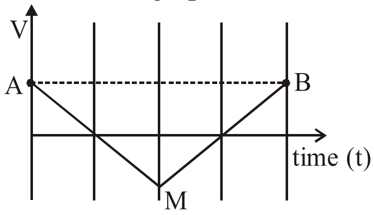
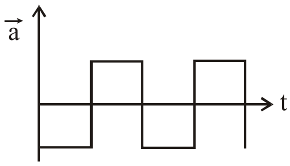
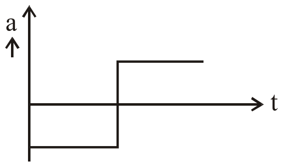
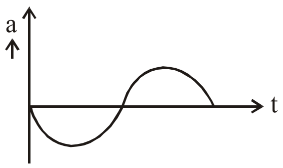
KINEMATICS

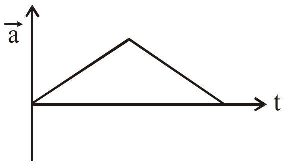
1. If the velocity-time graph has the shape AMB, what would be the shape of the corresponding acceleration-time graph ?



(1) 

(2) 

(3) 

(4) 

2. A particle is projected with velocity v_0 along x-axis. A damping force is acting on the particle which is proportional to the square of the distance from the origin i.e., $ma = -\alpha x^2$. The distance at which the particle stops :

(1) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{2}}$

(2) $\left(\frac{2v_0}{3\alpha}\right)^{\frac{1}{3}}$

(3) $\left(\frac{2v_0^2}{3\alpha}\right)^{\frac{1}{2}}$

(4) $\left(\frac{3v_0^2}{2\alpha}\right)^{\frac{1}{3}}$

3. An engine of a train, moving with uniform acceleration, passes the signal-post with velocity u and the last compartment with velocity v. The velocity with which middle point of the train passes the signal post is:

(1) $\sqrt{\frac{v^2+u^2}{2}}$ (2) $\frac{v-u}{2}$

(3) $\frac{u+v}{2}$ (4) $\sqrt{\frac{v^2-u^2}{2}}$

4. A stone is dropped from the top of a building. When it crosses a point 5 m below the top, another stone starts to fall from a point 25 m below the top. Both stones reach the bottom of building simultaneously. The height of the building is :

(1) 35 m (2) 45m (3) 50 m (4) 25m

5. The trajectory of a projectile in a vertical plane is $y = \alpha x - \beta x^2$, where α and β are constants and x & y are respectively the horizontal and vertical distances of the projectile from the point of projection. The angle of projection θ and the maximum height attained H are respectively given by :-

(1) $\tan^{-1}\alpha, \frac{\alpha^2}{4\beta}$

(2) $\tan^{-1}\beta, \frac{\alpha^2}{2\beta}$

(3) $\tan^{-1}\alpha, \frac{4\alpha^2}{\beta}$

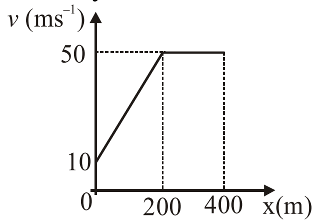
(4) $\tan^{-1}\left(\frac{\beta}{\alpha}\right), \frac{\alpha^2}{\beta}$

6. A scooter accelerates from rest for time t_1 at constant rate a_1 and then retards at constant rate a_2 for time t_2 and comes to rest. The correct value of $\frac{t_1}{t_2}$ will be :-

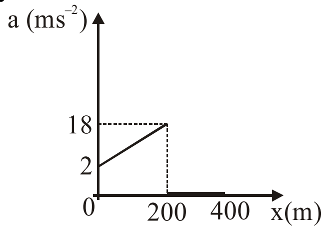
(1) $\frac{a_1+a_2}{a_2}$ (2) $\frac{a_2}{a_1}$

(3) $\frac{a_1}{a_2}$ (4) $\frac{a_1+a_2}{a_1}$

7. The velocity-displacement graph describing the motion of a bicycle is shown in the figure.



The acceleration-displacement graph of the bicycle's motion is best described by :

(1)


