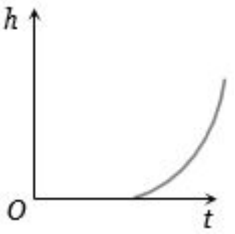
Jupiter Academy

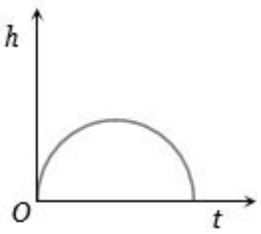
Subjects : Physics | PRACTICE PAPER 02

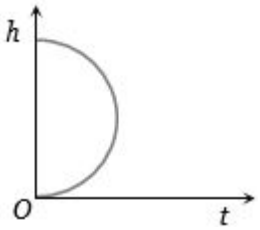
Total Marks : 180 | (Solutions)

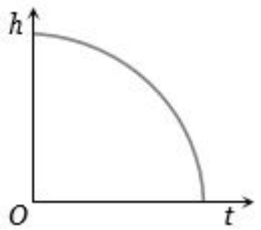
Physics - Section A (MCQ)

1. Which of the following is the altitude-time graph for a projectile thrown horizontally from the top of the tower

A) 

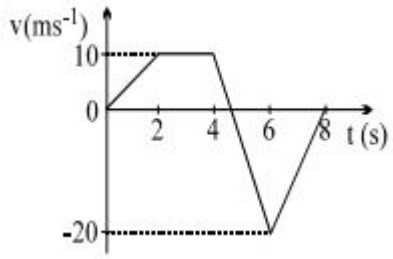
B) 

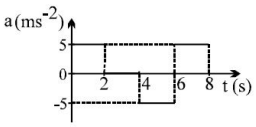
C) 

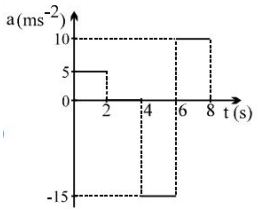
D) 

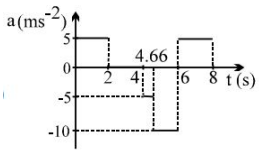
Solution : (Correct Answer: D)

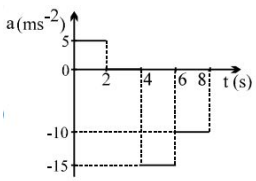
2. The figure shows a velocity-time graph of a particle moving along a straight line The correct acceleration-time graph of the particle is shown as



A) 

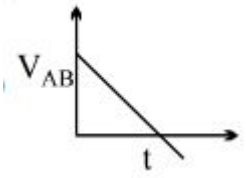
B) 

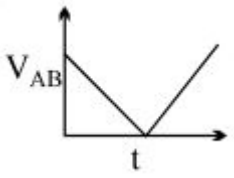
C) 

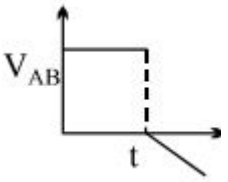
D) 

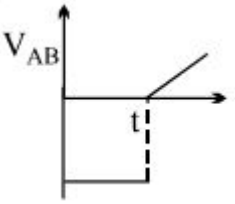
Solution : (Correct Answer: B)

3. A body A is thrown vertically upwards with such a velocity that it reaches a maximum height of h. Simultaneously another body B is dropped from height h. It strikes the ground and does not rebound. The velocity of A relative to $B v/s$ time graph is best represented by : (upward direction is positive)

A) 

B) 

C) 

D) 

Solution : (Correct Answer: C)

For first half,

$V_a = u - gt$

$V_b = -gt$

$V_{ab} = u - gt - (-gt)$

$= u \quad \Rightarrow$ constant

For Second half.

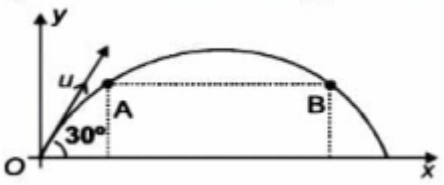
$V_a = -gt$

$V_b = 0$

$V_{ab} = -gt \Rightarrow -ve$ slope

$\Rightarrow$ Option C

4. A particle is thrown with a velocity of $u\ m/s$. It passes A and B as shown in figure at time $t_1 = 1\ s$ and $t_2 = 3\ s$. The value of u is ..... m/s $(g = 10\, m/s^2)$



A) 20 B) 10 C) 40 D) 5

Solution : (Correct Answer: C)

