KINEMATICS LEVEL 1

SELECT THE CORRECT ALTERNATIVE (ONLY ONE CORRECT ANSWER)

1. A bird moves from point (1, – 2, 3) to (4, 2, 3) . If the speed of the bird is 10 m/s, then the velocity vector of the bird is :-

(A) $5\left(\tilde{i}-2\tilde{j}+3\tilde{k}\right)$ (B) $5\left(4\tilde{i}+2\tilde{j}+3\tilde{k}\right)$ (C) $0.6\tilde{i}+0.8\tilde{j}$ (D) $6\tilde{i}+8\tilde{j}$

2. A particle moves in straight line in same direction for 20 seconds with velocity 3 m/s and then moves with velocity 4 m/s for another 20 sec and finally moves with velocity 5 m/s for next 20 seconds. What is the average velocity of the particle?

(A) 3 m/s (B) 4 m/s (C) 5 m/s (D) Zero

3. A particle is moving in x–y–plane at 2 m/s along x–axis. 2 seconds later, its velocity is 4 m/s in a direction making 60 with positive x–axis. Its average acceleration for this period of motion is:-

(A) $\sqrt{5}$ m/s^2, along y–axis (B) $\sqrt{3}$ m/s^2, along y–axis

(C) $\sqrt{5}$ m/s^2, along at 60 with positive x–axis (D) 3m/s^2, at 60 with positive x–axis.

4. The velocity of a particle moving along x–axis is given as v = x^2 – 5x + 4 (in m/s) where x denotes the x–coordinate of the particle in metres. Find the magnitude of acceleration of the particle when the velocity of particle is zero ?

(A) 0 m/s^2 (B) 2 m/s^2 (C) 3 m/s^2 (D) None of these

5. The coordinates of a moving particle at time t are given by x = ct^2 and y = bt^2. The speed of the particle is given by :–

(A) $2t(c+b)$ (B) $2t\sqrt{c^2-b^2}$ (C) $t\sqrt{c^2+b^2}$ (D) $2t\sqrt{c^2+b^2}$

6. A particle has an initial velocity of $(3\tilde{i}+4\tilde{j})$ m/s and a constant acceleration of $(4\tilde{i}-3\tilde{j})$ m/s^2. Its speed after one second will be equal to :-

(A) 0 (B) 10 m/s (C) $5\sqrt{2}$ m/s (D) 25 m/s

7. A body starts from rest and is uniformly accelerated for 30 s. The distance travelled in the first 10 s is x_1, next 10 s is x_2 and the last 10 s is x_3. Then $x_1 : x_2 : x_3$ is the same as:-

(A) 1 : 2 : 4 (B) 1 : 2 : 5 (C) 1 : 3 : 5 (D) 1 : 3 : 9

8. A, B, C and D are points in a vertical line such that AB = BC = CD. If a body falls from rest from A, then the times of descend through AB, BC and CD are in the ratio :-

(A) 1 : $\sqrt{2}$: $\sqrt{3}$ (B) $\sqrt{2}$: $\sqrt{3}$: 1

(C) $\sqrt{3}$: 1 : $\sqrt{2}$ (D) 1 : ($\sqrt{2}$ – 1) : ($\sqrt{3}$ – $\sqrt{2}$)

9. A particle is projected vertically upwards and it reaches the maximum height H in T seconds . The height of the particle at any time t will be :-

(A) H – g(t – T)^2 (B) g(t – T)^2 (C) H – $\frac{1}{2}$g(t – T)^2 (D) $\frac{g}{2}$(t – T)^2

10. A parachutist drops freely from an aeroplane for 10 s before the parachute opens out. Then he descends with a net retardation of 2.5 m/s^2. If he bails out of the plane at a height of 2495 m and g = 10 m/s^2, hit velocity on reaching the ground will be :-

(A) 5 m/s (B) 10 m/s (C) 15 m/s (D) 20 m/s

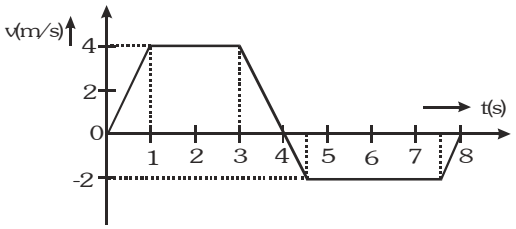
11. With what speed should a body be thrown upwards so that the distances traversed in 5th second and 6th second are equal ?

(A) 58.4 m/s (B) 49 m/s (C) $\sqrt{98}$ m/s (D) 98 m/s

12. A particle is projected vertically upwards from a point A on the ground. It takes t_1 time to reach a point B but it still continues to move up. If it takes further t_2 time to reach the ground from point B then height of point B from the ground is :-

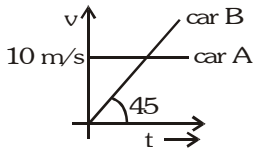
(A) $\frac{1}{2}g(t_1+t_2)^2$ (B) gt_1t_2 (C) $\frac{1}{8}g(t_1+t_2)^2$ (D) $\frac{1}{2}gt_1t_2$

13. The velocity – time graph of a linear motion is shown in figure. The displacement & distance from the origin after 8 sec. is :-



(A) 5 m, 19m (B) 16 m,22m (C) 8 m,19m (D) 6 m, 5m

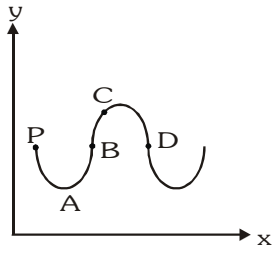
14. Initially car A is 10.5 m ahead of car B. Both start moving at time t=0 in the same direction along a straight line. The velocity time graph of two cars is shown in figure. The time when the car B will catch the car A, will be :-



(A) t = 21 sec (B) t = $2\sqrt{5}$ sec

(C) 20 sec (D) None of these

15. A man moves in x–y plane along the path shown. At what point is his average velocity vector in the same direction as his instaneous velocity vector. The man starts from point P.