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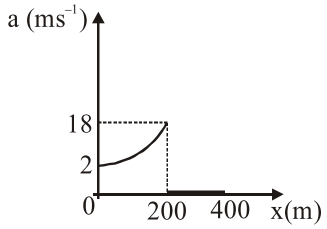
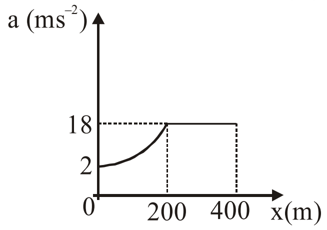


(3)


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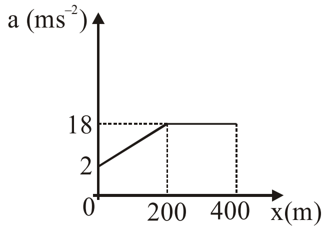


8. A mosquito is moving with a velocity $\vec{v} = 0.5t^2\,\hat{i} + 3t\,\hat{j} + 9\hat{k}$ m/s and accelerating in uniform conditions. What will be the direction of mosquito after 2s ?

(1) $\tan^{-1}\left(\frac{2}{3}\right)$ from x-axis

(2) $\tan^{-1}\left(\frac{2}{3}\right)$ from y-axis

(3) $\tan^{-1}\left(\frac{5}{2}\right)$ from y-axis

(4) $\tan^{-1}\left(\frac{5}{2}\right)$ from x-axis

9. A swimmer can swim with velocity of 12 km/h in still water. Water flowing in a river has velocity 6 km/h. The direction with respect to the direction of flow of river water he should swim in order to reach the point on the other bank just opposite to his starting point is _________°. (Round off to the Nearest Integer) (find the angle in degree)

10. A car accelerates from rest at a constant rate α for some time after which it decelerates at a constant rate β to come to rest. If the total time elapsed is t seconds, the total distance travelled is :

(1) $\frac{4\alpha\beta}{(\alpha+\beta)}t^2$ (2) $\frac{2\alpha\beta}{(\alpha+\beta)}t^2$

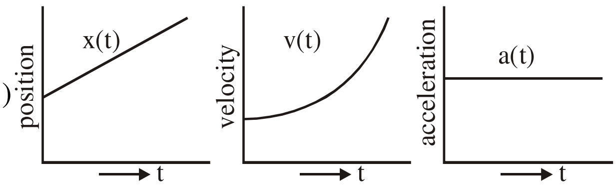
(3) $\frac{\alpha\beta}{2(\alpha+\beta)}t^2$ (4) $\frac{\alpha\beta}{4(\alpha+\beta)}t^2$

11. The velocity of a particle is $v = v_0 + gt + Ft^2$. Its position is x = 0 at t = 0 ; then its displacement after time (t = 1) is :

(1) $v_0 + g + F$ (2) $v_0 + \frac{g}{2} + \frac{F}{3}$

(3) $v_0 + \frac{g}{2} + F$ (4) $v_0 + 2g + 3F$

12. The position, velocity and acceleration of a particle moving with a constant acceleration can be represented by :

(1)


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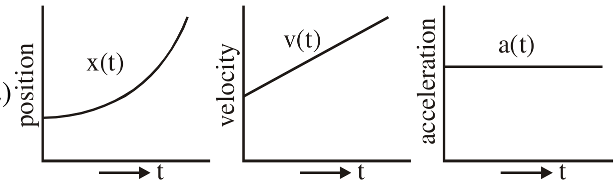
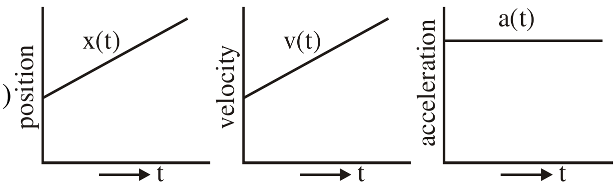


(3)


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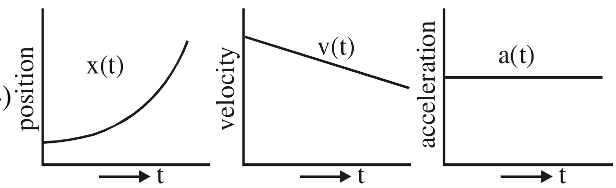
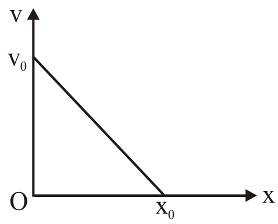
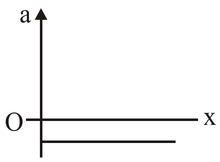


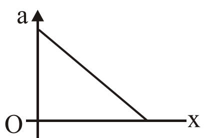
13. A person is swimming with a speed of 10 m/s at an angle of 120° with the flow and reaches to a point directly opposite on the other side of the river. The speed of the flow is 'x' m/s. The value of 'x' to the nearest integer is ______.