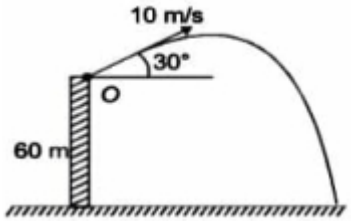
$t_1 + t_2 = \frac{2u \sin\theta}{g}$

$1 + 3 = \frac{2u \times \sin 30^\circ}{10}$

$20 \times 2 = u$

$\Rightarrow u = 40\, ms^{-1}$

5. A ball is projected from a point O as shown in figure. It will strike the ground after ..... s $(g = 10\, m/s^2)$



A) 4 **B)** 3 **C)** 2 **D)** 5

Solution : (Correct Answer: A)

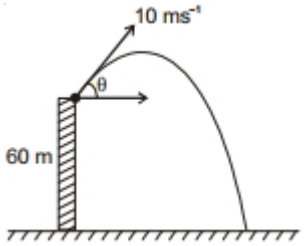
$s_y = u_x T + \frac{1}{2} a_y T^2$

$-60 = 10 \sin 30^\circ \cdot T - \frac{1}{2} g T^2$

$-60 = 5T - 5T^2$

$T^2 - T - 2 = 0$

$T = 4\, s$



6. Two particles A and B start moving with velocities $20\, m/s$ and $30\sqrt{2}\, m/s$ along x-axis and at an angle 45° with x-axis respectively in xy-plane from origin. The relative velocity of B w.r.t. A is ..... m/s

A) $(10\hat{i} + 30\hat{j})$ **B)** $(30\hat{i} + 10\hat{j})$
C) $(30\hat{i} - 20\sqrt{2}\hat{j})$ **D)** $(30\sqrt{2}\hat{i} + 10\sqrt{2}\hat{j})$

Solution : (Correct Answer: A)

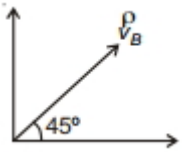
$v_A = 20\, m/s$

$v_B = 30\sqrt{2}\, m/s$ along 45° with x-axis

$\vec{v}_B = v_B \cos 45^\circ \hat{i} + v_B \sin 45^\circ \hat{j} = 30\hat{i} + 30\hat{j}$

$\vec{v}_{BA} = \vec{v}_B - \vec{v}_A = 30\hat{i} + 30\hat{j} - 20\hat{i}$

$\vec{v}_{BA} = 10\hat{i} + 30\hat{j}$



7. The initial position of an object at rest is given by $3\hat{i} - 8\hat{j}$ It moves with constant acceleration and reaches to the position $2\hat{i} + 4\hat{j}$ after $4\, s$. What is its acceleration?

A) $-\frac{1}{8}\hat{i} + \frac{3}{2}\hat{j}$
B) $2\hat{i} - \frac{1}{8}\hat{j}$
C) $-\frac{1}{2}\hat{i} + 8\hat{j}$
D) $8\hat{i} - \frac{3}{2}\hat{j}$

Solution : (Correct Answer: A)

(a)

initial position $x_i = 3 \quad y_i = -8$

final position $x_t = 2 \quad y_f = 4$

$x_f - x_i = \frac{1}{2} a_x t^2 = -1$

$y_f - y_i = \frac{1}{2} a_y t^2 = 12$

$a_x = -\frac{2}{16} = -\frac{1}{8}$

$ay = \frac{24}{16} = \frac{3}{2}$

$a = -\frac{1}{8}\hat{\imath} + \frac{3}{2}\hat{\jmath} = \text{ option (A)}$

8. A particle is moving on a circular path of radius r with uniform speed v. What is the displacement of the particle after it has described an angle of 60^o ?

A) $r\sqrt{2}$ **B)** $r\sqrt{3}$ **C)** r **D)** $2r$

Solution : (Correct Answer: C)

According to cosine formula

$\cos 60^\circ = \frac{r^2 + r^2 - x^2}{2r^2}$

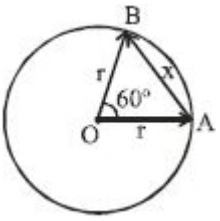
$2\mathrm{r}^2 \cos 60^\circ = 2\mathrm{r}^2 - \mathrm{x}^2$

$\mathrm{x}^2 = 2\mathrm{r}^2 - 2\mathrm{r}^2 \cos 60^\circ = 2\mathrm{r}^2 [1 - \cos 60^\circ]$

$= 2\mathrm{r}^2 [2 \sin^2 30^\circ] = \mathrm{r}^2$

$\therefore x = r$

Displacement $\mathrm{AB} = \mathrm{x} = \mathrm{r}$



9. A particle moves in a circular path of radius r with speed v. It then increases its speed to $2\, v$ while travelling along the same circular path. The centripetal acceleration of the particle has changed by a factor of

A) 0.25 **B)** 0.5 **C)** 2 **D)** 4

Solution : (Correct Answer: D)