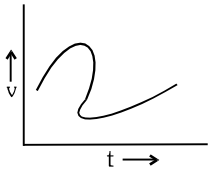
(A) A

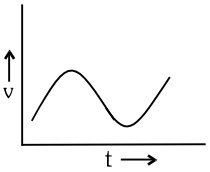
(B) B

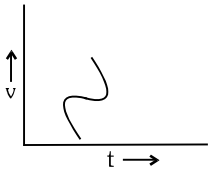
(C) C

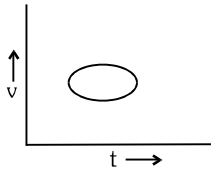
(D) D

16. Which of the following velocity–time graph shows a realistic situation for a body in motion :–

(A) 

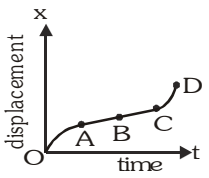
(B) 

(C) 

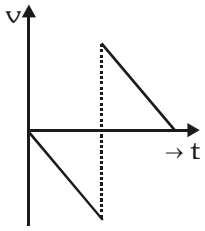
(D) 

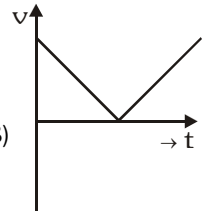
17. The graph between the displacement x and time t for a particle moving in a straight line is shown in figure. During the interval OA, AB, BC and CD, the acceleration of the particle is :

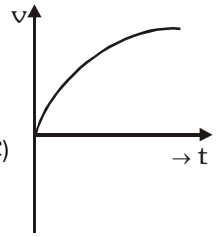
	OA,	AB,	BC,	CD
(A)	+	0	+	+
(B)	–	0	+	0
(C)	+	0	–	+
(D)	–	0	0	+

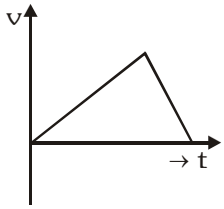


18. The velocity – time graph of a body falling from rest under gravity and rebounding from a solid surface is represented by which of the following graphs?

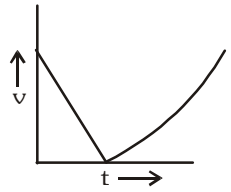
(A) 

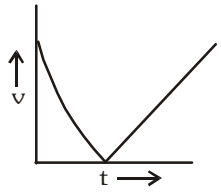
(B) 

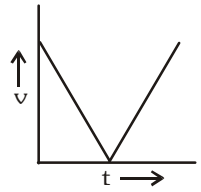
(C) 

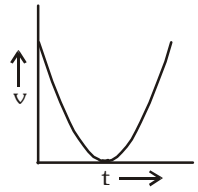
(D) 

19. A ball is thrown vertically upwards. Which of the following plots represents the speed–time graph of the ball during its flight if the air resistance is ignored :–

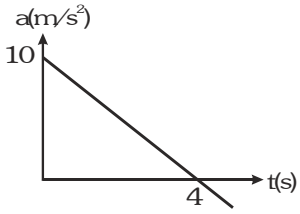
(A) 

(B) 

(C) 

(D) 

20. The acceleration–time graph of a particle moving along a straight line is as shown in figure. At what time the particle acquires its initial velocity?



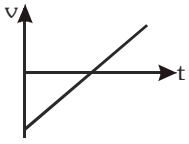
(A) 12 sec

(B) 5 sec

(C) 8 sec

(D) 16 sec

21. Which of the following situation is represented by the velocity–time graph as shown in the diagram :–



(A) A stone thrown up vertically, returning back to the ground

(B) A car decelerating at constant rate and then accelerating at the same rate

(C) A ball falling from a height and then bouncing back

(D) None of the above

22. A man starts running along a straight road with uniform velocity $\vec{u} = u\tilde{i}$ feels that the rain is falling vertically down along $\tilde{j}$. If he doubles his speed he finds that the rain is coming at an angle θ to the vertical . The velocity of rain with respect to the ground is :-

(A) $u\tilde{i} - u\tan\theta\tilde{j}$ (B) $u\tilde{i} - \frac{u}{\tan\theta}\tilde{j}$ (C) $u\tan\theta\tilde{i} - u\tilde{j}$ (D) $\frac{u}{\tan\theta}\tilde{i} - u\tilde{j}$

23. A river is flowing from west to east at a speed of 5 meters per minute. A man on the south bank of the river, capable of swimming at 10 meters per minute in still water, wants to swim across the river in the shortest time. He should swim in a direction :-

(A) Due north (B) 30 east of north (C) 30 north of west (D) 60 east of north

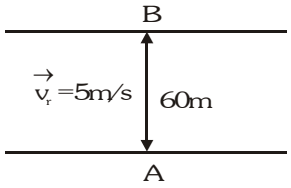
24. A boat moving towards east with velocity 4 m/s with respect to still water and river is flowing towards north with velocity 2 m/s and the wind is blowing towards north with velocity 6 m/s. The direction of the flag blown over by the wind hoisted on the boat is :-

(A) North–west (B) South–east (C) $\tan^{-1}(1/2)$ with east (D) North

25. Raindrops are falling vertically with a velocity 10m/s. To a cyclist moving on a straight road the rain drops appear to be coming with a velocity of 20m/s. The velocity of cyclist is :-

(A) 10m/s (B) $10\sqrt{3}$ m/s (C) 20 m/s (D) $20\sqrt{3}$ m/s

26. A man is crossing a river flowing with velocity of 5m/s. He reaches a point directly across at distance of 60 m in 5s. His velocity in still water should be :–



(A) 12 m/s (B) 13 m/s (C) 5 m/s (D) 10 m/s

27. A boat which has a speed of 5km per hour in still water crosses a river of width 1km along the shortest possible path in fifteen minutes. The velocity of the river water in km per hour is :-

(A) 1 (B) 2 (C) 3 (D) $\sqrt{41}$

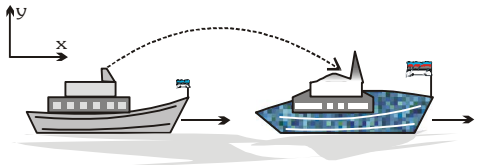
28. A river is flowing from east to west at a speed of 5 m/min. A man on south bank of river, capable of swimming 10 m/min in still water, wants to swim across the river in shorter time; he should swim :–

