6th advanced

ws-7

Tkank

(1)

$u=0$; $S_n = 22\,m$, $n = 6^{th}$ sec

From $S_n = u + \frac{a}{2}(2n-1)$

$\Rightarrow 22 = 0 + \frac{a}{2}(2\times6-1)$

$\Rightarrow 22 = \frac{a}{2}(12-1)$

$\Rightarrow 44 = a\times11 \Rightarrow a = \frac{44}{11} = 4\,m/s^2$

$t = 6$ sec.

distance travelled $s = ut + \frac{1}{2}at^2$

$\Rightarrow s = 0\times6 + \frac{1}{2}\times4\times6^2$

$\Rightarrow s = 0 + 2\times36$

$\Rightarrow s = 72\,m$

(2)

initial velocity $u = 108$ kmph

Final velocity $v = 36$ kmph ; distance = 200m

change in velocity $= v-u = 36-108 = -72$ kmph

$= -72\times\frac{5}{18} = -20\,m/s$

From $v = u+at \Rightarrow t = \frac{v-u}{a} = \frac{-20}{-2} = 10$ sec.

From $v^2-u^2 = 2as$

$\Rightarrow (v+u)(v-u) = 2\times a\times200$

$\Rightarrow 40\ (-20) = 2\times a\times200$

$a = \frac{-20}{10} = -2\,m/s^2$

(3)

Here the cars are coming to stop

i(e) their final velocity = 0

From $v^2 - u^2 = 2as$ [Car is in retardation

$\Rightarrow 0^2 - u^2 = -2as$

$\Rightarrow s = \frac{u^2}{2a} \Rightarrow s \propto u^2$

$\frac{s_1}{s_2} = \left[\frac{u_1}{u_2}\right]^2$

$\Rightarrow \frac{s_1}{s_2} = \left[\frac{v}{40}\right]^2 = \left(\frac{1}{4}\right)^2 = \frac{1}{16}$

(4)

$V_A = 10 m/s$ $V_B = 20 m/s$

The velocity of car midway between A and B

is $v_c = \sqrt{\frac{v_A^2 + v_B^2}{2}} = \sqrt{\frac{10^2 + 20^2}{2}} = \sqrt{\frac{500}{2}}$

$\Rightarrow \sqrt{\frac{250}{a}} = 5\sqrt{10} m/s$

(5) (8)

Initial velocity $u = 90 m/s$

Final velocity $v = 70 m/s$: distance $s = 100m$

From $v^2 - u^2 = 2as$

$\Rightarrow (v+u)(v-u) = 2as$

$\Rightarrow 160 \times 20 = 2 \times a \times 100$

$\Rightarrow a = 16 m/s^2$

⑤

In $t_1 = 2$ sec

$s_1 = 200$ cm.

In $t_2 = 6$ sec. $s_2 = 200 + 220 = 420$ cm.

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

$t_1 = 2$ sec, $s_1 = 200$ cm | $t_2 = 6$ sec, $s_2 = 420$ cm

$200 = 2u + \frac{1}{2}a(2)^2$

$\Rightarrow 200 = 2u + 2a$

$\Rightarrow a + u = 100 \rightarrow (1)$

$420 = 6u + \frac{1}{2}(a)6^2$

$\Rightarrow 70 = u + \frac{a}{2} \times 6\ 3$

$\Rightarrow 70 = u + 3a \rightarrow (2)$

By solving (1) and (2) we get

$\Rightarrow \begin{matrix} u + a = 100 \\ u + 3a = 70 \end{matrix}$

$\Rightarrow -2a = 30 \Rightarrow a = -15\ m/s^2$

From (1) $a + u = 100 \Rightarrow u = 100 - a$

$\Rightarrow u = 100 + 15$

$= 115$ cm/s

⑥

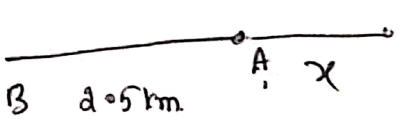
Total distance = 12 m.

