

6th advanced

ws-7

Task

①

①

$$u=0: \quad s_n = 22 \text{ m} \quad n = 6^{\text{th}} \text{ sec}$$

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

$$\Rightarrow 22 = 0 + \frac{a}{2} (2 \times 6 - 1)$$

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

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

$$\text{in } t = 6 \text{ sec.}$$

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

$$\Rightarrow s = 0 \times 6 + \frac{1}{2} \times 4 \times 6^2$$

$$\Rightarrow s = 0 + 2 \times 36$$

$$\Rightarrow s = 72 \text{ m}$$

②

$$\text{initial velocity } u = 108 \text{ kmph}$$

$$\text{Final velocity } v = 36 \text{ kmph}; \text{ distance} = 200 \text{ m}$$

$$\text{change in velocity} = v - u = 36 - 108 = -72 \text{ kmph}$$

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

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

$$\text{From } v^2 - u^2 = 2as$$

$$\Rightarrow (v + u)(v - u) = 2 \times a \times 200$$

$$\Rightarrow 40(-20) = 2 \times a \times 200$$

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



3)

Here the cars are coming to stop

i.e) their final velocity = 0

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

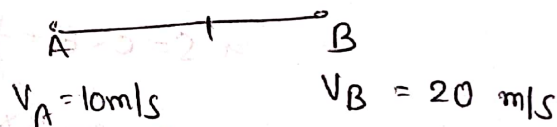
$$\Rightarrow 0^2 - u^2 = -2as$$

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

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

$$\Rightarrow \frac{s_1}{s_2} = \left[\frac{u}{4u} \right]^2 = \left[\frac{1}{4} \right]^2 = \frac{1}{16}$$

4)



The velocity of car midway between A and B

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

$$\Rightarrow \sqrt{\frac{250}{1}} = 5\sqrt{10} \text{ m/s}$$

5) 8)

initial velocity $u = 90 \text{ m/s}$

final velocity $v = 70 \text{ m/s}$: distance $s = 100 \text{ m}$

$$\text{From } v^2 - u^2 = 2as$$

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

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

$$\Rightarrow a = 16 \text{ m/s}^2$$



(5)

(2)

$$\text{In } t_1 = 2 \text{ sec.}$$

$$s_1 = 200 \text{ cm.}$$

$$\text{In } t_2 = 6 \text{ sec. } s_2 = 200 + 220 = 420 \text{ cm.}$$

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

$$t_1 = 2 \text{ sec, } s_1 = 200 \text{ cm} \quad | \quad t_2 = 6 \text{ sec, } s_2 = 420 \text{ cm}$$

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

$$\Rightarrow 200 = 2u + 2a$$

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

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

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

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

By solving (1) and (2) we get

$$\begin{aligned} u + a &= 100 \\ u + 3a &= 70 \end{aligned}$$

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

From (1)

$$a + u = 100 \Rightarrow u = 100 - a$$

$$\Rightarrow u = 100 + 15 = 115 \text{ cm/s}$$

(6)

Total distance = 12 m.

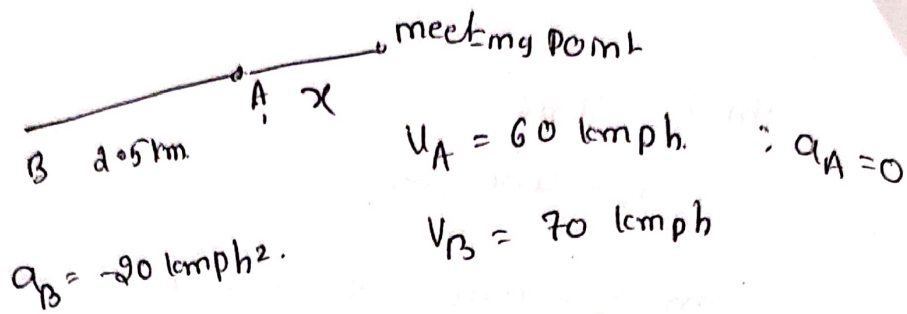
The person moves 6 steps forward and 4 steps back ward. In 10 sec. after that he is 2m away from an initial position.