(A) Due north (B) Due north–east
(C) Due north–east with double the speed of river (D) None of the above

29. Two particles P and Q are moving with velocities of $\left(\tilde{i} + \tilde{j}\right)$ and $\left(-\tilde{i} + 2\tilde{j}\right)$ respectively. At time t = 0, P is at origin and Q is at a point with position vector $\left(2\tilde{i} + \tilde{j}\right)$. Then the shortest distance between P & Q is :-

(A) $\frac{2\sqrt{5}}{5}$ (B) $\frac{4\sqrt{5}}{5}$ (C) $\sqrt{5}$ (D) $\frac{3\sqrt{5}}{5}$

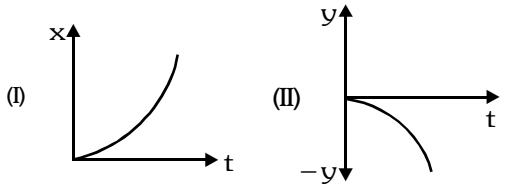
30. From a motorboat moving downstream with a velocity 2 m/s with respect to river, a stone is thrown. The stone falls on an ordinary boat at the instant when the motorboat collides with the ordinary boat. The velocity of the ordinary boat with respect to the river is equal to zero. The river flow velocity is given to be 1 m/s. The initial velocity vector of the stone with respect to earth is :-

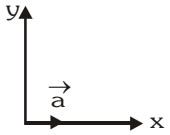


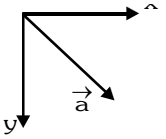
Take the value of g = 10 m/s^2
Initial separation between the two boats is 20m.

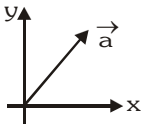
(A) 2i + 20j (B) 3i + 40j (C) 3i + 50j (D) 2i + 50j

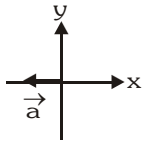
31. Graphs I and II give coordinates x(t) and y(t) of a particle moving in the x–y plane. Acceleration of the particle is constant and the graphs are drawn to the same scale. Which of the vector shown in options best represents the acceleration of the particle :-



(A) 

(B) 

(C) 

(D) 

32. Particle is dropped from the height of 20m on horizontal ground. There is wind blowing due to which horizontal acceleration of the particle becomes 6 ms^{-2}. Find the horizontal displacement of the particle till it reaches ground.

(A) 6m (B) 10 m (C) 12m (D) 24 m

33. The total speed of a projectile at its greatest height is $\sqrt{\frac{6}{7}}$ of its speed when it is at half of its greatest height . The angle of projection will be :-

(A) 60 (B) 45 (C) 30 (D) 50

34. A projectile is projected at an angle (α>45) with an initial velocity u. The time t, at which its magnitude of horizontal velocity will equal the magnitude of vertical velocity is :-

(A) $t = \frac{u}{g}(\cos\alpha - \sin\alpha)$ (B) $t = \frac{u}{g}(\cos\alpha + \sin\alpha)$ (C) $t = \frac{u}{g}(\sin\alpha - \cos\alpha)$ (D) $t = \frac{u}{g}(\sin^2\alpha - \cos^2\alpha)$.

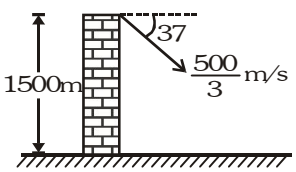
35. A particle is projected from a horizontal plane (x–z plane) such that its velocity vector at time t is given by $\vec{v} = a\tilde{i} + (b - ct)\tilde{j}$. Its range on the horizontal plane is given by :-

(A) $\frac{ba}{c}$ (B) $\frac{2ba}{c}$ (C) $\frac{3ba}{c}$ (D) None

36. A particle is dropped from a height h . Another particle which was initially at a horizontal distance 'd' from the first, is simultaneously projected with a horizontal velocity 'u' and the two particles just collide on the ground . The three quantities h. d and u are related to :-

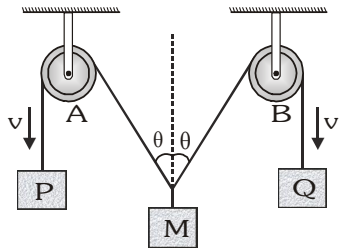
(A) $d^2 = \frac{u^2h}{2g}$ (B) $d^2 = \frac{2u^2h}{g}$ (C) d = h (D) $gd^2 = u^2h$

37. A particle is projected from a tower as shown in figure, then the distance from the foot of the tower where it will strike the ground will be :- (take g = 10 m/s^2)



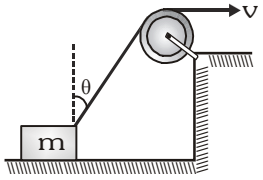
(A) 4000/3 m (B) 5000/3 m (C) 2000 m (D) 3000 m

38. In the figure, the ends P and Q of an unstrechable string move downwards with uniform speed v. Mass M moves upward with speed



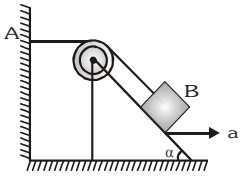
(A) $v\cos\theta$ (B) $\frac{v}{\cos\theta}$ (C) $2v\cos\theta$ (D) $\frac{2}{v\cos\theta}$

39. A block is dragged on a smooth plane with the help of a rope which moves with a velocity v as shown in figure. The horizontal velocity of the block is :



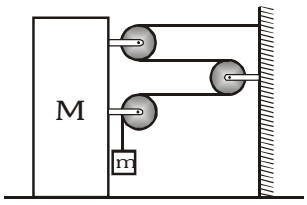
(A) v (B) $\frac{v}{\sin\theta}$ (C) $v\sin\theta$ (D) $\frac{v}{\cos\theta}$

40. A weightless inextensible rope rest on a stationary wedge forming an angle α with the horizontal. One end of the rope is fixed on the wall at point A. A small load is attached to the rope at point B. The wedge starts moving to the right with a constant acceleration a. The acceleration of the load is given by:



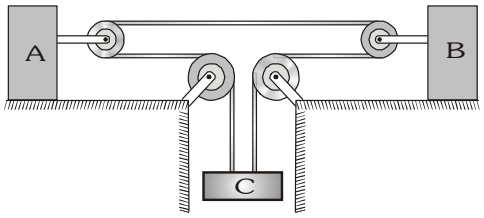
(A) a (B) $2a\sin\alpha$ (C) $2a\sin\frac{\alpha}{2}$ (D) $g\sin\alpha$

41. If acceleration of M is a then acceleration of m is



(A) 3a (B) $\frac{a}{3}$ (C) a (D) $\sqrt{10}\,a$

42. If acceleration of A is 2 m/s^2 towards left and acceleration of B is 1 m/s^2 towards left, then acceleration of C is :–



(A) 1 m/s^2 downwards (B) 1 m/s^2 upwards (C) 2 m/s^2 downwards (D) 2 m/s^2 upwards

43. If angular velocity of a disc depends an angle rotated θ as $\omega = \theta^2 + 2\theta$, then its angular acceleration α at $\theta = 1$ rad is :

(A) 8 rad/s^2 (B) 10rad/s^2 (C) 12 rad/s^2 (D) None of these

44. If the radii of circular path of two particles are in the ratio of 1 : 2, then in order to have same centripetal acceleration, their speeds should be in the ratio of :

(A) 1 : 4 (B) 4 : 1 (C) $1:\sqrt{2}$ (D) $\sqrt{2}:1$

45. A stone tied to the end of a string 80 cm long is whirled in a horizontal circle with a constant speed. If the stone makes 14 revolutions in 25 s, the magnitude of acceleration is :

(A) 20 ms^{-2} (B) 12 m/s^2 (C) 9.9 ms^{-2} (D) 8 ms^{-2}

46. A particle starts moving along a circle of radius (20/π)m with constant tangential acceleration. If the velocity of the particle is 50 m/s at the end of the second revolution after motion has began, the tangential acceleration in m/s^2 is :

(A) 1.6 (B) 4 (C) 15.6 (D) 13.2

47. For a body in circular motion with a constant angular velocity, the magnitude of the average acceleration over a period of half a revolution is.... times the magnitude of its instantaneous acceleration.

(A) $\frac{2}{\pi}$ (B) $\frac{\pi}{2}$ (C) π (D) 2

48. The second's hand of a watch has length 6 cm. Speed of end point and magnitude of difference of velocities at two perpendicular positions will be

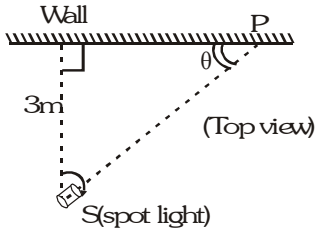
(A) 2π & 0 mm/s (B) $2\sqrt{2}\,\pi$ & 4.44 mm/s

(C) $2\sqrt{2}\,\pi$ & 2π mm/s (D) 2π & $2\sqrt{2}\pi$ mm/s

49. A particle is kept fixed on a turntable rotating uniformly. As seen from the ground, the particle goes in a circle, its speed is 20 cm/s and acceleration is 20 cm/s^2. The particle is now shifted to a new position to make the radius half of the original value. The new values of the speed and acceleration will be

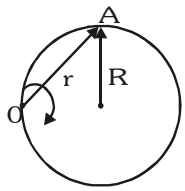
(A) 10 cm/s, 10 cm/s^2 (B) 10 cm/s, 80 cm/s^2 (C) 40 cm/s, 10 cm/s^2 (D) 40 cm/s, 40 cm/s^2

50. A spot light S rotates in a horizontal plane with a constant angular velocity of 0.1 rad/s. The spot of light P moves along the wall at a distance 3m. What is the velocity of the spot P when $\theta=45$?



(A) 0.6 m/s (B) 0.5 m/s (C) 0.4 m/s (D) 0.3 m/s

51. A particle A moves along a circle of radius R=50 cm so that its radius vector r relative to the point O (figure) rotates with the constant angular velocity $\omega=0.40$ rad/s. Then modulus of the velocity of the particle, and the modulus of its total acceleration will be



(A) v= 0.4 m/s, a = 0.4 m/s^2 (B) v = 0.32 m/s, a = 0.32 m/s^2

(C) v = 0.32 m/s, a = 0.4 m/s^2 (D) v = 0.4 m/s, a = 0.32 m/s^2

LEVEL 1

ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Ans.	D	B	B	A	D	C	C	D	C	A	B	D	A	A	C	B	D	A	C	C
Que.	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
Ans.	A	B	A	A	B	B	C	A	B	C	B	C	C	C	B	B	A	B	B	C
Que.	41	42	43	44	45	46	47	48	49	50	51									
Ans.	D	B	C	C	C	C	A	D	A	A	D									

KINEMATICS LEVEL 2

SELECT THE CORRECT ALTERNATIVES (ONE OR MORE THEN ONE CORRECT ANSWERS)

1. A particle is moving in a plane with velocity given by $\vec{u} = u_0\tilde{i} + (a\omega\cos\omega t)\tilde{j}$, where $\tilde{i}$ and $\tilde{j}$ are unit vectors along x and y axes respectively. If particle is at the origin at t = 0. Calculate the trajectory of the particle :-

(A) $y = a\sin\left(\frac{u_0}{\omega x}\right)$ (B) $y = a\sin\left(\frac{\omega x}{u_0}\right)$ (C) $y = \frac{1}{a}.\sin\left(\frac{u_0}{\omega x}\right)$ (D) $y = \frac{1}{a}.\sin\left(\frac{\omega x}{u_0}\right)$

2. A point moves in a straight line under the retardation av^2. If the initial velocity is u, the distance covered in 't' seconds is :-

(A) aut (B) $\frac{1}{a}\ell n(aut)$ (C) $\frac{1}{a}\ell n(1+aut)$ (D) $a\ell n(aut)$

3. The relation between time t and distance x is $t=\alpha x^2+\beta x$ where α and β are constants. The retardation is :-
(A) $2\alpha v^3$ (B) $2\beta v^2$ (C) $2\alpha\beta v^2$ (D) $2\beta^2 v^3$