$a_{cp} \propto V^2$

10. Two projectiles, one fired from surface of earth with velocity $10\ m/s$ and other fired from the surface of another planet with initial speed $5\ m/s$ trace identical trajectories. The value of acceleration due to the gravity on the planet is ..... m/s^2

A) 2.5 **B)** 3.6 **C)** 4.9 **D)** 6.4

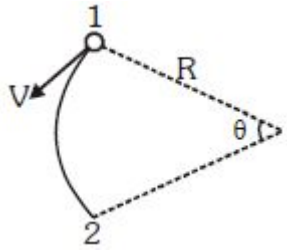
Solution : (Correct Answer: A)

$H_1 = H_2$

$\frac{(10)^2 \sin^2\theta}{2g_1} = \frac{(5)^2 \sin^2\theta}{2g_2}$

$\frac{g_2}{g_1} = \frac{1}{4} \Rightarrow g_2 = \frac{g_1}{4} = \frac{10}{4} = 2.5 \mathrm{m/s^2}$

11. A ring of mass m moves from point 1 to point 2 along a smooth rigid horizontal wire with a constant speed v. The average force acting the ring over the time of its motion from 1 to 2 is



A) $\frac{2mv^2}{R}\sin\theta$

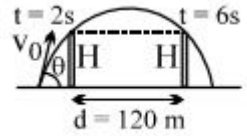
B) $\frac{mv^2}{R}$

C) $\frac{2mv^2 \sin\frac{\theta}{2}}{R\theta}$

D) None of these

Solution : (Correct Answer: C)

12. A projectile crosses two walls of equal height H symmetrically as shown The velocity of projection is..... ms^{-1}

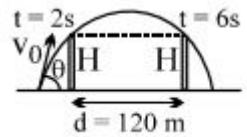


A) 30 **B)** 40

C) 50 **D)** none of these

Solution : (Correct Answer: C)

13. A projectile crosses two walls of equal height H symmetrically as shown The maximum height of the projectile is ..... m

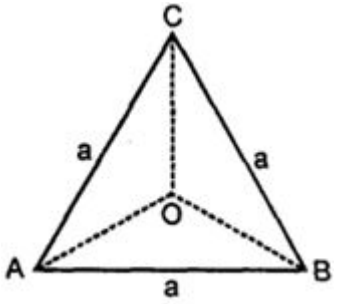


A) 120 **B)** 80

C) 160 **D)** cannot be obtained

Solution : (Correct Answer: B)

14. ABC is an equilateral triangle. Length of each side is a and centroid is point O. then $\overrightarrow{OA} + \overrightarrow{OB} + \overrightarrow{OC} = ...$



A) 0 **B)** 1 **C)** 2 **D)** 3

Solution : (Correct Answer: A)

$\overrightarrow{OA}, \overrightarrow{OB}$ and $\overrightarrow{OC}$ are three vectors of equal magnitude which are separated by equal angles of $120°$. Therefore their resultant is zero.

$\overrightarrow{OA} + \overrightarrow{OA} + \overrightarrow{OC} = \overrightarrow{0}$

15. A body is moving under the action of two forces $\vec{F}_1 = 2\hat{i} - 5\hat{j}$; $\vec{F}_2 = 3\hat{i} - 4\hat{j}$. Its velocity will become uniform under an additional third force $\vec{F}_3$ given by

A) $5\hat{i} - \hat{j}$ **B)** $-5\hat{i} - \hat{j}$

C) $5\hat{i} + \hat{j}$ **D)** $-5\hat{i} + 9\hat{j}$

Solution : (Correct Answer: D)

For uniform velocity, acceleration is zero. Hence resultant force will be zero.

$\therefore \overrightarrow{\mathrm{F}}_1 + \overrightarrow{\mathrm{F}}_2 + \overrightarrow{\mathrm{F}}_3 = 0$

$(2\hat{i} - 5\hat{j}) + (3\hat{i} - 4\hat{j}) + \vec{F}_3 = 0$

or $\overrightarrow{\mathrm{F}}_3 = (-5\hat{\mathrm{i}} + 9\hat{\mathrm{j}})$

16. If $\overrightarrow{\mathrm{A}} = 2\hat{i} + 3\hat{j} - \hat{k}$ and $\overrightarrow{B} = -\hat{i} + 3\hat{j} + 4\hat{k}$ a unit vector perpendicular to both $\overrightarrow{A}$ and $\overrightarrow{B}$ will be

A) $+\frac{1}{\sqrt{3}}(\hat{i} - \hat{j} - \hat{k})$ **B)** $-\frac{1}{\sqrt{3}}(\hat{i} - \hat{j} - \hat{k})$

C) Both (a) and (b) **D)** None of these

Solution : (Correct Answer: C)

