

8th advanced
WS-5

① For a Freely Falling body $u=0$

and velocity with which the body reaches ground $v^2 = 2gh$

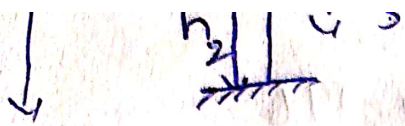
$$\Rightarrow v^2 \propto h$$

The ratio of heights

$$\Rightarrow \left(\frac{v_1}{v_2} \right)^2 = \frac{h_1}{h_2}$$

$$\frac{h_1}{h_2} = \frac{2}{3}$$

$$\Rightarrow \left[\frac{v_1}{v_2} \right]^2 = \frac{2}{3} \Rightarrow \frac{v_1}{v_2} = \frac{\sqrt{2}}{\sqrt{3}}$$



② we know that $s = ut + \frac{1}{2}at^2$ Here $u=0$; $a=g$

Total distance travelled in t_1 sec

$$s_1 = \frac{1}{2}gt_1^2 \Rightarrow s_1 = h \Rightarrow h = \frac{1}{2}gt_1^2 \Rightarrow t_1 = \sqrt{\frac{2h}{g}}$$

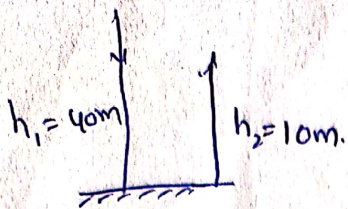
Distance travelled in t_2 & t_3 sec is $s_2 = \frac{1}{2}g(t_1+t_2)^2$; $s_3 = \frac{1}{2}g(t_1+t_2+t_3)^2$

$$s_2 = 2h \Rightarrow t_1+t_2 = \sqrt{\frac{2(2h)}{g}} \quad s_3 = 3h; t_1+t_2+t_3 = \sqrt{\frac{2(3h)}{g}}$$

$$\therefore t_1 : (t_1+t_2) : (t_1+t_2+t_3) = \sqrt{\frac{2h}{g}} : \sqrt{\frac{2(2h)}{g}} : \sqrt{\frac{2(3h)}{g}} = 1 : \sqrt{2} : \sqrt{3}$$

$$\Rightarrow t_1 : t_2 : t_3 = 1 : \sqrt{2}-1 : \sqrt{3}-\sqrt{2} = 1 : 0.41 : 0.32$$

③



Let the contact time Δt (or) $t = 0.02s$

$$v = \sqrt{2gh_1} \quad ; \quad u = \sqrt{2gh_2}$$

v & u are in opp direction

$$\therefore \langle \text{acceleration} \rangle = \frac{v - (-u)}{t} = \frac{\sqrt{2gh_1} + \sqrt{2gh_2}}{t}$$

$$= \frac{\sqrt{2g} [\sqrt{h_1} + \sqrt{h_2}]}{t} = \frac{\sqrt{2 \times 9.8} [\sqrt{40} + \sqrt{10}]}{0.02}$$

$$= \frac{\sqrt{196} (2+1)}{2 \times 10^{-2}} = \frac{7 \times 3 \times 10^2}{2}$$

$$= 2100 \text{ m/s}^2$$

④

First ball.

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

$$\Rightarrow 78.4 = 0 \times t + \frac{1}{2}(9.8)t^2$$

$$\Rightarrow 78.4 = \frac{9.8}{2} t^2$$

$$\Rightarrow t^2 = \frac{2 \times 78.4}{9.8} = 2 \times 8$$

$$\Rightarrow t^2 = 16 \Rightarrow t = 4 \text{ sec.}$$

For second ball, gt is thrown 2 sec later so time $t = 2 \text{ sec}$

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

$$\Rightarrow 78.4 = u(2) + \frac{1}{2}9.8(2)^2$$

$$\Rightarrow 78.4 = 2u + 19.6$$

$$\Rightarrow 2u = 78.4 - 19.6$$

$$\Rightarrow 2u = 58.8$$

$$\Rightarrow u = 29.4 \text{ m/s}$$

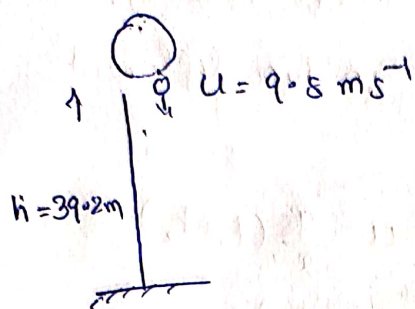
⑤

Given $t_1 = 3 \text{ sec} ; t_2 = 13 \text{ sec}$

The velocity of bullet with which it is projected

$$u = \frac{g}{2} (t_1 + t_2) = \frac{10}{2} (3 + 13) = 5 + 16 = 80 \text{ m/s}$$

⑥



In this case the velocity of stone is same as that of balloon at the time of dropping.