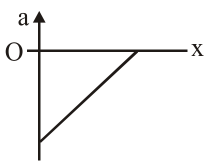
14. The velocity-displacement graph of a particle is shown in the figure.

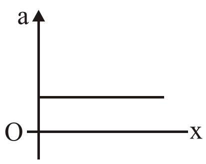


The acceleration-displacement graph of the same particle is represented by :

(1) 

(2) 

(3) 

(4) 

15. A butterfly is flying with a velocity $4\sqrt{2}$ m/s in North-East direction. Wind is slowly blowing at 1 m/s from North to South. The resultant displacement of the butterfly in 3 seconds is :

(1) 3 m (2) 20 m
(3) $12\sqrt{2}$ m (4) 15 m

16. A boy reaches the airport and finds that the escalator is not working. He walks up the stationary escalator in time t_1. If he remains stationary on a moving escalator then the escalator takes him up in time t_2. The time taken by him to walk up on the moving escalator will be :

(1) $\frac{t_1t_2}{t_2-t_1}$ (2) $\frac{t_1+t_2}{2}$
(3) $\frac{t_1t_2}{t_2+t_1}$ (4) $t_2 - t_1$

17. Water droplets are coming from an open tap at a particular rate. The spacing between a droplet observed at 4^{th} second after its fall to the next droplet is 34.3 m. At what rate the droplets are coming from the tap ? (Take g = 9.8 m/s^2)

(1) 3 drops / 2 seconds
(2) 2 drops / second
(3) 1 drop / second
(4) 1 drop / 7 seconds

18. The relation between time t and distance x for a moving body is given as $t = mx^2 + nx$, where m and n are constants. The retardation of the motion is : (When v stands for velocity)

(1) $2\,mv^3$ (2) $2\,mnv^3$
(3) $2nv^3$ (4) $2n^2v^3$

19. A force $\vec{F} = \left(40\hat{i} + 10\hat{j}\right)N$ acts on a body of mass 5 kg. If the body starts from rest, its position vector $\vec{r}$ at time t = 10 s, will be :

(1) $\left(100\hat{i}+400\hat{j}\right)m$ (2) $\left(100\hat{i}+100\hat{j}\right)m$
(3) $\left(400\hat{i}+100\hat{j}\right)m$ (4) $\left(400\hat{i}+400\hat{j}\right)m$

20. A balloon was moving upwards with a uniform velocity of 10 m/s. An object of finite mass is dropped from the balloon when it was at a height of 75 m from the ground level. The height of the balloon from the ground when object strikes the ground was around :
(takes the value of g as 10 m/s^2)

(1) 300 m (2) 200 m
(3) 125 m (4) 250 m

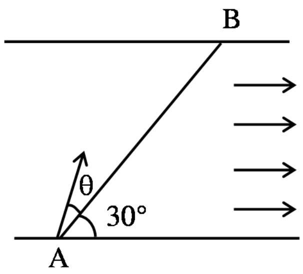
21. The instantaneous velocity of a particle moving in a straight line is given as $v = \alpha t + \beta t^2$, where α and β are constants. The distance travelled by the particle between 1s and 2s is :

(1) $3\alpha + 7\beta$ (2) $\frac{3}{2}\alpha + \frac{7}{3}\beta$
(3) $\frac{\alpha}{2} + \frac{\beta}{3}$ (4) $\frac{3}{2}\alpha + \frac{7}{2}\beta$

22. A ball is thrown up with a certain velocity so that it reaches a height 'h'. Find the ratio of the two different times of the ball reaching $\frac{h}{3}$ in both the directions.

(1) $\frac{\sqrt{2}-1}{\sqrt{2}+1}$ (2) $\frac{1}{3}$
(3) $\frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$ (4) $\frac{\sqrt{3}-1}{\sqrt{3}+1}$

23. A swimmer wants to cross a river from point A to point B. Line AB makes an angle of 30° with the flow of river. Magnitude of velocity of the swimmer is same as that of the river. The angle θ with the line AB should be ____°, so that the swimmer reaches point B.