The person moves 6 steps forward and 4 steps backward. In 10 sec. after that he is 2m away from an initial position.

After 30 sec he will be 6m away from initial position. He moves further 6m in 6 sec.

Total time = $30 + 6 = 36$ sec

(7)



$u_A = 60$ kmph. $\quad a_A = 0$

$a_B = -20$ kmph^2. $\quad u_B = 70$ kmph

$S_B = 2.5 \text{ km} + x \qquad S_A = x.$

$\Rightarrow u_B t + \frac{1}{2} a_B t^2 = 2.5 + x \quad ; \quad u_A t + \frac{1}{2} a_A t^2 = x$

$\therefore \quad 70t - \frac{1}{2} \times 20 t^2 = 2.5 + x \quad ; \quad x = 60t + \frac{1}{2}(0)t^2$

$x = 60t.$

$\Rightarrow 70t - 10t^2 = 2.5 + 60t$

$\Rightarrow 10t - 10t^2 = 2.5 \text{ m}$

$\Rightarrow t^2 - t + 0.25 = 0$

roots of $t = \frac{1 \pm \sqrt{b^2 - 4ac}}{2} = \frac{1 \pm \sqrt{1-1}}{2} = \frac{1}{2}$ hr.

From $x = 60t = 60 \times \frac{1}{2} = 30$ km.

Total distance travelled by B $= 30 + 2.5 = 32.5$ km

(9)

Given $t = \sqrt{x} + 3 \Rightarrow x = (t-3)^2 = t^2 - 6t + 9$

velocity $v = \frac{dx}{dt} = \frac{d}{dt}[t^2 - 6t + 9] = \frac{d}{dt} t^2 - 6\frac{d}{dt} t + \frac{d}{dt}(9)$

$v = 2t - 6 \qquad$ when $v = 0$

$\Rightarrow 2t - 6 = 0 \Rightarrow t = 3$ sec.

$\therefore \quad x = (3)^2 - 6(3) + 9 = 18 - 18 = 0$

(10)

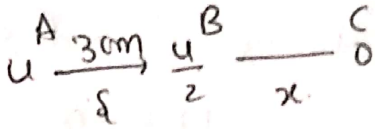
Here · the body coming to rest i.e) $v = 0$

From $v^2 - u^2 = 2as$ [the body is in retardation]

$\Rightarrow 0^2 - u^2 = 2as$

$\Rightarrow s \propto u^2$ $\quad v_1 = u$

$v_2 = \frac{u}{2}$



$\Rightarrow$ From $v^2 - u^2 = 2as$

$\Rightarrow \left(\frac{u}{2}\right)^2 - u^2 = 2(-a)(3)$

$\Rightarrow \frac{-3u^2}{4} = -6a \Rightarrow 3u^2 = 24a$

$\Rightarrow u^2 = 8a$

From B → C

$v^2 - u^2 = 2as$

$\Rightarrow 0^2 - \left(\frac{u}{2}\right)^2 = -2ax$

$\Rightarrow -\frac{u^2}{4} = -2ax \Rightarrow \frac{8a}{4} = 2ax$

$\Rightarrow 8a = 8ax \Rightarrow x = 1cm$

(19)

Given $s = 0.4t - \frac{3}{2}t^2$

compare with $s = ut + \frac{1}{2}at^2$

$u = 0.4\ m/s$ $\quad a = -3\ m/s^2$

(13)

$n_1 = 5$ $\qquad$ $n_2 = 7$ sec

$S_1 = 50m$ $\qquad$ $S_2 = 70m$

From $S_n = u + \frac{a}{2}(2n-1)$

$S_1 = 50m$, $n_1 = 5$ $\qquad$ $n_2 = 7$ sec, $S_2 = 70m$

$50 = u + \frac{a}{2}(2\times5-1)$ $\qquad$ $70 = u + \frac{a}{2}(2\times7-1)$

$\Rightarrow 50 = u + \frac{9a}{2} \rightarrow (1)$ $\qquad$ $\Rightarrow 70 = u + \frac{13}{2}a \rightarrow (2)$