(c) $\hat{n} = \frac{\overrightarrow{A} \times \overrightarrow{B}}{|\overrightarrow{A} \times \overrightarrow{B}|} = \frac{8\hat{i} - 8\hat{j} - 8\hat{k}}{8\sqrt{3}} = \frac{1}{\sqrt{3}}(\hat{i} - \hat{j} - \hat{k})$

There are two unit vectors perpendicular to both $\overrightarrow{A}$ and $\overrightarrow{B}$ they are $\hat{n} = \pm\frac{1}{\sqrt{3}}(\hat{i} - \hat{j} - \hat{k})$

17. Given that $\overrightarrow{A} + \overrightarrow{B} + \overrightarrow{C} = 0$ out of three vectors two are equal in magnitude and the magnitude of third vector is $\sqrt{2}$ times that of either of the two having equal magnitude. Then the angles between vectors are given by

A) $30°, 60°, 90°$

B) $45°, 45°, 90°$

C) $45°, 60°, 90°$

D) $90°, 135°, 135°$

Solution : (Correct Answer: D)

(d) From polygon law, three vectors having summation zero should form a closed polygon. (Triangle) since the two vectors are having same magnitude and the third vector is $\sqrt{2}$ times that of either of two having equal magnitude. i.e. the triangle should be right angled triangle

Angle between A and B, $\alpha = 90°$

Angle between B and C, $\beta = 135°$

Angle between A and C, $\gamma = 135°$

18. The resultant of two forces, one double the other in magnitude, is perpendicular to the smaller of the two forces. The angle between the two forces is ..... ^{o}

A) 60 **B)** 120 **C)** 150 **D)** 90

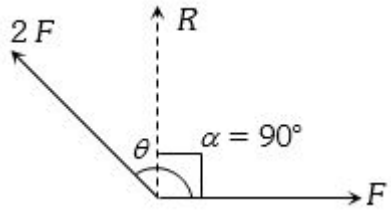
Solution : (Correct Answer: B)

$\tan\alpha = \frac{2F\sin\theta}{F+2F\cos\theta} = \infty$ (as $\theta = 90°$)

$\Rightarrow F + 2F\cos\theta = 0$

$\Rightarrow \cos\theta = -\frac{1}{2}$

$\theta = 120°$



19. What is the unit vector perpendicular to the following vectors $2\hat{i} + 2\hat{j} - \hat{k}$ and $6\hat{i} - 3\hat{j} + 2\hat{k}$

A) $\frac{\hat{i}+10\hat{j}-18\hat{k}}{5\sqrt{17}}$

B) $\frac{\hat{i}-10\hat{j}+18\hat{k}}{5\sqrt{17}}$

C) $\frac{\hat{i}-10\hat{j}-18\hat{k}}{5\sqrt{17}}$

D) $\frac{\hat{i}+10\hat{j}+18\hat{k}}{5\sqrt{17}}$

Solution : (Correct Answer: C)

(c) $\vec{A} = 2\hat{i} + 2\hat{j} - \hat{k}$ and $\vec{B} = 6\hat{i} - 3\hat{j} + 2\hat{k}$

$\vec{C} = \vec{A} \times \vec{B} = \left(2\hat{i} + 2\hat{j} - \hat{k}\right) \times \left(6\hat{i} - 3\hat{j} + 2\hat{k}\right)$

$$= \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ 2 & 2 & -1 \\ 6 & -3 & 2 \end{vmatrix} = \hat{i} - 10\hat{j} - 18\hat{k}$$

Unit vector perpendicular to both $\vec{A}$ and $\vec{B}$

$= \frac{\hat{i}-10\hat{j}-18\hat{k}}{\sqrt{1^2+10^2+18^2}}$

$= \frac{\hat{i}-10\hat{j}-18\hat{k}}{5\sqrt{17}}$

20. A person goes $10\ km$ north and $20\ km$ east. What will be displacement from initial point.....km

A) 22.36 **B)** 2 **C)** 5 **D)** 20

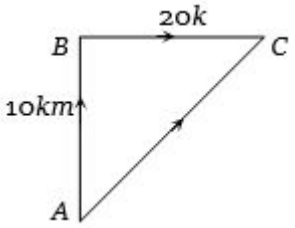
Solution : (Correct Answer: A)

$\overrightarrow{AC} = \overrightarrow{AB} + \overrightarrow{BC}$

$AC = \sqrt{(AB)^2 + (BC)^2}$

$= \sqrt{(10)^2 + (20)^2}$

$= \sqrt{100 + 400} = \sqrt{500} = 22.36\ km$



21. Which one of the following pair cannot be the rectangular components of force vector of $10\ N$?

A) $6\ N$ and $8\ N$

B) $7\ N$ and $\sqrt{51}\ N$

C) $6\sqrt{2}\ N$ and $2\sqrt{7}\ N$

D) $9\ N$ and $1\ N$

Solution : (Correct Answer: D)

