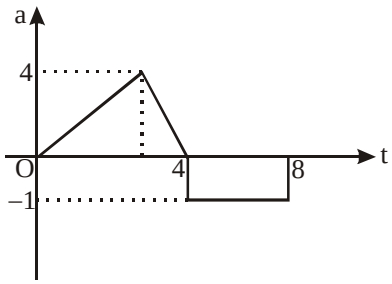
Kinematics

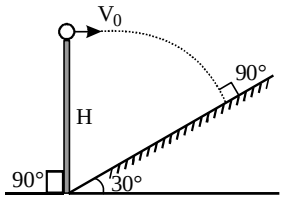
M.M.: 84 ***Time : 60 minutes***

Single Choice Correct (+3, –1)

1. The acceleration time graph of a particle is shown in the figure. What is the velocity of particle at t = 8s, if initial velocity of particle is 3 m/s?
(A) 4 m/s
(B) 5 m/s
(C) 6 m/s
(D) 7 m/s



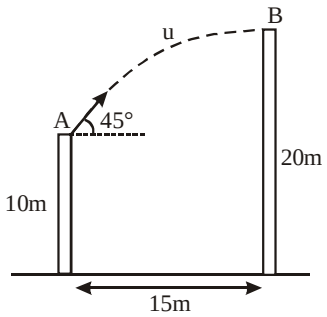
2. In the given figure, the angle of inclination of the inclined plane is 30°. Find the horizontal velocity V_0 so that the particle hits the inclined plane perpendicularly.



(A) $V_0 = \sqrt{\frac{2gH}{5}}$ (B) $V_0 = \sqrt{\frac{2gH}{7}}$

(C) $V_0 = \sqrt{\frac{gH}{5}}$ (D) $V_0 = \sqrt{\frac{gH}{7}}$

3. Find the value of 'u' so that the ball reaches at point B. (Take g = 10 m/s^2)
(A) 20 m/s (B) 40 m/s
(C) $15\sqrt{2}$ m/s (D) 50 m/s



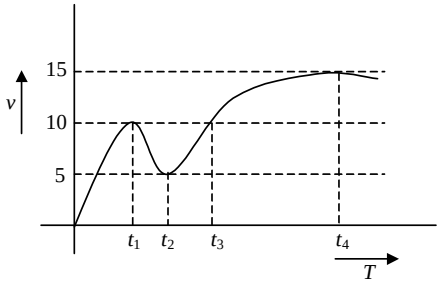
4. A particle moving in the positive x-direction has initial velocity v_0. The particle undergoes retardation kv^2, where v is its instantaneous velocity. The velocity of the particle as a function of time is given by

(A) $v = v_0/(1 + kv_0t)$ (B) $v = \frac{2v_0}{1+kt}$

(C) $v = \frac{v_0}{kt}$ (D) $v = \frac{v_0}{(1+k^2v_0^2t)}$

5. Two objects A and B are thrown upward simultaneously with the same speed. The mass of A is greater than the mass of B. Suppose the air exerted a constant and equal force of resistance on the two bodies
(A) The two bodies will reach the same height
(B) A will go higher than B
(C) B will go higher than A
(D) Any of the above three may happen depending on the speed with which the objects are thrown.

6. Velocity time graph of a particle undergoing rectilinear motion is plotted upto $T = t_4$ as shown in the figure. Average acceleration of the particle is zero in the time interval between
(A) 0 and t_1
(B) t_1 and t_2
(C) t_1 and t_3
(D) t_2 and t_4



7. The velocity vector of a projectile 2 seconds before it reaches the maximum height makes an angle of 53° with the horizontal. The speed at the highest print is $\left(\cos 53° = \frac{3}{5} \text{ and } g = 10 \text{ m/s}^2\right)$

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

8. A ball is released from the top of a building 180m high it takes time t to reach the ground. With what speed should it be projected down so that it reaches the ground in time $\frac{5t}{6}$.

(A) 50 ms^{-1}
(B) 61 ms^{-1}
(C) 11 ms^{-1}
(D) 2 ms^{-1}.

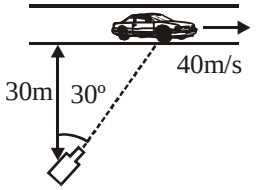
9. The K.E. (K) of a particle moving along a circle of radius R depends on the distance covered s as $K = as^2$. The force acting on particle is

(A) $\frac{2as^2}{R}$
(B) $\frac{2as}{\left(1+\frac{s^2}{R}\right)^{1/2}}$
(C) $2as\left(1+\frac{s^2}{R^2}\right)^{1/2}$
(D) none of these.