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

$$\text{Total time} = 30 + 6 = 36 \text{ sec}$$



(7)



(6)

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

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

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

$$x = 60t$$

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

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

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

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

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

$$\text{Total distance travelled by B} = 30 + 2.5 = 32.5 \text{ km}$$

(9)

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

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

$$v = 2t - 6 \quad \text{when } v = 0$$

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

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



(10)

(3)

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

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

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

$$\Rightarrow s \propto u^2$$

$$v_1 = u$$

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

$$u \xrightarrow[8]{A \text{ } 30m} \frac{u}{2} \xrightarrow[x]{B} C$$

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

$$\Rightarrow \left(\frac{u}{2}\right)^2 - u^2 = 2(-a)(8)$$

$$\Rightarrow \frac{-3u^2}{4} = -16a \Rightarrow 3u^2 = 64a \Rightarrow u^2 = \frac{64}{3}a$$

From B $\rightarrow$ C

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

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

$$\Rightarrow -\frac{u^2}{4} = -2a x \Rightarrow \frac{64}{4} = 2a x$$

$$\Rightarrow 16 = 2a x \Rightarrow x = 8m$$

(19)

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

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

$$u = 0.4 \text{ m/s}$$

$$a = -3 \text{ m/s}^2$$

(13)

$$n_1 = 5$$

$$s_1 = 50 \text{ m}$$

$$n_2 = 7 \text{ sec}$$

$$s_2 = 70 \text{ m}$$

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

$$s_1 = 50 \text{ m}, n_1 = 5$$

$$n_2 = 7 \text{ sec}; s_2 = 70 \text{ m}$$

$$50 = u + \frac{a}{2} (2 \times 5 - 1)$$

$$\Rightarrow 50 = u + \frac{9a}{2} \rightarrow \textcircled{1}$$

$$70 = u + \frac{a}{2} (2 \times 7 - 1)$$

$$\Rightarrow 70 = u + \frac{13a}{2} \rightarrow \textcircled{2}$$

By solving $\textcircled{1}$ and $\textcircled{2}$ we get

$$\Rightarrow u + \frac{9a}{2} = 50$$

$$u + \frac{13a}{2} = 70$$

$$\underline{\quad \quad \quad}$$

$$\Rightarrow -4\frac{a}{2} = -20$$

$$\Rightarrow -2a = -20$$

$$\Rightarrow a = 10 \text{ m/s}^2$$

From $\textcircled{1}$

$$\Rightarrow u + 9 \times \frac{10}{2} = 50$$

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

From $n = 9^{\text{th}}$ sec

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

$$= 5 + 5(19) = 100 \text{ m}$$

(15)

(a)

$$V = u + at$$

$$u = 3 - 2t \Rightarrow u = 3 \text{ m/s}; a = -2 \text{ m/s}^2$$

(b)

$$s = -4t + \frac{5}{2} t^2$$

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

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

$$a = 5 \text{ m/s}^2$$



15th continuation

9

(c)

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

compare with $v^2 - u^2 = 2as$ $\therefore v = 20 \text{ m/s}$
 $u = 10 \text{ m/s}$

(d)

$$S_n = 4 + (n-1)a = 4 + \frac{3}{2}a$$

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

$$\therefore u = 4 \quad \text{and} \quad 2n-1 = 3 \Rightarrow 2n = 4$$
$$n = 2 \text{ sec}$$

16

Train starts from rest $u = 0$.

$$a = 20 \text{ m/s}^2 ; t = 30 \text{ min}$$

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

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

$$S_1 = 9000 \text{ m} = 9 \text{ km}$$

velocity after 30 sec $v = u + at = 0 + 20 \times 30$
 $v = 600 \text{ m/s}$

This is the maximum speed attained by the train

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

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

$$= 18000 + 9000 = 27000$$

$$= 27 \text{ km}$$

$$\text{Total distance} = 9 \text{ km} + 27 \text{ km} = 36 \text{ km}$$



(17)

$$t = 15 \text{ sec}$$

$$u = 145 \text{ m/s}; \quad v = 7.5 \text{ m/sec.}$$

$$\text{From } v = u + at$$

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

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

$$\Rightarrow 137.5 = 15a$$

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

I = ram

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

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

$$= 2190 + \frac{1}{2} \times 2062.5$$

$$\Rightarrow 2190 + 1031.25 = 3221.25 \text{ m}$$

(18)

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

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

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

$$= 6.4 + 32 = 38.4 \text{ m}$$

(19)