(d)

The vector magnitude $= \sqrt{A_{x^2} + A_{y^2}}$

Vector magnitude $= 10$

But (d) option gives the magnitude

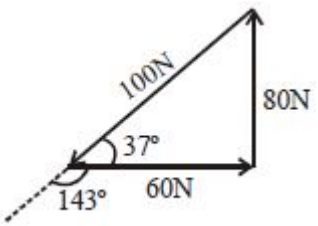
$\Rightarrow \sqrt{9^2 + 1^2} = \sqrt{82} \neq 10$

[by trial method check options]

22. The sum of three forces $\vec{F}_1 = 100\ N, \vec{F}_2 = 80\ N$ and $\vec{F}_3 = 60\ N$ acting on a particle is zero. The angle between $\vec{F}_1$ and $\vec{F}_2$ is nearly ..... ^{o}

A) 53 **B)** 143 **C)** 37 **D)** 127

Solution : (Correct Answer: B)



23. The resultant of two forces $3P$ and $2P$ is R. If the first force is doubled then the resultant is also doubled. The angle between the two forces is ..... ^{o}

A) 60 **B)** 120 **C)** 70 **D)** 180

Solution : (Correct Answer: B)

(b) $R^2 = (3P)^2 + (2P)^2 + 2 \times 3P \times 2P \times \cos\theta$...(i)

$(2R)^2 = (6P)^2 + (2P)^2 + 2 \times 6P \times 2P \times \cos\theta$...(ii)

by solving (i) and (ii), $\cos\theta = -1/2$

$\Rightarrow \theta = 120^\circ$

24. The angle between vectors $(\overrightarrow{A} \times \overrightarrow{B})$ and $(\overrightarrow{B} \times \overrightarrow{A})$ is

A) Zero **B)** π **C)** $\pi/4$ **D)** $\pi/2$

Solution : (Correct Answer: B)

(b)$\vec{A} \times \vec{B}$ and $\vec{B} \times \vec{A}$ are parallel and opposite to each other. So the angle will be π.

25. If for two vectors $\overrightarrow{A}$ and $\overrightarrow{B}$, $\overrightarrow{A} \times \overrightarrow{B} = 0$, the vectors

A) Are perpendicular to each other
B) Are parallel to each other
C) Act at an angle of 60°
D) Act at an angle of 30°

Solution : (Correct Answer: B)

(b) $\vec{A} \times \vec{B} = 0 \Rightarrow \sin\theta = 0 \Rightarrow \theta = 0^\circ$

Two vectors will be parallel to each other.

26. The angle between two vectors $-2\hat{i} + 3\hat{j} + \hat{k}$ and $\hat{i} + 2\hat{j} - 4\hat{k}$ is ..... ^{o}

A) 0 **B)** 90
C) 180 **D)** None of the above

Solution : (Correct Answer: B)

(b) $\cos\theta = \frac{\vec{A}.\vec{B}}{|\vec{A}||\vec{B}|} = \frac{-2+6-4}{\sqrt{14}\sqrt{21}} = 0$

$\therefore \theta = 90^\circ$

27. If $\overrightarrow{A} = 2\hat{i} + 4\hat{j} - 5\hat{k}$ the direction of cosines of the vector $\overrightarrow{A}$ are

A) $\frac{2}{\sqrt{45}}, \frac{4}{\sqrt{45}}$ and $\frac{-5}{\sqrt{45}}$
B) $\frac{1}{\sqrt{45}}, \frac{2}{\sqrt{45}}$ and $\frac{3}{\sqrt{45}}$
C) $\frac{4}{\sqrt{45}}, 0$ and $\frac{4}{\sqrt{45}}$
D) $\frac{3}{\sqrt{45}}, \frac{2}{\sqrt{45}}$ and $\frac{5}{\sqrt{45}}$

Solution : (Correct Answer: A)

(a)$\vec{A} = 2\hat{i} + 4\hat{j} - 5\hat{k}$

$|\overrightarrow{A}| = \sqrt{(2)^2 + (4)^2 + (-5)^2} = \sqrt{45}$

$\cos\alpha = \frac{2}{\sqrt{45}}, \quad \cos\beta = \frac{4}{\sqrt{45}}, \quad \cos\gamma = \frac{-5}{\sqrt{45}}$

28. Position of a particle in a rectangular-co-ordinate system is $(3, 2, 5)$. Then its position vector will be

A) $3\hat{i} + 5\hat{j} + 2\hat{k}$ **B)** $3\hat{i} + 2\hat{j} + 5\hat{k}$
C) $5\hat{i} + 3\hat{j} + 2\hat{k}$ **D)** None of these

Solution : (Correct Answer: B)

(b)If a point have coordinate (x, y, z) then its position vector $= x\hat{i} + y\hat{j} + z\hat{k}$.