10. A particle is projected from ground with speed u at angle θ with the horizontal. Radius of curvature of the trajectory of the particle

(A) is not minimum at highest point
(B) is minimum at the point of projection
(C) is same at all points
(D) varies from $\frac{u^2}{g\cos\theta}$ to $\frac{u^2\cos^2\theta}{g}$

11. A racing car is traveling along a straight track at a constant velocity of 40 m/s. A fixed TV camera is recording the event as shown in figure. In order to keep the car in view, in the position shown, the angular speed with which the camera should be rotated is



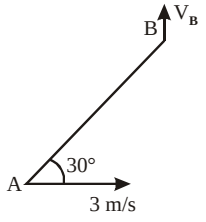
(A) 4/3 rad/s
(B) 3/4 rad/s
(C) $8/3/\sqrt{3}$ rad/s
(D) 1 rad/s

12. A particle is moving along a straight line such that its position depends on time as $x = 1 - at + bt^2$, where a = 2 m/s, b = 1 m/s^2 then distance covered by the particle during first 3 seconds from starting of the motion

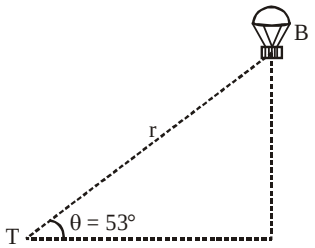
(A) 2 m
(B) 5 m
(C) 7 m
(D) None

13. A thin rod AB is moving in a vertical plane. At a certain instant when the rod is inclined at 30° to the horizontal the point A is moving horizontally with 3m/s while B is moving in the vertical direction. Then velocity of B is

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



14. A balloon B is moving vertically upward and viewed by a telescope T. At a particular angular position θ = 53° measured parameters are r = 1 km, $\frac{dr}{dt} = 3 m/s$ and $\frac{d\theta}{dt}$ = 0.002 rad/s. The magnitude of the linear velocity of the balloon at this instant is



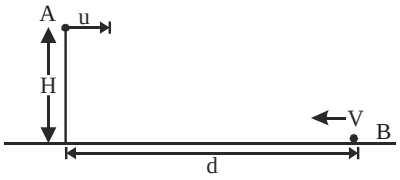
(A) 1.2 m/s (B) 2.4 m/s
(C) 3.6 m/s (D) 4.8 m/s

15. Wind is blowing at constant velocity $\vec{V}$ towards west. A man initially at rest starts moving with constant acceleration $\vec{a}$ towards north. Then the moment of time at which direction of wind appears south west to him is

(A) $\frac{\vec{V}}{\vec{a}}$ (B) $\frac{2\vec{V}}{\vec{a}}$

(C) $\frac{|\vec{V}|}{|\vec{a}|}$ (D) none of these

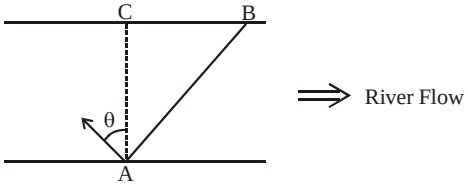
16. Two particles *A* and *B* are placed as shown in the figure. The particle *A*, on the top of tower, is projected horizontally with a velocity *u* and particle *B* is projected along the surface towards the tower, simultaneously. If both particles meet each other. Then speed of projection of particle *B* is [Ignore any friction]



(A) $d\sqrt{\frac{g}{2H}} - u$ (B) $d\sqrt{\frac{g}{2H}}$

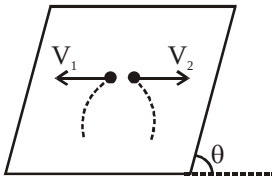
(C) $d\sqrt{\frac{g}{2H}} + u$ (D) u

17. Width of a river is 60 m. A swimmer wants to cross the river such that he reaches from A to B directly. Point B is 45 m ahead of line AC (perpendicular to river) Assume speed of river and speed of swimmer as equal. Swimmer must try to swim at angle θ with line AC. Value of θ is



(A) 37º (B) 53º
(C) 30º (D) 16º.

18. Two particles are projected horizontally in opposite directions from a point in a smooth inclined plane of inclination θ with the horizontal as shown in figure. Find the separation between the particles in the inclined plane when their velocity becomes perpendicular is



(A) $\frac{(V_1 + V_2)\sqrt{V_1 V_2}}{g \sin\theta}$ (B) $\frac{(V_1 - V_2)\sqrt{V_1 V_2}}{g \sin\theta}$

(C) $\frac{(V_1 + V_2)\sqrt{V_1 V_2}}{g \cos\theta}$ (D) $\frac{(V_1 + V_2)\sqrt{V_1 V_2}}{g}$.

