DPP

DAILY PRACTICE PROBLEMS

CLASS : XITH
DATE :

Solutions

SUBJECT : PHYSICS
DPP NO. : 5

Topic :- MOTION IN A STRAIGHT LINE

2 **(a)**

Distance covered in 5^{th} second

$$S_{5^{th}} = u + \frac{a}{2}(2n - 1) = 0 + \frac{a}{2}(2 \times 5 - 1) = \frac{9a}{2}$$

and distance covered in 5 second,

$$S_5 = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2} \times a \times 25 = \frac{25a}{2}$$

$$\therefore \frac{S_{5^{th}}}{S_5} = \frac{9}{25}$$

4 **(a)**

$$S \propto u^2 \ \therefore \frac{S_1}{S_2} = \left(\frac{u_1}{u_2}\right)^2 \Rightarrow \frac{2}{S_2} = \frac{1}{4} \Rightarrow S_2 = 8\,m$$

5 **(c)**

$$\frac{dx}{dt} = 2at - 3bt^2 \Rightarrow \frac{d^2x}{dt^2} = 2a - 6bt = 0 \Rightarrow t = \frac{a}{3b}$$

6 **(c)**

Distance travelled by the particle is

$$x = 40 + 12t - t^3$$

We know that, speed is rate of change of distance i.e.

$$v = \frac{dx}{dt}$$

$$\therefore v = \frac{d}{dt}(40 + 12t - t^3) = 0 + 12 - 3t^2$$

But final velocity $v = 0$

$$\therefore 12 - 3t^2 = 0$$

$$\Rightarrow t^2 = \frac{12}{3} = 4 \Rightarrow t = 2s$$

Hence, distance travelled by the particle before coming to rest is given by

$$x = 40 + 12(2) - (2)^3 = 40 + 24 - 8 = 64 - 8 = 56m$$

7 **(c)**

From equation of motion, we have

$$s = ut + \frac{1}{2}gt^2$$

Where, u is initial velocity, g the acceleration due to gravity and t the time.

For upward motion

$$h = -ut_1 - \frac{1}{2}gt_1^2 \quad ...(i)$$

for downward motion

$$h = -ut_2 + \frac{1}{2}gt_2^2 \quad ...(ii)$$

multiplying Eq. (i) by t_2 and Eq. (ii) by t_1 and subtracting Eq. (ii) by Eq. (i), we get

$$h(t_2 - t_1) = \frac{1}{2}gt_1t_2(t_2 - t_1)$$

$$h = \frac{1}{2}\,gt_1t_2 \quad ...(iii)$$

When stone is dropped from rest $u = 0$, reaches the ground in t second.

$$\therefore \quad h = \frac{1}{2}gt^2 \quad ...(iv)$$

Equating Eqs. (iii) and (iv), we get

$$\frac{1}{2}gt^2 = \frac{1}{2}g\,t_1t_2$$

$$\Rightarrow \quad t^2 = t_1t_2 \Rightarrow t = \sqrt{t_1t_2}$$

8 **(c)**

$\frac{dv}{dt} = 6t$ or $dv = 6t, mv = \frac{6t^2}{2} = 3t^2,$

$dx = 3t^2dt \Rightarrow x = 3\,\frac{t^3}{2} = t^3$

9 **(b)**

Region OA shows that graph bending toward time axis *i.e*. acceleration is negative.

Region AB shows that graph is parallel to time axis *i.e*. velocity is zero. Hence acceleration is zero.

Region BC shows that graph is bending towards displacement axis *i.e*. acceleration is positive.

Region CD shows that graph having constant slope $i.e.$ velocity is constant. Hence acceleration is zero

10 **(a)**

$s \propto t^2$[Given] $\therefore s = Kt^2$

Acceleration $a = \frac{d^2s}{dt^2} = 2k$ [constant]

It means the particle travels with uniform acceleration

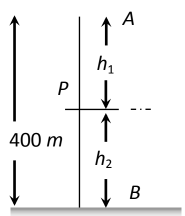
11 **(c)**

$v^2 = u^2 + 2gh \Rightarrow v = \sqrt{u^2 + 2gh}$

So for both the cases velocity will be equal

12 **(c)**

Let both balls meet at point P after time t



The distance travelled by ball A, $h_1 = \frac{1}{2}gt^2$

The distance travelled by ball B, $h_2 = ut - \frac{1}{2}gt^2$

$h_1 + h_2 = 400\ m \Rightarrow ut = 400$, $t = 400/50 = 8\ sec$

$\therefore h_1 = 320m$ and $h_2 = 80\ m$

13 **(c)**

$v = (180 - 16x)^{1/2}$

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

$\therefore a = \frac{1}{2}(180 - 16x)^{-1/2} \times (-16)\left(\frac{dx}{dt}\right)$