29. A balloon rises, up with constant net acceleration of $10\ m/s^2$. After $2\ s$ a particle drops from the balloon. After further $2\ s$ match the following columns. (Take $g = 10\,m/s^2$)

colum I	colum II
(A) Height of particle from ground	(p) 0
(B) Speed of particle	(q) 10 SI unit
(C) Displacement of particle	(r) 40 SI unit
(D) Acceleration of particle	(s) 20 SI unit

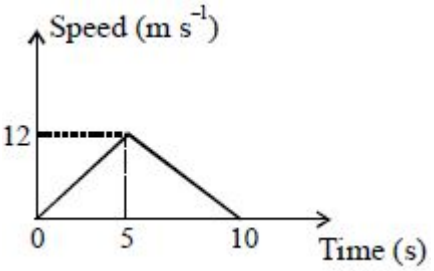
A) $(A \to r, B \to p, C \to s, D \to q)$
B) $(A \to q, B \to p, C \to s, D \to r)$
C) $(A \to r, B \to s, C \to p, D \to q)$
D) $(A \to q, B \to r, C \to s, D \to p)$

Solution : (Correct Answer: A)

(a)

After $2\,s$, velocity of balloon and hence the velocity of the particle will be $20\,m/s(= at)$ and its height from the ground will be $20\,m\,(= \frac{1}{2}at^2)$ Now, g will start acting on the particle.

30. The speed-time graph of a particle moving along a fixed direction is shown in the figure. The distance traversed by the particle between $t = 2\,s$ to $t = 6\,s$ is.....m



A) 26 **B)** 36 **C)** 46 **D)** 56

Solution : (Correct Answer: B)

Let S_1 be the distance travelled by particle in time 2 to $5\,s$ and S_2 be the distance travelled by particle in time 5 to $6\,s$.

Total distance travelled, $S = S_1 + S_2$

During the time interval 0 to $5\,s$, the acceleration of particle is equal to the slope of line OA

i.e., $a = \frac{12}{5} = 2.4\text{ms}^{-2}$

Velocity at the end of $2\,s$ will be,

$v = 0 + 2.4 \times 2 = 4.8\text{ms}^{-1}$

Taking motion of particle for time interval $2\,s$

to 5s

Here, $u = 4.8\text{ms}^{-1}, \text{a} = 2.4\text{ms}^{-2}, \text{S} = \text{S}_1$

$t = 5 - 2 = 3s$

Then, $S_1 = 4.8 \times 3 + \frac{1}{2} \times 2.4 \times 3^2 = 25.2\text{m}$

Acceleration of the particle during the motion

$t = 5s$ to $t = 10s$ is

$a =$ Slope of line $AB = -\frac{12}{5} = -2.4\text{ms}^2$

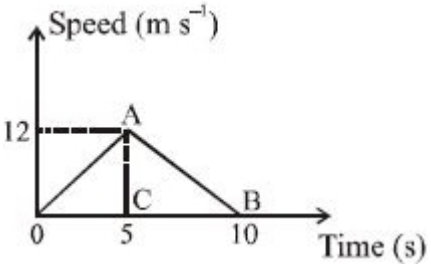
Taking motion of the particle for the time $1\,s$

$(\text{ie}, 5\text{s to } 6\text{s})$, Here $\text{u} = 12\text{ms}^{-1}, \text{a} = 2.4\text{ms}^{-2}$

$t = 1s, S = S_2$

$\therefore S_2 = 12 \times 1 + \frac{1}{2}(-2.4) \times 1^2 = 10.8\text{m}$

$\therefore \text{S} = \text{S}_\text{t} + \text{S}_2 = 25.2 + 10.8 = 36\text{m}$



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

A) 2 **B)** 4 **C)** 12 **D)** 14

Solution : (Correct Answer: D)

(d) Average acceleration $= \frac{\text{Change in velocity}}{\text{Time taken}}$

$= \frac{v_2 - v_1}{t_2 - t_1} = \frac{\left[10+2(5)^2\right] - \left[10+2(2)^2\right]}{3} = \frac{60-18}{3} = 14\ m/s^2.$

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

A) Equal to the time of fall
B) Less than the time of fall
C) Greater than the time of fall
D) Twice the time of fall

Solution : (Correct Answer: B)

(b) Let the initial velocity of ball be u

Time of rise $t_1 = \frac{u}{g+a}$ and height reached $= \frac{u^2}{2(g+a)}$

Time of fall t_2 is given by

$\frac{1}{2}(g-a)t_2^2 = \frac{u^2}{2(g+a)}$

$\Rightarrow t_2 = \frac{u}{\sqrt{(g+a)(g-a)}} = \frac{u}{(g+a)}\sqrt{\frac{g+a}{g-a}}$

$\therefore t_2 > t_1$ because $\frac{1}{g+a} < \frac{1}{g-a}$

33. A ball of mass m_1 and another ball of mass m_2 are dropped from equal height. If time taken by the balls are t_1 and t_2 respectively, then

A) $t_1 = \frac{t_2}{2}$ **B)** $t_1 = t_2$
C) $t_1 = 4t_2$ **D)** $t_1 = \frac{t_2}{4}$

Solution : (Correct Answer: B)

(b)The time of fall is independent of the mass.