$\therefore$ the displacement of the stone is

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

$$\Rightarrow 39.2 = -9.8t + \frac{1}{2} \cdot 9.8t^2$$

$$\Rightarrow 39.2 = -9.8t + 4.9t^2$$

$$\Rightarrow 8 = -2t + t^2$$

$$\therefore t^2 - 2t = 8$$

$$\Rightarrow t^2 - 2t - 8 = 0$$

$$\Rightarrow t^2 - 4t + 2t - 8 = 0$$

$$\Rightarrow t(t-4) + 2(t-4) = 0$$

$$\Rightarrow (t-4)(t+2) = 0$$

$$(i.e.) t-4=0 \text{ or } t+2=0$$

$$\Rightarrow t = 4 \text{ sec}$$

$t = -2 \text{ sec}$ but NO Negative values for time.

⑦

Given $H_{\text{max}} = 50\text{m}$; $u_1 = 4$

If the velocity is doubled $u' = 2u$
let H' be the maximum height reached.

$$\text{From } H_{\text{max}} = \frac{u^2}{2g}$$

$$\Rightarrow H_{\text{max}} \propto u^2$$

$$\Rightarrow \frac{H'}{H_{\text{max}}} = \left[\frac{u'}{u_1} \right]^2$$

$$\Rightarrow \frac{H'}{50} = \left[\frac{2 \cdot 4}{4} \right]^2$$

$$\Rightarrow \frac{H'}{50} = 2^2$$

$$\Rightarrow H' = 2^2 \times 50 = 200\text{m}$$

⑧

⑧

when the lift is accelerating downwards
then the relative acceleration of the lift is

$$a' = g - a$$

$$= 9.8 - 1.8$$

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

$\therefore$ The time of descent

$$t = \sqrt{\frac{2h}{a'}} = \sqrt{\frac{2 \times 2}{8}}$$

$$t = \sqrt{\frac{4}{8}} = \sqrt{\frac{1}{2}}$$

$$t = \frac{1}{\sqrt{2}} \text{ sec}$$

(9) let u be the velocity of projection, $u = 39.2 \text{ m/s}$
 If the body reaches a point in two different intervals of time. Then the

$$\text{velocity of projection } u = \frac{g}{2} (t_1 + t_2)$$

$$\Rightarrow 39.2 = \frac{4.9}{2} (t_1 + t_2)$$

$$\Rightarrow 39.2 = 4.9 (t_1 + t_2)$$

$$\Rightarrow t_1 + t_2 = 8 \text{ sec}$$

(10) let ' n ' be the time taken by the body to reach ground $\therefore$ From $s = ut + \frac{1}{2}at^2$

For a Freely falling body $u=0$; $a=g$; $s=h$

$$\therefore h = 0 \times n + \frac{1}{2}gn^2 \Rightarrow h = \frac{1}{2}gn^2$$

Distance travelled by the body in the last second of

$$\text{fall is } S = \frac{g}{2} (2n-1) \quad \text{here } S = \frac{7h}{16}$$

$$\Rightarrow \frac{7h}{16} = \frac{g}{2} (2n-1)$$

$$\Rightarrow 7n^2 - 28n - 4n + 16 = 0$$

$$\Rightarrow 7n(n-4) - 4(n-4) = 0$$

$$\Rightarrow (n-4)(7n-4) = 0$$

$$\Rightarrow n-4=0 \quad \text{or} \quad 7n-4=0$$

$$\Rightarrow n = 4 \text{ sec}$$

$$\Rightarrow 7n^2 = 32n - 16$$

$$\therefore \text{From } h = \frac{1}{2}gn^2$$

$$= \frac{1}{2} \times 10 \times 4^2 = 5 \times 16$$

$$h = 80 \text{ m}$$

$$\Rightarrow 7n^2 - 32n + 16 = 0$$

(11)

Given that the body is projected with a velocity $u = 29.23 \text{ m/s}$.