24. Two spherical balls having equal masses with radius of 5 cm each are thrown upwards along the same vertical direction at an interval of 3s with the same initial velocity of 35 m/s, then these balls collide at a height of .... m. (Take $g = 10\ m/s^2$)

25. A bomb is dropped by fighter plane flying horizontally. To an observer sitting in the plane, the trajectory of the bomb is a :
(1) hyperbola
(2) parabola in the direction of motion of plane
(3) straight line vertically down the plane
(4) parabola in a direction opposite to the motion of plane

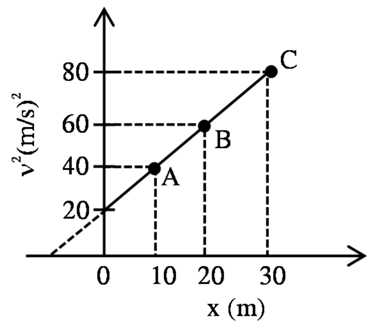
26. If the velocity of a body related to displacement x is given by $\upsilon = \sqrt{5000 + 24x}\ m/s$, then the acceleration of the body is ...... m/s^2.

27. Water drops are falling from a nozzle of a shower onto the floor, from a height of 9.8 m. The drops fall at a regular interval of time. When the first drop strikes the floor, at that instant, the third drop begins to fall. Locate the position of second drop from the floor when the first drop strikes the floor.
(1) 4.18 m (2) 2.94 m
(3) 2.45 m (4) 7.35 m

28. A player kicks a football with an initial speed of $25\ ms^{-1}$ at an angle of 45° from the ground. What are the maximum height and the time taken by the football to reach at the highest point during motion ? (Take $g = 10\ ms^{-2}$)
(1) $h_{max} = 10$ m T = 2.5 s
(2) $h_{max} = 15.625$ m T = 3.54 s
(3) $h_{max} = 15.625$ m T = 1.77 s
(4) $h_{max} = 3.54$ m T = 0.125 s

29. A helicopter is flying horizontally with a speed 'v' at an altitude 'h' has to drop a food packet for a man on the ground. What is the distance of helicopter from the man when the food packet is dropped?
(1) $\sqrt{\frac{2ghv^2+1}{h^2}}$ (2) $\sqrt{2ghv^2+h^2}$
(3) $\sqrt{\frac{2v^2h}{g}+h^2}$ (4) $\sqrt{\frac{2gh}{v^2}+h^2}$

30. A particle is moving with constant acceleration 'a'. Following graph shows v^2 versus x(displacement) plot. The acceleration of the particle is___m/s^2.

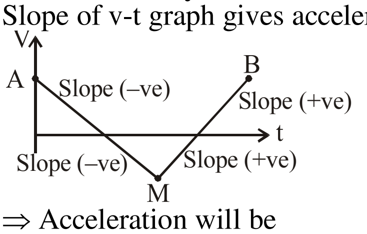


31. The ranges and heights for two projectiles projected with the same initial velocity at angles 42° and 48° with the horizontal are R_1, R_2 and H_1, H_2 respectively. Choose the correct option :
(1) $R_1 > R_2$ and $H_1 = H_2$
(2) $R_1 = R_2$ and $H_1 < H_2$
(3) $R_1 < R_2$ and $H_1 < H_2$
(4) $R_1 = R_2$ and $H_1 = H_2$

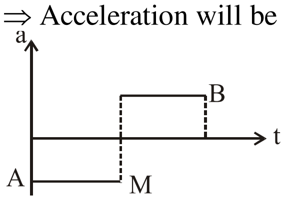
SOLUTION

1. Official Ans. by NTA (2)

Sol. Slope of v-t graph gives acceleration



$\Rightarrow$ Acceleration will be



2. Official Ans. by NTA (4)

Sol. $F = -\alpha x^2$

$ma = -\alpha x^2$

$a = \frac{-\alpha x^2}{m}$

$\frac{vdv}{dx} = -\frac{\alpha}{m}x^2$

$\int_{v_0}^{0} v\,dv = \int_{0}^{x} -\frac{\alpha}{m}x^2 dx$

$\left(\frac{v^2}{2}\right)_{v_0}^{0} = -\frac{\alpha}{m}\left(\frac{x^3}{3}\right)_0^x$

