by it to slide along *CD* is

(a) 1 : 1 (b) $\sqrt{2}:1$ (c) $1:\sqrt{2}$ (d) $3^{1/4}:2^{1/2}$

**165.** A particle is projected up a smooth inclined plane of inclination $60^o$ along the line of greatest slope. If it comes to instantaneous rest after 2 *second* then the velocity of projection is $(g = 9.8 m/\sec^2)$

(a) 9.8 *m/s* (b) 10 *m/s* (c) 16.97 *m/s* (d) 19.6 *m/s*

**166.** A body is projected through an angle $\alpha$ from vertical so that its range is half of maximum range, $\alpha$ is

(a) $60^o$ (b) $75^o$ (c) $30^o$ (d) $22.5^o$

## Advance Level

**167.** The angular elevation of an enemy's position on a hill *h* feet high is $\beta$. Show that is order to shell if the initial velocity of the projectile must not be less than

(a) $[gh(1+\sin\beta)]^{1/2}$ (b) $[gh(1-\sin\beta)]^{1/2}$ (c) $[gh(1+\text{cosec }\beta)]^{1/2}$ (d) $[gh(1-\text{cosec }\beta)]^{1/2}$

**168.** The ratio of the greatest range up an inclined plane through the point of projection and the distance through which a particle falls freely during the corresponding time of flight is

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

**169.** A stone is projected so that its horizontal range is maximum and equal to 80 *ft*. Its time of flight and the height it rises are

(a) $\sqrt{3}, 1$ (b) $\sqrt{4}$, 15 (c) $\sqrt{5}, 20$ (d) None of these

**170.** The velocity and direction of projection of a shot which passes in horizontal direction just over the top of a wall which is 50 yds. away and 75 feet high

(a) $40, 30^o$ (b) $40\sqrt{6}, 45^o$ (c) $50, 60^o$ (d) None of these

**171.** A shot fired from a gun on top of a tower, 272 feet high hits the ground at a distance of 4352 feet in 17 *seconds*. The velocity and direction of projection are

(a) 256, $30^o$ (b) $256\sqrt{2}, 45^o$ (c) $180, 60^o$ (d) None of these

**172.** If the time taken in slipping down on smooth inclined plane is twice to the time taken in falling from the vertical height of that plane, then the inclination of plane will be

(a) $45^o$ (b) $60^o$ (c) $75^o$ (d) $30^o$

# Work power and Energy

## Basic Level

**173.** A labour throws 12 bricks per minute from the ground so as to just reach the roof 3.3 *metres* high. If each brick weights 3.75 *kg*, the horse power at which he is working, is

(a) 0.0325 (b) 0.325 (c) 3.25 (d) None of these

**174.** A weight of 10 metric tons is dragged in half an hour through a distance of 110 *metre* up a rough inclined plane inclined at an angle of $30^o$ to the horizon, the coefficient of friction being $1/\sqrt{3}$. The horse power (nearly) of the engine by which this work will be done is

(a) 6 (b) 8 (c) 10 (d) 20

**175.** A body is 3 *kg* is projected upwards with such a velocity that it can reach the height 196 *metres* only. The kinetic energy of the body at the time of projection is

(a) 5000 *Joule* (b) 5762.4 *Joule* (c) 6000 *Joule* (d) None of these

**176.** A bullet of 125 *grams* strikes a target with a velocity of 400 *metres per second* and is embedded in it. If the target weighs 10 *kg* and is free to move, then the velocity of the target after impact is

(a) 400/81 *m/sec* (b) 400 *m/sec* (c) 300 *m/sec* (d) None of these

**177.** A bullet is shot with a velocity of 600 *m/sec* into a target weighing 12 *kg* and is free to move with a velocity 1.5 *m/sec* after impact. Then the percentage loss of kinetic energy in the impact is

(a) 79.75 % (b) 89.75 % (c) 99.75 % (d) None of these

**178.** A 15 *kg* block is moving on ice with a speed of 5 *metre per second* when a 10 *kg* block is dropped onto it vertically. The two together move with a velocity which in *metre per second* is

(a) 3 (b) $\sqrt{(15)}$ (c) 5 (d) Indeterminate

**179.** A ball weighing 0.01 *kg* hits a hard surface vertically with a speed of 5 *m/sec* and rebounds with the same speed. The ball reamins in contact with the surface for 0.01 *sec*. The average force exerted by the surface on the ball (in Newton) is