In case of vertically projected body $a = -g$

From $S = ut + \frac{a}{2}(2n-1) \rightarrow (1)$

let us know the time of ascent $t_a = \frac{u}{g} = \frac{29.23}{9.8}$

$$t_a = 3 \text{ sec}$$

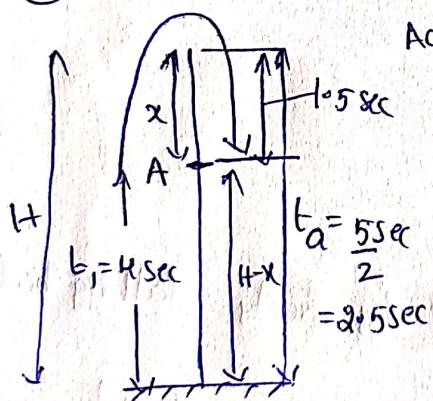
$\therefore$ in last sec $S = 29.23 - \frac{g}{2}(2 \times 3 - 1)$

$$= 29.23 - 4.9[6-1]$$

$$= 29.23 - 24.5$$

$$= 4.73 \approx 4.9 \text{ m}$$

(12)



Acc to Given question Time of flight = 5 sec

$$\therefore \text{time of ascent} = \text{time of descent} = 2.5 \text{ sec}$$

$$\frac{u}{g} = 2.5 \Rightarrow u = 2.5g$$

$\therefore$ Maximum height reached by the

body is $H = \frac{u^2}{2g} \Rightarrow H = \frac{(2.5g)^2}{2g}$

$$\Rightarrow H = \frac{(2.5)^2 \times g^2}{2g} = \frac{6.25 \times g}{2}$$

$$\Rightarrow H = \frac{6.25 \times 10}{2} = 6.25 \times 5$$

$$\Rightarrow H = 31.25 \text{ m.}$$

Now From Max height

$u = 0$; Already 2.5 sec are

over so to reach A, the

body must travel 1.5 sec

more.

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

$$H - x = 0 \times (1.5) + \frac{1}{2} \times g(1.5)^2$$

$$\Rightarrow 31.25 - x = 0 + \frac{1}{2} \times 10 \times 2.25$$

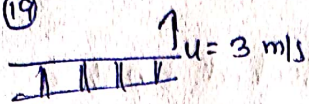
$$\Rightarrow 31.25 - x = 5 \times 2.25$$

$$\Rightarrow 31.25 - x = 11.25$$

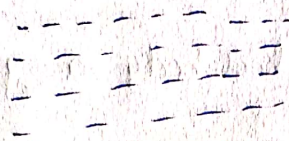
$$\Rightarrow x = 20 \text{ m.}$$



⑦ ⑧ ⑨



Total time taken to reach the water = 2 sec.



In this case
 $a = -g$

Height of the bridge is determined
By using $s = ut + \frac{1}{2}at^2$

$$h = -3 \times 2 + \frac{1}{2} \times 10 \times 2^2$$

$$= -6 + 5 \times 4 = 20 - 6 = 14 \text{ m}$$

let $H_{\max}$ = maximum height reached by the stone

$$H_{\max} = \frac{u^2}{2g} = \frac{3^2}{2 \times 10} = \frac{9}{20} = 0.45 \text{ m}$$

In this case displacement of the stone is nothing but height of the bridge from water.

$$\therefore \text{Displacement} = 14 \text{ m}$$

L Task

SAQ

① let 'h' be the distance travelled by freely falling body in 'n' sec

$$\therefore \text{From } s = ut + \frac{1}{2}at^2 \quad (a=0; a=g)$$

$$= h = 0 \times n + \frac{1}{2}gn^2$$

$$= h = \frac{g}{2}n^2 \rightarrow \text{①}$$

distance travelled by the body in last sec is $\frac{11h}{36}$

$$\therefore \text{From } s = u + \frac{g}{2}(2n-1)$$

$$= \frac{11h}{36} = 0 + \frac{g}{2}(2n-1)$$

(9)