By solving (1) and (2) we get

$$\Rightarrow u + \frac{9a}{2} = 50$$
$$u + \frac{13}{2}a = 70$$
$$-\frac{4a}{2} = -20$$

$\Rightarrow -2a = -20$

$\Rightarrow a = 10\ m/s^2$

From (1) $\Rightarrow u + 9\times\frac{(10)}{2} = 50$

$\Rightarrow u + 45 = 50 \Rightarrow u = 50 - 45 = 5\ m/s$

From $n = 9^{th}$ sec

$S_n = u + \frac{a}{2}(2n-1) = 5 + \frac{10}{2}(2\times10-1)$

$= 5 + 5(19) = 100m$

(15)

(a)

$V = u + at$

$v = 3 - 2t$ $\Rightarrow u = 3\ m/s$; $a = -2\ m/s^2$

(b)

$S = -4t + \frac{5}{2}t^2$ $\qquad$ $u = -4\ m/s$

Compare with $s = ut + \frac{1}{2}at^2$ $\qquad$ $a = 5\ m/s^2$

(15)th continuation

(c)

$20^2 - 10^2 = 2as$

compare with $v^2 - u^2 = 2as$

$v = 20$ m/s

$u = 10$ m/s

(d)

$S_n = 4 + (1.5)a = 4 + \frac{3}{2}a$

compare with $S_n = u + \frac{a}{2}(2n-1)$

$\therefore u = 4$; $2n-1 = 3 \Rightarrow 2n = 4$

$n = 2$ sec

(16)

Train starts from rest $u = 0$.

$a = 20$ m/s^2 ; $t = 30$ min

In first 30 sec distance $S_1 = ut + \frac{1}{2}at^2$

$S_1 = 0 \times 30 + \frac{1}{2}(20)(30)^2$

$S_1 = 9000$ m $= 9$ km

velocity after 30 sec $v = u + at = 0 + 20 \times 30$

$v = 600$ m/s

This is the maximum speed attained by the train

Distance travelled $S_2 = vt + \frac{1}{2}at^2$

$= 600 \times 30 + \frac{1}{2} \times 20 \times (30)^2$

$= 18000 + 9000 = 27000$

$= 27$ km

Total distance $= 9$ km $+ 27$ km $= 36$ km.

(17)

$t = 15$ sec

$u = 145$ m/s ; $v = 7.5$ m/sec.

From $v = u + at$

$\Rightarrow 145 = 7.5 + a \times 15$

$\Rightarrow [145 - 7.5] = 15a$

$\Rightarrow 137.5 = 15a$

$\Rightarrow a = \frac{137.5}{15} = 9.16 \text{ m/s}^2$

From $s = ut + \frac{1}{2} a t^2$

$s = 145 \times 15 + \frac{1}{2} \times \frac{137.5}{15} (15)^2$

$= 2190 + \frac{1}{2} \times 2062.$

$= 2190 + 1031.25 = 3221.25$ m

(18)

$u = 1.6$ m/sec ; $a = 4 \text{ m/s}^2$; $t = 4$ sec.

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

$s = 1.6 \times 4 + \frac{1}{2} \times 4^2 \times 4^2$

$= 6.4 + 32 = 38.4$m

(19)

$u = 0$; $s = 500$ m ; $a = 5 \text{ m}^2$

From $v^2 - u^2 = 2as$ $\Rightarrow v = \sqrt{5000}$

$\Rightarrow v^2 - 0 = 2 \times 5 \times 500$ $\Rightarrow v = 71$ m/sec

L TASK

CUQ's

(2)

$u = 22.4$ m/s ; $t = 2.55$ sec. (Body is in retardation)

acceleration $a = \frac{u}{t} = \frac{22.4}{2.55}$ m/s^2

skidding distance $s = ut + \frac{1}{2}at^2$

$s = 22.4 \times \frac{22.4}{2.55} - \frac{1}{2}\left(\frac{22.4}{2.55}\right)(2.55)^2$

$= 196.768$ $22.4 \times 2.55 - \frac{1}{2}(22.4)(2.55)$

$= \frac{1}{2} \times 22.4 \times 2.55$

$= \frac{57.12}{2} = 28.56 = 28.6$ m

(3)

$h = 2.62$ m

$v = \sqrt{2gh}$

$= \sqrt{2 \times 9.8 \times 2.62}$

$= \sqrt{51.352}$

$= 7.17$ m/s.