(a) 0.1 (b) 1.0 (c) 5.0 (d) 10.0

## *Advance Level*

**180.** A labour has to throw bricks near mistry 16 feet vertically above. He throws the bricks in such a manner that the brick reach the mistry with the velocity of 16 *ft/sec*. If the throws bricks such that bricks just reach the mistry, then the portion of the energy saved is

(a) 1/3 (b) 1/4 (c) 1/5 (d) 1/6

**181.** A hammer of mass 2 *kg* falls vertically through 1 *metre* on the top of a nail of mass 100 *gm* and drives it a distance of 10 *cm* in the ground. The resistance of the ground is

(a) 3441/210 *kg wt* (b) 4441/210 *kg wt* (c) 5441/210 *kg wt* (d) None of these

**182.** A bullet of mass *m* penetrates a thickness *a* of a plate of mass *M* at rest. If this plate is free to move, then the thickness to which the bullet will penetrate is

(a) $Ma/(m+M)$ (b) $ma/(m+M)$ (c) $(M-m)a/(m+M)$ (d) None of these

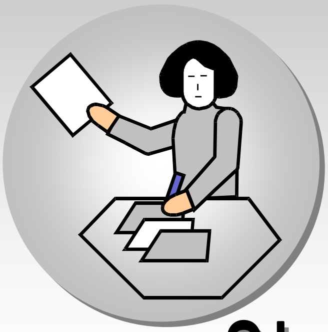
**183.** A glass marble, whose mass is $(1/10)kg$ falls from a height of 2.5 *m* and rebounds to a height of 1.6 *m*. Then the average force between the marble and the floor, if the time during which they are in contact be one-tenth of a second, is

(a) 10.58 *N* (b) 11.58 *N* (c) 12.58 *N* (d) 13.58 *N*

**184.** A fire engine lifts 50 *kg* water up to 2 *m* height per minutes and throws it out with the velocity of 19.62 *m/sec*. The horse power of engine will be

(a) 0.12 (b) 0.24 (c) 0.36 (d) 0.48

* * *



# Answer Sheet

*Dynamics* | *Assignment (Basic and Advance Level)*

| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | c | b | b | b | b | c | c | a | d | d | b | a | c | b | c | b | d | d | c |
| 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 | 38 | 39 | 40 |
| a | b | b | d | a | c | d | a | a | c | b | b | b | b | b | c | b | b | a | b |
| 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 | 56 | 57 | 58 | 59 | 60 |
| a | d | c | a | c | a | b | c | a | a | c | b | c | d | c | a | a | c | c | c |
| 61 | 62 | 63 | 64 | 65 | 66 | 67 | 68 | 69 | 70 | 71 | 72 | 73 | 74 | 75 | 76 | 77 | 78 | 79 | 80 |
| c | b | d | d | a | a | c | b | c | c | b | c | a | b | c | d | c | b | c | b |
| 81 | 82 | 83 | 84 | 85 | 86 | 87 | 88 | 89 | 90 | 91 | 92 | 93 | 94 | 95 | 96 | 97 | 98 | 99 | 100 |
| b | c | b | a | d | c | d | c | d | b | c | b | d | d | a | b | c | b | d | d |
| 101 | 102 | 103 | 104 | 105 | 106 | 107 | 108 | 109 | 110 | 111 | 112 | 113 | 114 | 115 | 116 | 117 | 118 | 119 | 120 |
| b | b | c | a | b | b | d | a | d | c | a | b | a | a | c | d | c | d | b | d |
| 121 | 122 | 123 | 124 | 125 | 126 | 127 | 128 | 129 | 130 | 131 | 132 | 133 | 134 | 135 | 136 | 137 | 138 | 139 | 140 |
| d | c | c | b | a | b | d | a | d | d | b | d | a | b | a | c | d | b | a | b |
| 141 | 142 | 143 | 144 | 145 | 146 | 147 | 148 | 149 | 150 | 151 | 152 | 153 | 154 | 155 | 156 | 157 | 158 | 159 | 160 |

| | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| b | b | c | c | c | d | a | d | b | a | a | c | a | b | c | a | d | b | a | b |
| 161 | 162 | 163 | 164 | 165 | 166 | 167 | 168 | 169 | 170 | 171 | 172 | 173 | 174 | 175 | 176 | 177 | 178 | 179 | 180 |
| c | b | d | c | c | b | c | c | c | b | b | d | a | b | b | a | c | a | d | c |
| 181 | 182 | 183 | 184 | | | | | | | | | | | | | | | | |
| b | a | d | b | | | | | | | | | | | | | | | | |