$= -8(180 - 16x)^{-1/2} \times v$

$= -8(180 - 16x)^{-1/2} \times (180 - 16x)^{1/2} = -8\ m/s^2$

14 **(a)**

Slope of displacement time-graph is velocity

$$\frac{v_1}{v_2} = \frac{\tan\theta_1}{\tan\theta_2} = \frac{\tan 30°}{\tan 45°} = \frac{1}{\sqrt{3}}$$

$$v_1 : v_2 = 1 : \sqrt{3}$$

15 **(a)**

The v - x equation from the given graph can be written as,

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

$$\therefore \qquad a = \frac{dv}{dt} = \left(-\frac{v_0}{x_0}\right)\frac{dx}{dt} = \left(-\frac{v_0}{x_0}\right)v$$

Substituting v from Eq. (i), we get

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

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

Thus, a - x graph is a straight line with positive slope and negative intercept.

16 **(a)**

When the stone is released from the balloon. Its height

$h = \frac{1}{2}at^2 = \frac{1}{2} \times 1.25 \times (8)^2 = 40\ m$ and velocity

$v = at = 1.25 \times 8 = 10\ m/s$

Time taken by the stone to reach the ground

$$t = \frac{v}{g}\left[1 + \sqrt{1 + \frac{2gh}{v^2}}\right] = \frac{10}{10}\left[1 + \sqrt{1 + \frac{2 \times 10 \times 40}{(10)^2}}\right] = 4sec$$

17 **(c)**

Let v_1, v_2 be the initial speeds of first and second runners. Let t be time by them when the first runner has completed 50m. During this time, the second runner has covered a distance $= 50 - 1 = 49$m.

So, $t = \frac{50}{v_1} = \frac{49}{v_2}$ ...(i)

Suppose, the second runner increases his speed to v_3 so that he covers the remaining distance ($= 51$m) in times t. So

$$t = \frac{51}{v_3} = \frac{49}{v_2}$$

or $v_3 = \frac{51}{49}v_2$

or $v_3 = \left(1 + \frac{2}{49}\right)v_2$ or $\frac{v_3}{v_2} - 1 = \frac{2}{49}$

or $\frac{v_3 - v_2}{v_2} = \frac{2}{49}$

or % increase $= \frac{2}{49} \times 100 = 4.1\%$

18 **(a)**

If $t_0$is the reaction time, then the distance covered during decelerated motion is $10 - 10t_0$.

Now, in the first case,

$10^2 = 2a(10 - 10t_0)$ ...(i)

Similarly, in the second case,

$20^2 = 2a(30 - 20t_0)$ ...(ii)

Again, in the third case,

$15^2 = 2a(x - 5t_0)$ ...(iii)

Dividing Eq.(ii) by Eq. (i), $\frac{20^2}{10^2} = \frac{30 - 20t_0}{10 - 10t_0}$

or $40 - 40t_0 = 30 - 20t_0$

or $20t_0 = 10$ or $t_0 = \frac{1}{2}s$

Dividing Eq. (iii) by Eq. (i), we get

$\frac{225}{100} = \frac{x - 15t_0}{10 - 10t_0}$ or $\frac{9}{4} = \frac{x - 15 \times \frac{1}{2}}{10 - 10 \times \frac{1}{2}}$

$45 = 4x - 30$ or $4x = 75$

or $x = \frac{75}{4}\text{m} = 18.75\text{m}$

19 **(c)**

$\mathbf{u} = 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}}, \mathbf{a} = 0.4\hat{\mathbf{i}} + 0.3\hat{\mathbf{j}}$

Speed $\mathbf{v} = \mathbf{u} + \mathbf{a}t$

$= 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}} + (0.4\hat{\mathbf{i}} + 0.3\hat{\mathbf{j}})10$

$= 3\hat{\mathbf{i}} + 4\hat{\mathbf{j}} + 4\hat{\mathbf{i}} + 3\hat{\mathbf{j}} = 7\hat{\mathbf{i}} + 7\hat{\mathbf{j}}$

$v = \sqrt{7^2 + 7^2} = 7\sqrt{2}$ unit

20 **(a)**

If t_1 and $2t_2$ are the time taken by particle to cover first and second half distance respectively

$t_1 = \frac{x/2}{3} = \frac{x}{6}$ ...(i)

$x_1 = 4.5\ t_2$ and $x_2 = 7.5\ t_2$

So, $x_1 + x_2 = \frac{x}{2} \Rightarrow 4.5\ t_2 + 7.5\ t_2 = \frac{x}{2}$

$t_2 = \frac{x}{24}$ ...(ii)

Total time $t = t_1 + 2t_2 = \frac{x}{6} + \frac{x}{12} = \frac{x}{4}$

So, average speed $= 4\ m/sec$

ANSWER-KEY										
Q.	1	2	3	4	5	6	7	8	9	10
A.	D	A	A	A	C	C	C	C	B	A
Q.	11	12	13	14	15	16	17	18	19	20
A.	C	C	C	A	A	A	C	A	C	A