4. A particle is moving with uniform acceleration along a straight line . Its velocities at A & B are respectively 7 m/s & 17 m/s . M is mid point of AB . If t_1 is the time taken to go from A to M and t_2 the time taken to go from M to B, the ratio $\frac{t_1}{t_2}$ is equal to :-

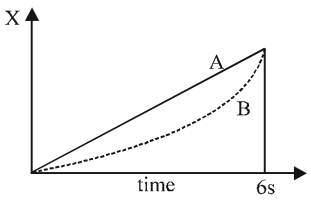
(A) 3 : 2 (B) 3 : 1 (C) 2 : 1 (D) 2 : 3

5. A, B & C are three objects each moving with constant velocity . A's speed is 10 m/s in a direction $\overrightarrow{PQ}$. The velocity of B relative to A is 6 m/s at an angle of, $\cos^{-1}(15/24)$ to PQ . The velocity of C relative to B is 12 m/s in a direction $\overrightarrow{QP}$. Then the magnitude of the velocity of C is :-

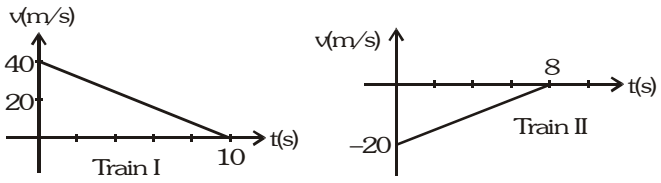
(A) 5 m/s (B) $2\sqrt{10}$ m/s (C) 3 m/s (D) 4 m/s

6. A person drops a stone from a building of height 20 m . At the same instant the front end of a truck passes below the building moving with constant acceleration of 1 m/s^2 and velocity of 2 m/s at that instant. Length of the truck if the stone just misses to hit its rear part is :-
(A) 6 m (B) 4 m (C) 5 m (D) 2 m

7. In the diagram shown, the displacement of particles is given as a function of time. The particle A is moving under constant velocity of 9 m/s. The particle B is moving under variable acceleration. From time t = 0 s. to t = 6 s., the average velocity of the particle B will be equal to :-
(A) 2.5 m/s (B) 4 m/s
(C) 9 m/s (D) None



8. Two trains, which are moving along different tracks in opposite directions, are put on the same track due to a mistake. Their drivers, on noticing the mistake, start slowing down the trains when the trains are 300 m apart. Given graphs show their velocities as function of time as the trains slow down. The separation between the trains when both have stopped,, is :-

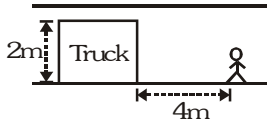


(A) 120 m (B) 280 m (C) 60 m (D) 20 m

9. The position vector of a particle is given as $\vec{r} = (t^2 - 4t + 6)\,\tilde{i} + (t^2)\,\tilde{j}$. The time after which the velocity vector and acceleration vector becomes perpendicular to each other is equal to :-

(A) 1 sec (B) 2 sec (C) 1.5 sec (D) Not possible

10. A 2m wide truck is moving with a uniform speed of 8 m/s along a straight horizontal road. A pedestrian starts crossing the road at an instant when the truck is 4 m away from him. The minimum constant velocity with which he should run to avoid an accident is :-



(A) $1.6\sqrt{5}$ m/s (B) $1.2\sqrt{5}$ m/s (C) $1.2\sqrt{7}$ m/s (D) $1.6\sqrt{7}$ m/s

11. If some function say x varies linearly with time and we want to find its average value in a given time interval we can directly find it by $\frac{x_i + x_f}{2}$. Here, x_i is the initial value of x and x_f its final value.

x and y co–ordinates of a particle moving in x–y plane at some instant are : $x = 2t^2$ and $y = 3/2\ t^2$. The average velocity of particle in at time interval from t = 1 s to t = 2s is :-

(A) $(8\tilde{i} + 5\tilde{j})$ m/s (B) $(12\tilde{i} + 9\tilde{j})$ m/s (C) $(6\tilde{i} + 4.5\tilde{j})$ m/s (D) $(10\tilde{i} + 6\tilde{j})$ m/s

12. A particle 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 ?

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

13. A particle starts from rest with constant acceleration. The ratio of space–average velocity to the time average velocity is :–

(A) 1/2 (B) 3/4 (C) 4/3 (D) 3/2

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

(A) 24 m (B) 40 m (C) 56 m (D) 16 m

15. A ball is dropped from the top of a building. The ball takes 0.5 s to fall the 3m length of a window some distance from the top of the building. If the velocities of the ball at the top and at the bottom of the window are v_T and v_B respectively, then (take $g = 10\ m/s^2$) :-

(A) $v_T + v_B = 12\ ms^{-1}$ (B) $v_B - v_T = 4.9\ ms^{-1}$ (C) $v_B v_T = 1\ ms^{-1}$ (D) $\frac{v_B}{v_T} = 1\ ms^{-1}$

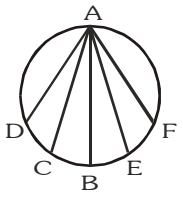
16. A particle is thrown upwards from ground. It experiences a constant resistance force which can produce retardation $2\ m/s^2$. The ratio of time of ascent to the time of descent is :- [$g = 10\ m/s^2$]

(A) 1 : 1 (B) $\sqrt{\frac{2}{3}}$ (C) $\frac{2}{3}$ (D) $\sqrt{\frac{3}{2}}$

17. Drops of water fall from the roof of a building 9m. high at regular intervals of time, the first drop reaching the ground at the same instant fourth drop starts to fall. What are the distances of the second and third drops from the roof ?