$\frac{-v_0^2}{2} = -\frac{\alpha}{m}\frac{x^3}{3}$

$x = \left(\frac{3mv_0^2}{2\alpha}\right)^{\frac{1}{3}}$

Option(4) is most suitable option as (m) is not given in any option

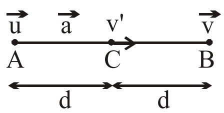
3. Official Ans. by NTA (1)

Sol. $(v')^2 = u^2 + 2ad$

$v^2 = (v')^2 + 2ad$

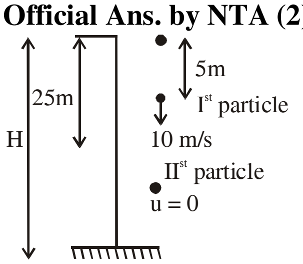
solving, we get

$v' = \sqrt{\frac{v^2 + u^2}{2}}$



4. Official Ans. by NTA (2)

Sol.



Time for particle to meet = $t' = \frac{S_{rel}}{S_{rel}} = \frac{20}{10} = 2\text{sec}$

Time taken by Ist particle to reach ground = 3sec

$H = \frac{1}{2}g(3)^2 = 45$ m

5. Official Ans. by NTA (1)

Sol. $y = \alpha x - \beta x^2$

comparing with trajectory equation

$y = x\tan\theta - \frac{1}{2}\frac{gx^2}{u^2\cos^2\theta}$

$\tan\theta = \alpha \Rightarrow \theta = \tan^{-1}\alpha$

$\beta = \frac{1}{2}\frac{g}{u^2\cos^2\theta}$

$u^2 = \frac{g}{2\beta\cos^2\theta}$

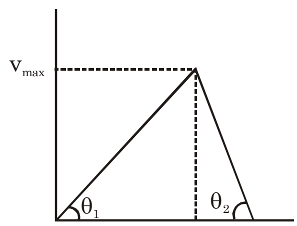
Maximum height : H

$H = \frac{u^2\sin^2\theta}{2g} = \frac{g}{2\beta\cos^2\theta}\frac{\sin^2\theta}{2g}$

$H = \frac{\tan^2\theta}{4\beta} = \frac{\alpha^2}{4\beta}$

6. Official Ans. by NTA (2)

Sol. Draw vt curve



$\tan\theta_1 = a_1 = \frac{v_{max}}{t_1}$

& $\tan\theta_2 = a_2 = \frac{v_{max}}{t_2}$

÷ above

$\frac{t_1}{t_2} = \frac{a_2}{a_1}$

7. Official Ans. by NTA (1)

Sol. For $0 \le x \le 200$

$v = mx + C$

$v = \frac{1}{5}x + 10$

$a = \frac{vdv}{dx} = \left(\frac{x}{5}+10\right)\left(\frac{1}{5}\right)$

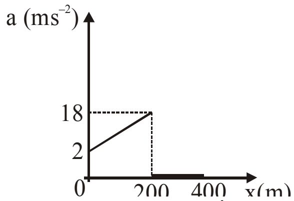
$a = \frac{x}{25} + 2 \Rightarrow$ Straight line till $x = 200$

for $x > 200$

v = constant

$\Rightarrow a = 0$

$\Rightarrow$



Hence most approriate option will be (1), otherwise it would be BONUS.

8. Official Ans. by NTA (2)

Official Ans. by ALLEN (Bonus)

Sol. Given :

$\vec{v} = 0.5t^2\,\hat{i} + 3t\,\hat{j} + 9\hat{k}$

$\vec{v}_{at\ t=2} = 2\,\hat{i} + 6\,\hat{j} + 9\hat{k}$

$\therefore$ Angle made by direction of motion of mosquito will be,

$\cos^{-1}\frac{2}{11}$ (from x-axis) $= \tan^{-1}\frac{\sqrt{117}}{2}$

$\cos^{-1}\frac{6}{11}$ (from y-axis) $= \tan^{-1}\frac{\sqrt{85}}{6}$

$\cos^{-1}\frac{9}{11}$ (from z-axis) $= \tan^{-1}\frac{\sqrt{40}}{9}$

None of the option is matching.

Hence this question should be bonus.