∴ From ①

$$\Rightarrow \frac{11}{36} \left(\frac{1}{2} g n^2 \right) = \frac{g}{2} (2n-1) \quad \Rightarrow 11n(n-6) - 6(n-6) = 0$$

$$\Rightarrow \frac{11}{36} n^2 = 2n-1 \quad \Rightarrow (n-6)(11n-6) = 0$$

$$\Rightarrow 11n^2 = 72n - 36 \quad \Rightarrow n-6=0 \text{ (or) } 11n-6=0$$

$$\Rightarrow 11n^2 - 72n + 36 = 0 \quad \Rightarrow n = 6 \text{ sec.}$$

$$\Rightarrow 11n^2 - 66n - 6n + 36 = 0$$

∴ From ①

$$h = \frac{1}{2} \times g \times 6^2$$

$$h = \frac{1}{2} \times 10 \times 36 = 180 \text{ m}$$

(2)

For a Freely falling body $u=0$; $a=g=10 \text{ m/s}^2$

$$\text{For } u \text{ sec the } v = gt \Rightarrow v = g(u)$$

$$\Rightarrow v = 40 \text{ m/s}$$

After u sec, gravity ceases i.e. $g=0$

∴ Distance travelled in next 3 sec is

$$S = vt = 40 \times 3 = 120 \text{ m}$$

(3)

The height from which the body dropped $= 125 \text{ m}$

$$\therefore \text{Time of descent } t_d = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 125}{10}} = \sqrt{\frac{250}{10}} = \sqrt{25} = 5 \text{ sec}$$

Distance travelled in the last sec

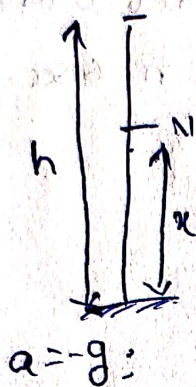
$$S_n = \frac{g}{2} (2n-1) = \frac{10}{2} (2(5)-1)$$

$$S_n = 5(10-1) = 5 \times 9 = 45 \text{ m.}$$



⑤ For ⑦ also

let 'u' be the velocity of projection and 'h' is the maximum height reached by the body.



$$H_{\max} = \frac{u^2}{2g} \Rightarrow h = \frac{u^2}{2g} \Rightarrow h \propto u^2$$

If the velocity of projection $v = \frac{u}{3}$ then the distance travelled is x from ground.

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

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

$$\Rightarrow \frac{u^2}{9} - u^2 = -2gx$$

$$\Rightarrow \frac{8u^2}{9} = 2gx$$

$$\Rightarrow x = \frac{8}{9} \frac{u^2}{2g}$$

$$\Rightarrow x = \frac{8}{9} h \text{ from ground.}$$

⑥

let $u = 58.8 \text{ m/s}$ be the velocity of projection

After 3 sec velocity $v = u + at$ [$a = g = 9.8 \text{ m/s}^2$]

$$\Rightarrow v = 58.8 + (-9.8) \times 3$$

$$= 58.8 - 29.4$$

$$v = 29.4 \text{ m/s}$$

After 3 sec acceleration due to gravity disappears

(i.e., the body is moving with uniform velocity.

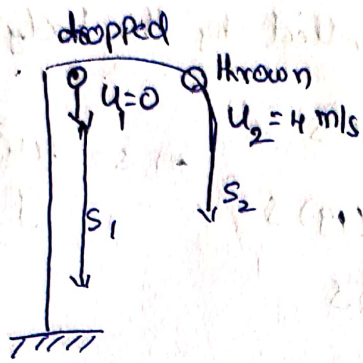
$$\text{in next 5 sec distance} = v \times t$$

$$= 29.4 \times 5$$

$$s = 147.0 \text{ m}$$

⑦

Given body is a freely falling body so; $u=0$; $a=g$



in a time 't' sec

s_1 = distance travelled by dropped body

$$s_1 = u_1 t + \frac{1}{2} a t^2$$

$$s_1 = 0 \times t + \frac{1}{2} g t^2$$

$$s_1 = \frac{1}{2} g t^2$$

s_2 = distance travelled by thrown body [$a=g$]