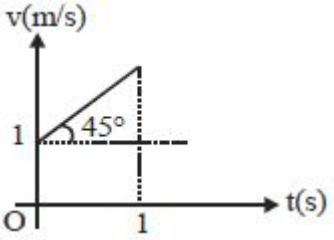
34. A stone thrown upward with a speed u from the top of the tower reaches the ground with a velocity $3u$. The height of the tower is

A) $3u^2/g$ **B)** $4u^2/g$
C) $6u^2/g$ **D)** $9u^2/g$

Solution : (Correct Answer: B)

(b)$v^2 = u^2 + 2gh \Rightarrow (3u)^2 = (-u)^2 + 2gh \Rightarrow h = \frac{4u^2}{g}$

35. From the $v - t$ graph, the



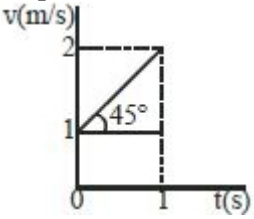
A) speed at $t = 1\,s$ is $1.2\,m/s$
B) acceleration is $2\,m/s^2$
C) average speed during $1^{st}\,second$ is $1.5\,m/s$
D) speed of the particle can be zero

Solution : (Correct Answer: C)

$v_{avg} = \frac{\text{distance}}{\text{time}}$

$v_{avg} = \frac{\frac{1}{2}(1+2)\times 1}{1}$

$= \frac{3}{2} = 1.5\text{m/s}$



36. Two cars leave one after the other and travel with an acceleration of $0.4\ m/s^2$. Two minutes after the departure of the first, the distance between the cars becomes $1.9\ km$. The time interval between the departures of the cars is .....s

A) 190 **B)** 50 **C)** 80 **D)** 60

Solution : (Correct Answer: B)

Distance covered by First Car in 2 Minutes

$\text{S} = \text{ut} + \frac{1}{2}\text{at}^2$

$\text{u} = 0$ from rest $\text{a} = 0.4\text{m/s}^2\ ;\ \text{t} = 2\text{mins} = 120\text{sec}$

$S = 0 + \frac{1}{2}(0.4)(120)^2$

$\Rightarrow S = 2880\text{m}$

$\Rightarrow S = 2.88\text{km}$

distance between the cars $= 1.9\text{km}$

Other car travelled $= 2.88 - 1.9 = 0.98\text{km} = 980\text{m}$

Time taken by another car to travel 980m

$980 = \frac{1}{2}(0.4)t^2$

$\Rightarrow t = 70\text{sec}$

Another car started after $120 - 70 = 50$ sec $= \frac{5}{6}\text{min}$

time

interval between the departure of the cars is
$= \frac{5}{6}\text{min} = 50\ sec$

37. If $v = x^2 - 5x + 4$, find the acceleration of particle when velocity of the particle is zero

A) 4 **B)** 1 **C)** 3 **D)** 0

Solution : (Correct Answer: D)

$a = \frac{dv}{dt} = \frac{dv}{dx} \cdot \frac{dx}{dt} = v\frac{dv}{dx}$

$\therefore a = v\frac{dv}{dx}$

so when $\text{v} = 0$ we get $a = 0$

OR

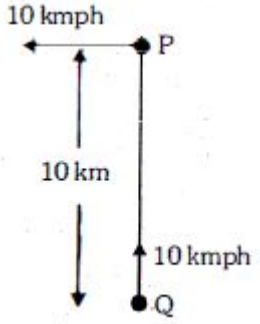
$v = x^2 - 5x + 4$

$\therefore \frac{\text{dv}}{\text{dt}} = 2\text{x}\frac{\text{dx}}{\text{dt}} - 5\frac{\text{dx}}{\text{dt}} + 0$

$\Rightarrow$ acc. $'a' = (2x - 5)v$

$\text{when v} = 0, \text{a} = 0$

38. There are two particles P and Q separated by distance $10\ km$ and moving with velocities $10\ kmph$ as shown on a smooth horizontal surface. The time elapsed before they come at minimum separation is.....hr