(A) 6 m and 2 m (B) 6 m and 3 m (C) 4 m and 1 m (D) 4 m and 2 m

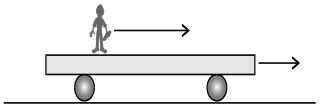
18. A disc in which several grooves are cut along the chord drawn from a point 'A', is arranged in a vertical plane, several particles starts slipping from 'A' along the grooves simultaneously. Assuming friction and resistance negligible, the time taken in reaching the edge of disc will be :-



(A) Maximum in groove AB
(B) Maximum in groove AD
(C) Same in all groove
(D) According to the heights of B, C, D, E, F

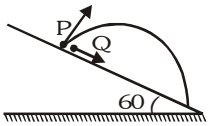
19. Two boats A and B are moving along perpendicular paths in a still lake at night. Boat A move with a speed of 3 m/s and boat B moves with a speed of 4 m/s in the direction such that they collide after sometime. At t = 0, the boats are 300 m apart. The ratio of distance travelled by boat A to the distance travelled by boat B at the instant of collision is:-
(A) 1 (B) 1/2 (C) 3/4 (D) 4/3

20. A trolley is moving horizontally with a constant velocity of v m/s w.r.t. earth. A man starts running from one end of the trolley with a velocity 1.5v m/s w.r.t. to trolley. After reaching the opposite end, the man return back and continues running with a velocity of 1.5 v m/s w.r.t. the trolley in the backward direction. If the length of the trolley is L then the displacement of the man with respect to earth during the process will be :-



(A) 2.5L (B) 1.5 L (C) $\frac{5L}{3}$ (D) $\frac{4L}{3}$

21. A particle P is projected from a point on the surface of smooth inclined plane (see figure). Simultaneously another particle Q is released on the smooth inclined plane from the same position. P and Q collide after t = 4 second. The speed of projection of P is :-



(A) 5 m/s (B) 10 m/s (C) 15 m/s (D) 20 m/s

22. A particle is projected from a point P(2,0,0)m with a velocity 10m/s making an angle 45 with the horizontal. The plane of projectile motion passes through a horizontal line PQ which makes an angle of 37 with positive x–axis, xy plane is horizontal. The coordinates of the point where the particle will strike the line PQ is :- (take g = 10 m/s^2)
(A) (10,6,0)m (B) (8,6,0)m (C) (10,8,0)m (D) (6,10,0)m

23. A body is thrown horizontally with a velocity $\sqrt{2gh}$ from the top of a tower of height h. It strikes the level ground through the foot of the tower at a distance x from the tower. The value of x is :-
(A) h (B) h/2 (C) 2h (D) 2h/3

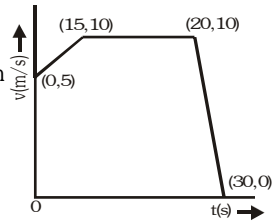
24. A particle A is projected with speed v_A from a point making an angle 60 with the horizontal. At the same instant, a second particle B is thrown vertically upward from a point directly below the maximum height point of parabolic path of A with velocity v_B. If the two particles collide then the ratio of v_A/v_B should be :-

(A) 1 (B) $\frac{2}{\sqrt{3}}$ (C) $\frac{\sqrt{3}}{2}$ (D) $\sqrt{3}$

25. A ball is projected from a certain point on the surface of a planet at a certain angle with the horizontal surface. The horizontal and vertical displacements x and y vary with time t in second as : $x = 10\sqrt{3}\,t$; $y = 10t - t^2$ the maximum height attained by the ball is :-
(A) 100m (B) 75m (C) 50 m (D) 25m

26. A particle moves in the xy plane and at time t is at the point $(t^2, t^3 - 2t)$. Then :-
(A) At t = 2/3 s, directions of velocity and acceleration are perpendicular
(B) At t = 0, directions of velocity and acceleration are perpendicular
(C) At $t = \sqrt{\frac{2}{3}}$ s, particle is moving parallel to x–axis
(D) Acceleration of the particle when it is at point (4, 4) is $2\tilde{i} + 24\tilde{j}$

27. The figure shows the velocity time graph of a particle which moves along a straight line starting with velocity at 5 m/sec and coming to rest at t = 30s . Then :-
(A) Distance travelled by the particle is 212.5 m
(B) Distance covered by the particle when it moves with constant velocity is 100 m
(C) Velocity of the particle at t = 25s is 5 m/sec
(D) Velocity of the particle at t = 9s is 8 m/sec .



28. An object may have :-
(A) Varying speed without having varying acceleration
(B) Varying velocity without having varying speed
(C) Non–zero acceleration without having varying velocity
(D) Non–zero acceleration without having varying speed .

29. A particle moves with constant speed v along a regular hexagon ABCDEF in the same order . Then the magnitude of the average velocity for its motion from A to :-
(A) F is $\frac{v}{5}$ (B) D is $\frac{v}{3}$ (C) C is $\frac{v\sqrt{3}}{2}$ (D) B is v .

30. A particle moves along x–axis according to the law $x = (t^3 - 3t^2 - 9t + 5)$m. Then :-
(A) In the interval $3<t<5$, the particle is moving in +x direction
(B) The particle reverses its direction of motion twice in entire motion if it starts at t=0
(C) The average acceleration from $1 \le t \le 2$ seconds is $6 m/s^2$.
(D) In the interval $5 \le t \le 6$ seconds, the distance travelled is equal to the displacement.

31. A particle moving along a straight line with uniform acceleration has velocities 7m/s at A and 17m/s at C. B is the mid point of AC. Then :-
(A) The velocity at B is 12m/s
(B) The average velocity between A and B is 10m/s
(C) The ratio of the time to go from A to B to that from B to C is 3 : 2
(D) The average velocity between B and C is 15m/s

32. A particle moves along the X–axis as $x = u(t - 2s) + a(t - 2s)^2$:-
(A) The initial velocity of the particle is u
(B) The acceleration of the particle is a
(C) The acceleration of the particle is 2a
(D) At t = 2s particle is at the origin.

33. The co–ordinate of the particle in x–y plane are given as $x = 2 + 2t + 4t^2$ and $y = 4t + 8t^2$:-
The motion of the particle is :-
(A) Along a straight line
(B) Uniformly accelerated
(C) Along a parabolic path
(D) Non-uniformly accelerated

34. A particle leaves the origin with an initial velocity $\vec{u} = 3\tilde{i}$ m/s and a constant acceleration $\vec{a} = (-1.0\tilde{i} - 0.5\tilde{j})\ m/s^2$.
Its velocity $\vec{v}$ and position vector $\vec{r}$ when it reaches its maximum x–co–ordinate are :-
(A) $\vec{v} = -2\tilde{j}$ (B) $\vec{v} = -1.5\tilde{j}\ m/s$ (C) $\vec{r} = (4.5\tilde{i} - 2.25\tilde{j})$ m (D) $\vec{r} = (3\tilde{i} - 2\tilde{j})$ m

35. Pick the correct statements :-

(A) Average speed of a particle in a given time is never less than the magnitude of the average velocity.