9. Official Ans. by NTA (120)

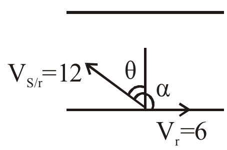
Sol. Ans. (12)

$12\sin\theta = v_r$

$\sin\theta = \frac{1}{2}$

$\theta = 30°$

$\therefore\ \alpha = 120°$



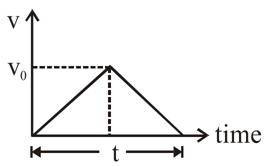
10. Official Ans. by NTA (3)

Sol. $v_0 = \alpha t_1$ and $0 = v_0 - \beta t_2 \Rightarrow v_0 = \beta t_2$

$t_1 + t_2 = t$

$v_0\left(\frac{1}{\alpha}+\frac{1}{\beta}\right) = t$

$\Rightarrow v_0 = \frac{\alpha\beta t}{\alpha+\beta}$



Distance = area of v-t graph

$= \frac{1}{2}\times t\times v_0 = \frac{1}{2}\times t\times\frac{\alpha\beta t}{\alpha+\beta} = \frac{\alpha\beta t^2}{2(\alpha+\beta)}$

11. Official Ans. by NTA (2)

Sol. (2) $v = v_0 + gt + Ft^2$

$\frac{ds}{dt} = v_0 + gt + Ft^2$

$\int ds = \int_0^1 (v_0 + gt + Ft^2)dt$

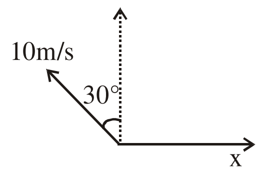
$s = \left[v_0 t + \frac{gt^2}{2} + \frac{Ft^3}{3}\right]_0^1$; $\quad s = v_0 + \frac{g}{2} + \frac{F}{3}$

12. Official Ans. by NTA (2)

Sol. Option (2) represent correct graph for particle moving with constant acceleration, as for constant acceleration velocity time graph is straight line with positive slope and x-t graph should be an opening upward parabola.

13. Official Ans. by NTA (5)

Sol.



$10\sin 30° = x$

$x = 5$ m/s

14. Official Ans. by NTA (3)

Sol. $v = -\left(\frac{v_0}{x_0}\right)x + v_0$

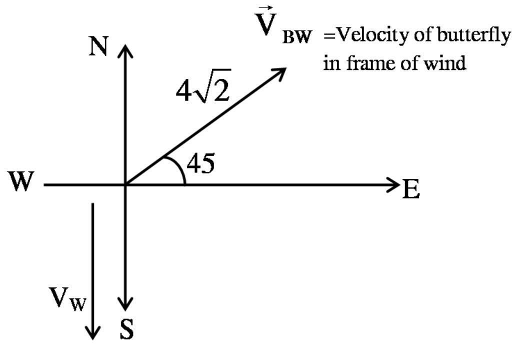
$a = \frac{vdv}{dx}$

$a = \left[-\left(\frac{v_0}{x_0}\right)x + v_0\right]\left[-\frac{v_0}{x_0}\right]$

$a = \left(\frac{v_0}{x_0}\right)^2 x - \frac{v_0^2}{x_0}$

15. Official Ans. by NTA (4)

Sol.



$\vec{V}_{BW} = 4\sqrt{2}\cos 45\hat{i} + 4\sqrt{2}\sin 45\hat{j}$

$= 4\hat{i} + 4\hat{j}$

$\vec{V}_W = -\hat{j}$

$\vec{V}_B = \vec{V}_{BW} + \vec{V}_W = 4\hat{i} + 3\hat{j}$

$\vec{S}_B = \vec{V}_B \times t = \left(4\hat{i} + 3\hat{j}\right) \times 3 = 12\hat{i} + 9\hat{j}$

$\left|\vec{S}_B\right| = \sqrt{(12)^2 + (9)^2} = 15\text{m}$

16. Official Ans. by NTA (3)

Sol. L = Length of escalator

$V_{b/esc} = \frac{L}{t_1}$

When only escalator is moving.

$V_{esc} = \frac{L}{t_2}$

when both are moving

$V_{b/g} = V_{b/esc} + V_{esc}$

$V_{b/g} = \frac{L}{t_1} + \frac{L}{t_2} \Rightarrow \left[t = \frac{L}{V_{b/g}} = \frac{t_1 t_2}{t_1 + t_2}\right]$

17. Official Ans. by NTA (3)

Sol. In 4 sec. 1st drop will travel

$\Rightarrow \frac{1}{2} \times (9.8) \times (4)^2 = 78.4$ m

$\therefore$ 2nd drop would have travelled

$\Rightarrow 78.4 - 34.3 = 44.1$ m.