Jee main's level

(1)

$u = 20$ m/sec $\quad s = 4\times10^{-2}$ m $\quad v = 0$

From $s = ut + \frac{1}{2}at^2$; $v = u + at$

$\Rightarrow 4\times10^{-2} = 20t + \frac{1}{2}\left(\frac{-20}{t}\right)t^2$; $\Rightarrow a = -\frac{u}{t}$

$\Rightarrow 4\times10^{-2} = 20t - 10t$ $\qquad a = \frac{-20}{t}$

$\Rightarrow 4\times10^{-2} = 10t \Rightarrow t = 4\times10^{-3}$ sec

(2)

$v_1 = 20$ kmph ; $v_2 = 40$ kmph.

$$\langle \text{speed} \rangle = \frac{2v_1v_2}{v_1+v_2} = \frac{2\times20\times40}{20+40}$$

$$= \frac{2\times20\times40}{60\ 3} = \frac{80}{3} \text{ kmph}$$

(3)

$$\langle \text{velocity} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{v_1t_1 + v_2t_2}{t_1+t_2+t_3}$$

$$= \frac{20\times10 + 40\times20}{10+5+20} = \frac{1000}{35}$$

$$= 28.57 \text{ m/s}$$

(4)

Given $v = \sqrt{150+8x}$

$\Rightarrow v^2 = 150 + 8x.$

$\Rightarrow v^2 = (\sqrt{150})^2 + 8x$

$\Rightarrow v^2 - (\sqrt{150})^2 = 8x.$

Compare with $v^2 - u^2 = 2as$

$\Rightarrow 2a = 8 \Rightarrow a = 4 \text{ m/s}^2$

(5), (6)

Given $v = \sqrt{3x+16}$

$\Rightarrow v^2 = 3x + 16$

$\Rightarrow v^2 = 3x + 4^2$

$\Rightarrow v^2 - 4^2 = 3x$

Compare with $v^2 - u^2 = 2as$

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

$u = 4 \text{ m/s}$

(7)

Given

$S_n = 2 + 0.4n$

Compare with $S_n = u + \frac{a}{2}(2n-1)$

$= u + an - \frac{a}{2}$

$S_n = u - \frac{a}{2} + an$

$a = 0.4 \text{ m/s}^2$

(8)

$u=0$; $a=5\ m/s^2$; $t=8\ sec$

Distance covered $s = ut + \frac{1}{2}at^2$

$$s = 0\times 8 + \frac{1}{2}\times 5\times 8^2$$

$$\Rightarrow s = \frac{1}{2}\times 5\times 64^{32}$$

$$\Rightarrow s = 160\ m.$$

(9)

$u = 60\ kmph$; $v = 15\ kmph$; $s = 450\ m.$

$$= 60^{10}\times\frac{5}{18_3} \qquad = 15^{5}\times\frac{5}{18_6}$$

$$= \frac{50}{3}\ m/s \qquad = \frac{25}{6}\ m/s$$

From $v^2 - u^2 = 2as$

$$\Rightarrow (v+u)(v-u) = 2as$$

$$\Rightarrow \left(\frac{50}{3}+\frac{25}{6}\right)\left[\frac{25}{6}-\frac{50}{3}\right] = 2\times a\times 450$$

$$\Rightarrow \frac{125}{6}\times\left[-\frac{75}{6_2}^{25}\right] = 900\times a.$$

$$\Rightarrow \frac{125\times 25}{12} = 9\times 100^{4}\times a$$

$$\Rightarrow a = \frac{125}{12\times 36} = 0.29\ m/s^2.$$

(10) If a bullet looses $\frac{1}{n}$th of it's velocity in passing through a plank.