$$\therefore s_2 = u_2 t + \frac{1}{2} a t^2$$

$$s_2 = 4t + \frac{1}{2} g t^2 \rightarrow (2)$$

Given $s_1 = s_2 = 30 \text{ m}$

$$\Rightarrow \frac{1}{2} g t^2 = [4t + \frac{1}{2} g t^2] = 30$$

$$\Rightarrow 4t + \frac{1}{2} g t^2 - \frac{1}{2} g t^2 = 30$$

$$\Rightarrow 4t = 30$$

$$\Rightarrow t = \frac{30}{4}$$

$$\Rightarrow t = 7.5 \text{ sec}$$

⑧

Let 'H' be the max height reached by the body

$$H = \frac{u^2}{2g} \rightarrow (1)$$

At half of max height; Velocity $v = 49 \text{ m/s}$

$$\therefore \text{From } v^2 - u^2 = 2as \quad [a = -g; s = \frac{H}{2}]$$

$$\Rightarrow (49)^2 - u^2 = 2(-g) \frac{H}{2}$$

$$\Rightarrow (49)^2 - u^2 = -g \times \frac{u^2}{2g}$$

$$\Rightarrow (49)^2 - u^2 = -\frac{u^2}{2}$$

$$\Rightarrow (49)^2 = -\frac{u^2}{2} + u^2$$

$$\Rightarrow (49)^2 = \frac{u^2}{2}$$

$$\Rightarrow H = 245 \text{ m}$$

Already body is at $\frac{H}{2}$, so the further height raised by the body = $\frac{H}{2} = 122.5 \text{ m}$

⑧

for ⑩ ⑫ also

velocity of Projection = u ; Here $a = g$

velocity with which the body reaches ground $v = 30$

let s be the distance travelled by the body

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

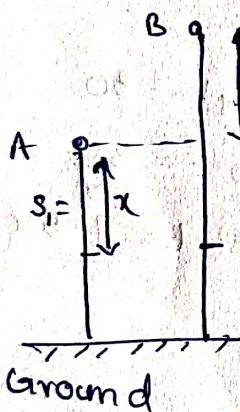
$$\Rightarrow (30)^2 - u^2 = 2(1g)s$$

$$\Rightarrow 900 - u^2 = 2gs$$

$$\Rightarrow 4g u^2 = 2gs$$

$$\Rightarrow s = \frac{4u^2}{g}$$

⑩



Here two balls are dropped at a time and both are freely falling bodies

(ie) $u = 0$; $a = g$ [for two bodies]

$t = 2 \text{ sec}$

$s_1 = x$ = distance travelled by 1st body

$s_2 = 6 + x$ = distance travelled by 2nd body

so after 2nd sec $s_2 - s_1 = 6 + x - x$

$$= 6 \text{ m}$$

For ⑬ ⑭ ⑮

Given $u = 50 \text{ m/s}$

Distance travelled in 6th sec

$$S_n = u - \frac{g}{2} (2n-1) = 50 - \frac{10}{2} (2(6)-1)$$

$$= 50 - 5 (12-1) = 50 - 5 \times 11$$

$$= 50 - 55 = -5 \text{ m}$$

ie the body is in downward motion.
and covered 5m in downward journey

maximum height reached

$$h_{\max} = \frac{u^2}{2g} = \frac{(50)^2}{2(10)} = \frac{2500}{2 \times 10}$$
$$= \frac{250}{2} = 125 \text{ m}$$

The time taken to reach max height

$$t_a = \frac{u}{g} = \frac{50}{10} = 5 \text{ sec.}$$

s_1 = distance travelled in n^{th} sec of upward motion

$$s_1 = u - \frac{g}{2}(2n-1) \quad \text{Here } n=1$$

$$= 50 - \frac{10}{2}(2(1)-1)$$

$$= 50 - 5(2-1) = 50 - 5 = 45 \text{ m.}$$

s_2 = distance travelled in n^{th} sec of downward motion
in this the body behaves like Freely falling body

$$\text{so } u=0 ; a=+g ; n=1$$

$$\therefore s_2 = u + \frac{g}{2}(2n-1)$$

$$s_2 = 0 + \frac{10}{2}(2(1)-1)$$

$$= 5(2-1)$$

$$= 5$$

$$\therefore s_1, s_2 = 45 : 5 = 9 : 1.$$

$\Rightarrow$