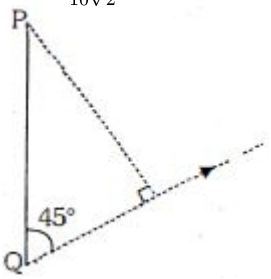


A) 1 **B)** 0.5 **C)** 0.25 **D)** 2

Solution : (Correct Answer: B)

Diagram shows relative path of Q w.r.t. P

$t = \frac{10\cos 45}{10\sqrt{2}}$



39. A $100\ m$ long train is moving with a uniform velocity of $45\ km/hr$. The time taken by the train to cross a bridge of length $1\ km$ is.....s

A) 58 **B)** 68 **C)** 78 **D)** 88

Solution : (Correct Answer: D)

(d) Length of train $= 100\,m$

Velocity of train$= 45\ km/hr = 45 \times \frac{5}{18} = 12.5\ m/s$

Length of bridge $= 1\,km = 1000\,m$

Total length covered by train $= 1100\,m$

Time taken by train to cross the bridge $= \frac{1100}{12.5} = 88$ sec

40. A cricketer can throw a ball to a maximum horizontal distance of $100\ m$. The speed with which he throws the ball is (to the nearest integer) (in ms^{-1})

A) 30 **B)** 42 **C)** 32 **D)** 35

Solution : (Correct Answer: C)

The formula for maximum range is given as,

$R_{\max} = \frac{u^2}{g}$

$100 = \frac{u^2}{10}$

$u = 10\sqrt{10}m/s = 32m/s$

41. A particle moves in a circle of radius $25\ cm$ at two revolutions per second. The acceleration of the particle in $meter/second^2$ is

A) π^2 **B)** $8\,\pi^2$ **C)** $4\,\pi^2$ **D)** $2\,\pi^2$

Solution : (Correct Answer: C)

$Here\, T = \frac{1}{2}\text{sec}\ the\ required\ centripetal$
$acceleration\ for\ moving\ in\ a\ circle\ is$

$a_C = \frac{v^2}{r} = \frac{(r\omega)^2}{r} = r\omega^2 r \times (2\pi/T)^2$

$so\ a_c = 0.25 \times (2\pi/0.5)^2$

$= 16\pi^2 \times .25 = 4.0\pi^2$

42. A small block slides down on a smooth inclined plane, starting from rest at time $t = 0$. Let S_n be the distance travelled by the block in the interval $\text{t} = \text{n} - 1$ to $\text{t} = \text{n}$. Then, the ratio $\frac{\text{S}_\text{n}}{\text{S}_{\text{n+1}}}$ is

A) $\frac{2n-1}{2n}$ **B)** $\frac{2n-1}{2n+1}$

C) $\frac{2n+1}{2n-1}$ D) $\frac{2n}{2n-1}$

Solution : (Correct Answer: B)

$\frac{s_n}{S_{n+1}} = \frac{\frac{a}{2}(2n-1)}{\frac{a}{2}(2(n+1)-1)} = \frac{2n-1}{2n+2-1} = \frac{2n-1}{2n+1}$

43. $Assertion$: Two balls of different masses are thrown vertically upward with same speed. They will pass through their point of projection in the downward direction with the same speed.

$Reason$: The maximum height and downward velocity attained at the point of projection are independent of the mass of the ball

A) If both Assertion and Reason are correct and the Reason is a correct explanation of the Assertion.

B) If both Assertion and Reason are correct but Reason is not a correct explanation of the Assertion.

C) If the Assertion is correct but Reason is incorrect.

D) If both the Assertion and Reason are incorrect.

Solution : (Correct Answer: A)

$h = ut - \frac{1}{2}gt^2$ and $v^2 = u^2 - 2gh$; These equations are independent of mass

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

A) 5 B) 8 C) 10 D) 12

Solution : (Correct Answer: C)

(c) Let student will catch the bus after $t\ sec$. So it will cover distance ut.

Similarly distance travelled by the bus will be $\frac{1}{2}at^2$ for the given condition

$ut = 50 + \frac{1}{2}at^2 = 50 + \frac{t^2}{2}$ $[a = 1\ m/s^2]$

$\Rightarrow u = \frac{50}{t} + \frac{t}{2}$

To find the minimum value of u

$\frac{du}{dt} = 0$, so we get $t = 10\,\text{sec}$, then $u = 10\ m/s$

45. The position x of a particle varies with time t as $x = at^2 - bt^3$. The acceleration of the particle will be zero at time t equal to

A) $\frac{a}{b}$ B) $\frac{2a}{3b}$ C) $\frac{a}{3b}$ D) Zero

Solution : (Correct Answer: C)

$\frac{dx}{dt} = 2at - 3bt^2$

$\Rightarrow \frac{d^2x}{dt^2} = 2a - 6bt = 0$

$\Rightarrow t = \frac{a}{3b}$