Then Number of such bullets required

$$= \frac{n^2}{2n-1}$$

Given bullet is loosing $\frac{1}{20}$th of it's velocity

$$n = 20$$

$$\therefore \text{Number of planks} = \frac{20^2}{(2\times 20)-1} \simeq \frac{20^2}{39} \simeq 11$$

(11)

Given $S_n = 0.4n + 9.8$ m

compare with $S_n = u + \frac{a}{2}(2n-1)$

$$= u + an - \frac{a}{2}$$

$$= (u - \frac{a}{2}) + an$$

$\therefore u - \frac{a}{2} = 9.8$: $an = 0.4n$

$\Rightarrow u - 0.2 = 9.8$ $\Rightarrow a = 0.4$ m/s^2

$\Rightarrow u = 10$ m/s

(15)

(a) $v = at \Rightarrow$ From $v = u + at$ if $u = 0$ Then $v = at$

(b) if $a = 0 \Rightarrow$ From $s = ut + \frac{1}{2}at^2 \Rightarrow s = ut$

(c) if $v = 0 \Rightarrow$ from $v^2 - u^2 = 2as \Rightarrow u = \sqrt{2as}$ (Retardation)

(d) if ~~the~~ body $n = 0 \Rightarrow$ Then from $s = u + \frac{a}{2}(2n-1) \Rightarrow s = u - \frac{a}{2}$

(16)

Given $v = 2 + 3t$ $\qquad v^2 - 2^2 = 6a$

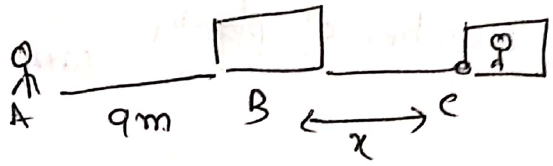
Compare with $v = u + at$ & $v^2 - u^2 = 2as$

$u = 2$ m/s ; $a = 3$ m/s^2 ; $2as = 6a3$

$s = 3$ m

(17)

$u = 0$; $a = 2$ m/s^2



$a_m = 0$

At C the man catches train : so time taken by the man and train is same.

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

For man		train	
$s = 9 + x$; $t = 7.5$ sec		$s = x$	$a = 2$ m/s^2

$\Rightarrow 9 + x = 0 \times u_m \times t$ $\qquad x = 0 \times t + \frac{1}{2} \times 2 \times (7.5)^2$

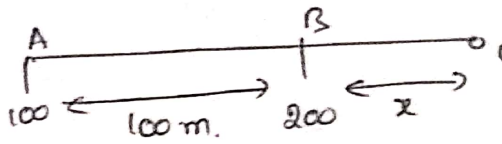
$\Rightarrow 9 + (7.5)^2 = u_m \times 7.5$ $\qquad x = (7.5)^2$ m

$$u_m = \frac{9 + (7.5)^2}{7.5}$$

$$= \frac{9 + 56.25}{7.5}$$

$$= \frac{65.25}{7.5} = 8.7 \text{ m/s}$$

(18)



$V_A = 10 m/s$ $V_B = 5 m/s$

Here time taken to reach 'C' is same for both cars.

Car A travels a distance $S_A = 100 + x$

where car B travels a distance $S_B = 5t$

$x = 5t$.

$[S_B = V_B \times t]$

$\therefore \quad 100 + 5t = 10t$.

$\Rightarrow t = \frac{100}{5} = 20$ sec.

$\therefore$ distance from origin $= 200 + 5t$

$= 200 + 5 \times 20$

$= 300m$

(19)

Given $u_A = 10 m/s$; $u_B = 12 m/s$; $a = 2 m/s^2$; $d = 150m$

Distance travelled by A, when it stops $S_A = \frac{u^2}{2a} = \frac{10^2}{2 \times 2}$

$S_A = 25m$

Distance travelled by B, when it stops $S_B = \frac{u_B^2}{2a} = \frac{12^2}{2 \times 2} = 36m$

minimum distance between the cars when both are

stop $= 150 - (25 + 36) = 89m$.