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

$$\text{From } v^2 - u^2 = 2as$$

$$\Rightarrow v = \sqrt{5000}$$

$$\Rightarrow v^2 - 0 = 2 \times 5 \times 500$$

$$\Rightarrow v = 71 \text{ m/sec}$$



$$\frac{L_{\text{Taxi}}}{C_{\text{UGA}}}$$

(5)

(2)

$$u = 22.04 \text{ m/s}; \quad t = 2.55 \text{ sec. (Body in motion)}]$$

$$\text{acceleration } a = \frac{u}{t} = \frac{22.04}{2.55} \text{ m/s}^2$$

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

$$s = 22.04 \times \frac{2.55}{2.55} + \frac{1}{2} \left(\frac{22.04}{2.55} \right) (2.55)^2$$

$$= \cancel{196.768} \quad 22.04 \times 2.55 - \frac{1}{2} (22.04)(2.55)$$

$$= \frac{1}{2} \times 22.04 \times 2.55$$

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

(3)

$$h = 2.62 \text{ m}$$

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

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

$$= \sqrt{51.352}$$

$$= 7.17 \text{ m/s.}$$

5

(1)

$$u = 20 \text{ m/sec} \quad s = 4 \times 10^{-2} \text{ m} \quad v = 0$$

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

$$a = -\frac{u}{t}$$

$$\Rightarrow 4 \times 10^{-2} = 20t + \frac{1}{2} \left(-\frac{20}{t} \right) t^2 \quad ; \quad \Rightarrow a = -\frac{20}{t}$$

$$\Rightarrow 4 \times 10^{-2} = 20t - 10t$$

$$\Rightarrow 4 \times 10^{-2} = 10t \quad \Rightarrow t = 4 \times 10^{-3} \text{ sec}$$

(2)

$$V_1 = 20 \text{ kmph} \quad ; \quad V_2 = 40 \text{ kmph}$$

$$\langle \text{speed} \rangle = \frac{2V_1V_2}{V_1+V_2} = \frac{2 \times 20 \times 40}{20+40}$$

$$= \frac{2 \times 20 \times 40}{60} = \frac{80}{3} \text{ kmph}$$

(3)

$$\langle \text{velocity} \rangle = \frac{\text{Total distance}}{\text{Total time}} = \frac{V_1t_1 + V_2t_2}{t_1 + t_2 + t_3}$$

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

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

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

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

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

⑧

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

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

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

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

$$\Rightarrow s = 160 \text{ m.}$$

⑨

$$u = 60 \text{ kmph} \quad ; \quad v = 15 \text{ kmph} \quad ; \quad s = 450 \text{ m.}$$

$$\begin{aligned} &= 60 \times \frac{5}{18} \\ &= \frac{50}{3} \text{ m/s.} \end{aligned}$$

$$\begin{aligned} &= 15 \times \frac{5}{18} \\ &= \frac{25}{6} \text{ m/s} \end{aligned}$$

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

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

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

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

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

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

(10)

If a bullet loses $\frac{1}{n}$ th of its velocity in passing through a plank.

Then number of such bullets required

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

Given bullet is losing $\frac{1}{20}$ th of its velocity

$$n = 20$$

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

(11)

$$\text{Given } S_n = 0.4n + 9.8 \text{ m}$$

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

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

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

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

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

$$\Rightarrow u - 0.2 = 9.8$$

$$\Rightarrow u = 10 \text{ m/s}$$

(15)

(a)

$$v = at \Rightarrow \text{From } v = u + at \text{ if } \underline{u=0} \text{ then } v = at$$

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

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

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

(16)

Given $v = 2 + 3t$

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

compare with $v = u + at$ and $v^2 - u^2 = 2as$

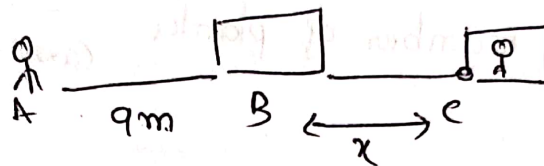
$u = 2 \text{ m/s}$; $a = 3 \text{ m/s}^2$;

$s = 3 \text{ m}$

$s = 3 \text{ m}$

(17)

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



$a_m = 0$

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

From

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

For man

$s = 9 + x$; $t = 7.5 \text{ sec}$

brain

$s = x$

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

$\Rightarrow 9 + x = u_m \times t$

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

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

$x = (7.5)^2 \text{ m}$

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

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

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