19. A boy is standing on a cart moving along x–axis with the speed of 10 m/s. When the cart reaches the origin he throws a stone in the horizontal x–y plane, with the speed of 5 m/s with respect to himself at an angle θ with the x–axis. It is found that the stone hits a ball lying at rest at a point whose co–ordinates are $(\sqrt{3}m, 1m)$. The value of θ is (gravitational effect is to be ignored).

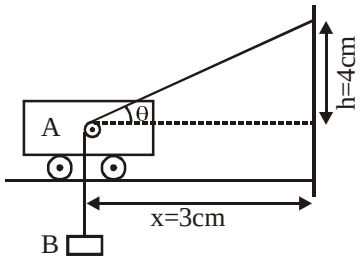
(A) 30º (B) 60º (C) 90º (D) 120º.

20. A particle is moving with a constant speed of π m/s on a circular track of radius 12 m. The magnitude of its average acceleration for the time interval of 6 s is

(A) $\frac{\pi^2}{12}\text{m/s}^2$ (B) $\frac{\pi}{3\sqrt{2}}\text{m/s}^2$ (C) $\frac{\pi}{6}\text{m/s}^2$ (D) 0 m/s^2.

Multiple Choice Multi-Correct *(+4, –2) with partical marking*

21. The string shown in the figure is passing over small smooth pulley rigidly attached to trolley *A*. If speed of trolley is constant and equal to V_A. Speed and magnitude of acceleration of block B at the instant shown in figure is

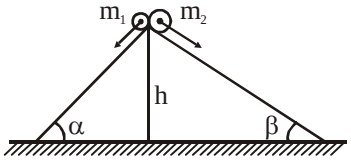


(A) $v_B = v_A$, $a_B = 0$ (B) $a_B = 0$

(C) $v_B = \frac{3}{5}v_A$ (D) $a_B = \frac{16v_A}{125}$

22. A particle is projected at an angle $\theta = 30^\circ$ with the horizontal, with a velocity of 10 m/s then
(A) after 2 s the velocity of particle makes an angle of 60º with initial velocity vector
(B) after 1 s the velocity of particle makes an angle of 60º with initial velocity vector
(C) the magnitude of velocity of particle after 1 s is 10 m/s
(D) the magnitude of velocity of particle after 1 s is 5 m/s

23. Two different balls of masses m_1 and m_2 are allowed to slide down from rest and from same height h along two smooth inclined planes having different angles of inclination α and β. Then



(A) the final speed velocity acquired by them will be the same
(B) the final speed acquired by them will be different
(C) the times taken by them to reach the bottom will be the same
(D) the times taken by them to reach the bottom will be in the ratio ($\sin\beta/\sin\alpha$)

24. A particle moves in such a way that time dependent '*x*' and 'y' co-ordinates are given by the equations

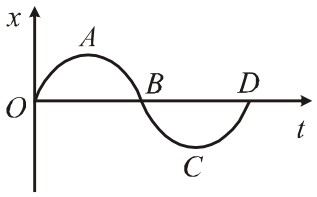
$x = \omega Rt + R\sin\omega t$

$y = R + R\cos\omega t$

Choose the correct alternative(s) from the following
(A) at the maximum value of its Y co–ordinate its speed is $2\omega R$
(B) at the minimum value of its Y co–ordinate its speed is zero
(C) at the maximum value of its Y co–ordinate its accelerations is equal to $\omega^2 R$ directed along negative y–axis.
(D) at the minimum value of its Y co–ordinate its accelerations is equal to $\omega^2 R$ directed along positive y–axis.

25. The position of a particle moving along x-axis depends on time as $x = 2(1 - e^{-3t})$. Choose the correct statement(s).
(A) Total displacement of the particle is 2 units
(B) Total distance covered by particle is 2 units
(C) velocity of the particle will change its direction at any instant.
(D) velocity of particle will not change its direction throughout the motion.

26. A particle has a rectilinear motion and the figure gives its displacement as a function of time. Which of the following statements are true with respect to the motion



(A) in the motion between O and A the velocity is positive and acceleration is negative
(B) between A and B the velocity and acceleration are positive
(C) between B and C the velocity is negative and acceleration is positive
(D) between C and D the acceleration is positive