Time for 2nd drop

$\frac{1}{2}(9.8)t^2 = 44.1$

$\boxed{t = 3\text{sec}}$

$\therefore$ each drop have time gap of 1 sec

$\therefore$ 1 drop per sec

18. Official Ans. by NTA (1)

Sol. $t = mx^2 + nx$

$\frac{1}{v} = \frac{dt}{dx} = 2mx + n$; $v = \frac{1}{2mx + n}$

$\frac{dv}{dt} = -\frac{2m}{(2mx + n)^2}\left(\frac{dx}{dt}\right)$

$a = -(2m)v^3$

19. Official Ans. by NTA (3)

Sol. $\frac{d\vec{v}}{dt} = \vec{a} = \frac{\vec{F}}{m} = \left(8\hat{i} + 2\hat{j}\right) m/s^2$

$\frac{d\vec{r}}{dt} = \vec{v} = \left(8t\,\hat{i} + 2t\,\hat{j}\right) m/s$

$\vec{r} = \left(8\hat{i} + 2\hat{j}\right)\frac{t^2}{2} m$

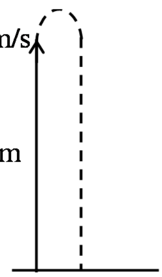
At t = 10 sec

$\vec{r} = \left[\left(8\hat{i} + 2\hat{j}\right)50\right] m$

$\Rightarrow \vec{r} = \left(400\hat{i} + 100\hat{j}\right) m$

20. Official Ans. by NTA (3)

Sol.



Object is projected as shown so as per motion under gravity

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

$-75 = +10t + \frac{1}{2}(-10)t^2 \Rightarrow t = 5$ sec

Object takes t = 5 s to fall on ground

Height of balloon from ground

H = 75 + ut

= 75 + 10 × 5 = 125 m

21. Official Ans. by NTA (2)

Sol. $V = \alpha t + \beta t^2$

$\frac{ds}{dt} = \alpha t + \beta t^2$

$\int_{S_1}^{S_2} ds = \int_1^2 (\alpha t + \beta t^2) dt$

$S_2 - S_1 = \left[\frac{\alpha t^2}{2} + \frac{\beta t^3}{3}\right]_1^2$

As particle is not changing direction
So distance = displacement.

Distance = $\left[\frac{\alpha[4-1]}{2} + \frac{\beta[8-1]}{3}\right]$

$= \frac{3\alpha}{2} + \frac{7\beta}{3}$

22. Official Ans. by NTA (3)

Sol. $u = \sqrt{2gh}$

Now,

$S = \frac{h}{3}$ $\qquad a = -g$

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

$\frac{h}{3} = \sqrt{2gh}\, t + \frac{1}{2}(-g)t^2$

$t^2\left(\frac{g}{2}\right) - \sqrt{2gh}\ t + \frac{h}{3} = 0$

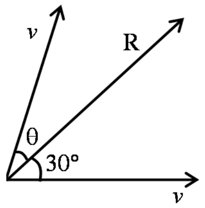
From quadratic equation

$t_1, t_2 = \frac{\sqrt{2gh} \pm \sqrt{2gh - \frac{4g}{2}\frac{h}{3}}}{g}$

$\frac{t_1}{t_2} = \frac{\sqrt{2gh} - \sqrt{\frac{4gh}{3}}}{\sqrt{2gh} + \sqrt{\frac{4gh}{3}}} = \frac{\sqrt{3}-\sqrt{2}}{\sqrt{3}+\sqrt{2}}$

23. Official Ans. by NTA (30)

Sol.

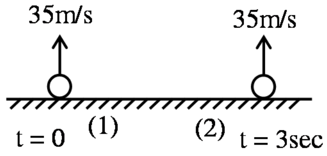


Both velocity vectors are of same magnitude therefore resultant would pass exactly midway through them

θ = 30°

24. Official Ans. by NTA (50)

Sol.