(B) It is possible to have a situation in which $\left|\frac{d\vec{u}}{dt}\right| \neq 0$ but $\frac{d}{dt}|\vec{u}| = 0$.

(C) The average velocity of a particle is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval.

(D) The average velocity of a particle moving on a straight line is zero in a time interval. It is possible that the instantaneous velocity is never zero in the interval. (infinite acceleration is not allowed)

36. Which of the following statements are true for a moving body ?

(A) If its speed changes, its velocity must change and it must have some acceleration

(B) If its velocity changes, its speeds must change and it must have some acceleration

(C) If its velocity changes, its speed may or may not change, and it must have some acceleration

(D) If its speed changes but direction of motion does not change, its velocity may remain constant

37. If velocity of the particle is given by $v = \sqrt{x}$, where x denotes the position of the particle and initially particle was at x = 4m, then which of the following are correct.

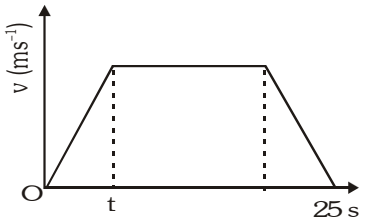
(A) At t = 2 s, the position of the particle is at x = 9m

(B) Particle acceleration at t = 2 s. is 1 m/s^2

(C) Particle acceleration is 1/2 m/s^2 through out the motion

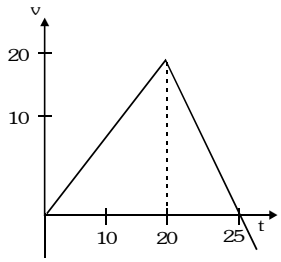
(D) Particle will never go in negative direction from it's starting position

38. The velocity – time graph of the particle moving along a straight line is shown. The rate of acceleration and deceleration is constant and it is equal to 5 ms^{-2}. If the average velocity during the motion is 20 ms^{-1}, then the value of t is



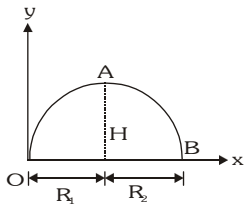
(A) 3 sec (B) 5 sec (C) 10 sec (D) 12 sec

39. The figure shows the v–t graph of a particle moving in straight line. Find the time when particle returns to the starting point.



(A) 30 sec (B) 34.5 sec (C) 36.2 sec (D) 35.4 sec

40. In a projectile motion assuming no air drag let $t_{0A} = t_1$ and $t_{AB} = t_2$. The horizontal displacement from O to A is R_1 and from A to B is R_2. Maximum height is H and time of flight is T. Now if air drag is to be considered, then choose the correct alternative(s).



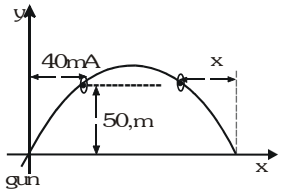
(A) t_1 will decrease while t_2 will increase
(B) H will increase
(C) R_1 will decrease while R_2 will increase
(D) T may increase or decrease

41. A particle is projected from a point P with a velocity v at an angle θ with horizontal. At a certain point Q it moves at right angle to its initial direction. Then :-
(A) Velocity of particle at Q is vsinθ
(B) Velocity of particle at Q is vcotθ
(C) Time of flight from P to Q is (v/g)cosecθ
(D) Time of flight from P to Q is (v/g)secθ

42. If T is the total time of flight, H the maximum height and R is the horizontal range of a projectile. Then x and y co–ordinates at any time t are related as :-

(A) $y = 4H\left(\frac{t}{T}\right)\left(1-\frac{t}{T}\right)$
(B) $y = 4H\left(\frac{T}{t}\right)\left(1-\frac{T}{t}\right)$
(C) $y = 4H\left(\frac{x}{R}\right)\left(1-\frac{x}{R}\right)$
(D) $y = 4H\left(\frac{R}{x}\right)\left(1-\frac{R}{x}\right)$

43. A gun is set up in such a way that the muzzle is at ground level as in figure. The hoop A is located at a horizontal distance 40m from the muzzle and is 50m above the ground level. Shell is fired with initial horizontal component of velocity as 40m/s. Which of the following is/are correct?



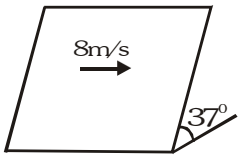
(A) The vertical component of velocity of the shell just after it is fired is 55m/s, if the shell has to pass through the hoop A.
(B) The shell will pass through both the hoops if x=40m.
(C) The shell will pass through both the hoops if x=20m.
(D) The vertical component of velocity of the shell just after it is fired is 45m/s, if the shell is to pass through both the hoops.

44. Two particles A & B projected along different directions from the same point P on the ground with the same velocity of 70 m/s in the same vertical plane . They hit the ground at the same point Q such that PQ = 480 m. Then :- ($g = 9.8 m/s^2$]
(A) Ratio of their times of flight is 4 : 5
(B) Ratio of their maximum heights is 9 : 16
(C) Ratio of their minimum speeds during flights is 4 : 3
(D) The bisector of the angle between their directions of projection makes 45^0 with horizontal

45. Two particles P & Q are projected simultaneously from a point O on a level ground in the same vertical plane with the same speed in directions making angle of 30^0 and 60^0 respectively with the horizontal.
(A) Both reach the ground simultaneously
(B) P reaches the ground earlier than Q
(C) Both strike the same point on the level ground
(D) The maximum height attained by Q is thrice that attained by P

46. A particle of mass m moves along a curve $y = x^2$. When particle has x – co–ordinate as 1/2 and x–component of velocity as 4m/s. Then :-
(A) The position coordinate of particle are (1/2, 1/4)
(B) The velocity of particle will be along the line 4x – 4y –1 = 0
(C) The magnitude of velocity at that instant is $4\sqrt{2}$ m/s
(D) The magnitude of angular momentum of particle about origin at that position is 0.