When both balls will collied

$y_1 = y_2$

$35t - \frac{1}{2}\times 10 \times t^2 = 35(t-3) - \frac{1}{2}\times 10 \times (t-3)^2$

$35t - \frac{1}{2}\times 10\times t^2 = 35t - 105 - \frac{1}{2}\times 10 \times t^2$

$- \frac{1}{2}\times 10 \times 3^2 + \frac{1}{2}\times 10 \times 6t$

0 = 150 – 30 t

t = 5 sec

∴ Height at which both balls will collied

$h = 35t - \frac{1}{2}\times 10 \times t^2$

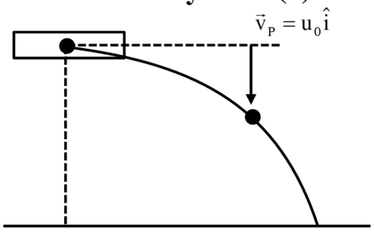
$= 35\times 5 - \frac{1}{2}\times 10\times 5^2$

h = 50 m

Ans. 50.00

25. Official Ans. by NTA (3)

Sol.



$v_B = u_0\hat{i} - gt\hat{j}$

$\vec{v}_{B/P} = \vec{v}_B - \vec{v}_P$

$\vec{v}_{B/P} = -8t\hat{j}$

straight line vertically down

Ans.3

26. Official Ans. by NTA (12)

Sol. $V = \sqrt{5000 + 24x}$

$\frac{dV}{dx} = \frac{1}{2\sqrt{5000+24x}} \times 24 = \frac{12}{\sqrt{5000+24x}}$

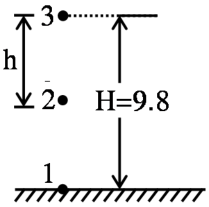
now $a = V\frac{dV}{dx}$

$= \sqrt{5000+24x} \times \frac{12}{\sqrt{5000+24x}}$

$\boxed{a = 12 m/s^2}$

27. Official Ans. by NTA (4)

Sol.



$$H = \frac{1}{2}gt^2$$

$$\frac{9.8 \times 2}{9.8} = t^2$$

$t = \sqrt{2}$ sec

Δt: time interval between drops

$$h = \frac{1}{2}g(\sqrt{2} - \Delta t)^2$$

$$0 = \frac{1}{2}g(\sqrt{2} - 2\Delta t)^2$$

$$\Delta t = \frac{1}{\sqrt{2}}$$

$$h = \frac{1}{2}g\left(\sqrt{2} - \frac{1}{\sqrt{2}}\right)^2 = \frac{1}{2} \times 9.8 \times \frac{1}{2} = \frac{9.8}{4} = 2.45\text{m}$$

$H - h = 9.8 - 2.45$

$= 7.35$ m

28. Official Ans. by NTA (3)

Sol. $H = \dfrac{U^2 \sin^2\theta}{2g}$

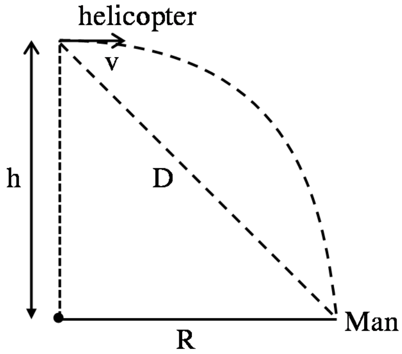
$$= \frac{(25)^2.(\sin 45)^2}{2 \times 10} = 15.625 \text{ m}$$

$$T = \frac{U\sin\theta}{g} = \frac{25 \times \sin 45°}{10}$$

$= 2.5 \times 0.7 = 1.77$ s

29. Official Ans. by NTA (3)

Sol.



$$R = \sqrt{\frac{2h}{g}} \cdot v$$

$$D = \sqrt{R^2 + h^2}$$

$$= \sqrt{\left(\sqrt{\frac{2h}{g}} \cdot v\right)^2 + h^2}$$

$$D = \sqrt{\frac{2hv^2}{g} + h^2}$$

Option (3) is correct

30. Official Ans. by NTA (1)

Sol. $y = mx + C$

$$v^2 = \frac{20}{10}x + 20$$

$v^2 = 2x + 20$

$$2v\frac{dv}{dx} = 2$$

$$\therefore\ a = v\frac{dv}{dx} = 1$$

31. Official Ans. by NTA (2)

Sol. Range $R = \dfrac{u^2 \sin 2\theta}{g}$ and same for θ and $90 - \theta$

So same for 42° and 48°

Maximum height $H = \dfrac{u^2 \sin^2\theta}{2g}$

H is high for higher θ

So H for 48° is higher than H for 42°

Option (2)