47. A ball is projected on smooth inclined plane in direction perpendicular to line of greatest slope with velocity of 8m/s. Find it's speed after 1 sec.



(A) 10 m/s (B) 12 m/s (C) 15 m/s (D) 20 m/s

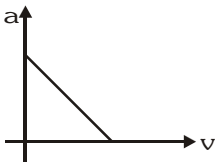
48. The horizontal range of a projectile is R and the maximum height attained by it is H. A strong wind now begins to blow in the direction of motion of the projectile, giving it a constant horizontal acceleration = g/2. Under the same conditions of projection. Find the horizontal range of the projectile.

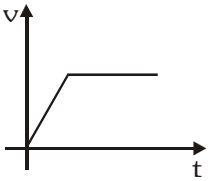
(A) R +H (B) R + 2H (C) R (D) R +H/2

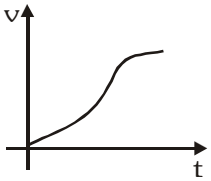
49. Balls are thrown vertically upward in such a way that the next ball is thrown when the previous one is at the maximum height. If the maximum height is 5m, the number of balls thrown per minute will be :-

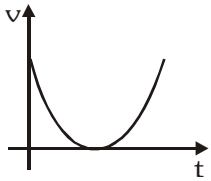
(A) 40 (B) 50 (C) 60 (D) 120

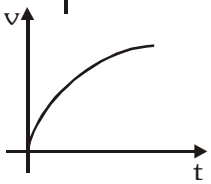
50. Acceleration versus velocity graph of a particle moving in a straight line starting from rest is as shown in figure. The corresponding velocity – time graph would be:-



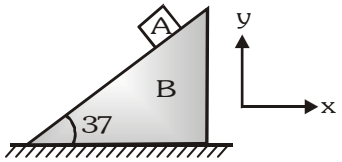
(A) 

(B) 

(C) 

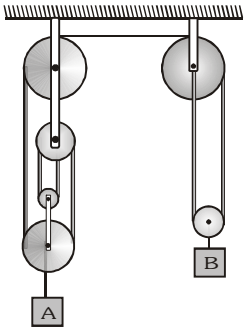
(*D) 

51. In the figure shown the acceleration of A is, $\vec{a}_A = 15\hat{i} + 15\hat{j}$ then the acceleration of B is (A remains in contact with B)



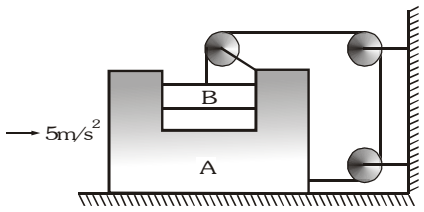
(A) $6\hat{i}$ (B) $-15\hat{i}$ (C) $-10\hat{i}$ (D) $-5\hat{i}$

52. Block B has a downward velocity in m/s and given by $v_B = \frac{t^2}{2} + \frac{t^3}{6}$, where t is in s. Acceleration of A at t = 2 second is



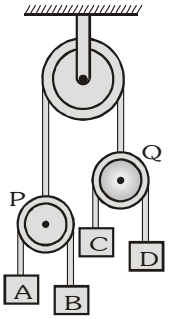
(A) 2 m/s^2 (B) 4 m/s^2 (C) 6 m/s^2 (D) None of these

53. If block A is moving with an acceleration of 5 m/s^2, the acceleration of B w.r.t. ground is



(A) 5 m/s^2 (B) $5\sqrt{2}$ m/s^2 (C) $5\sqrt{5}$ m/s^2 (D) 10 m/s^2

54. In the figure acceleration of A is 1 m/s^2 upwards, acceleration of B is 7 m/s^2 upwards and acceleration of C is 2m/s^2 upwards. Then acceleration of D will be



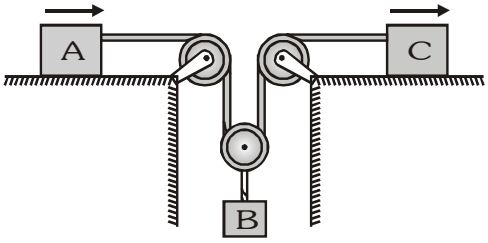
(A) 7 m/s^2 downwards

(B) 2 m/s^2 downwards

(C) 10 m/s^2 downwards

(D) 8 m/s^2 downwards

55. Block A and C start from rest and move to the right with acceleration a_A=12t m/s^2 and a_C=3 m/s^2 . Here t is in seconds. The time when block B again comes to rest is



(A) 2s (B) 1s (C) $\frac{3}{2}$ s (D) $\frac{1}{2}$ s

56. A particle moves with deceleration along the circle of radius R so that at any moment of time its tangential and normal accelerations are equal in moduli. At the initial moment t =0 the speed of the particle equals v_0, then the speed of the particle as a function of the distance covered S will be

(A) $v = v_0 e^{-S/R}$ (B) $v = v_0 e^{S/R}$ (C) $v=v_0 e^{-R/S}$ (D) $v=v_0 e^{R/S}$

57. A particle moves along an arc of a circle of radius R. Its velocity depends on the distance covered as $v=a\sqrt{s}$, where a is a constant then the angle α between the vector of the total acceleration and the vector of velocity as a function of s will be

(A) $\tan\alpha = \frac{R}{2s}$ (B) $\tan\alpha = \frac{2s}{R}$ (C) $\tan\alpha = \frac{2R}{s}$ (D) $\tan\alpha = \frac{s}{2R}$

LEVEL 2 ANSWER KEY

Que.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Ans.	B	C	A	A	A	A	C	D	A	A	C	B	C	D	A,B
Que.	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Ans.	B	C	C	C	D	B	A	C	B	D	A,B,C,D	A,C,D	A,B,D	A,C,D	A,D
Que.	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Ans.	B,C,D	C,D	A,B	B,C	A,B,C	A,C	A,C,D	B	C	A,D	B,C	A,C	A,B	B,C,D	B,C,D
Que.	46	47	48	49	50	51	52	53	54	55	56	57			
Ans.	A,B,C	A	B	C	D	D	A	C	C	D	A	B			