

Qs-6 7th advanced
FFB
THANK

①

Given stone is freely falling body

Given $t_d = \sqrt{\frac{2h}{g}}$

$$\Rightarrow 4.2 = \sqrt{\frac{2h}{9.8 \times 4.9}}$$

$$\Rightarrow (4.2)^2 = \frac{h}{4.9} \Rightarrow h = (4.2)^2 \times 4.9$$

$$\Rightarrow h = 86.44 \text{ m}$$

②

Given $h = 65 \text{ m}$, Given body is a freely falling body

$$t_d = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 65}{9.8}} = \sqrt{13.3} = 3.64 \text{ sec}$$

③

$$h = 65 \text{ m}$$

velocity of a freely falling body to reach ground

$$v = \sqrt{2gh} = \sqrt{2 \times 10 \times 65} = \sqrt{1300} = 36 \text{ m/sec}$$

④

$$\frac{t_{d1}}{t_{d2}} = \frac{1}{2} ; \text{ we know that } t_d = \sqrt{\frac{2h}{g}}$$

$$t_d^2 \propto h \Rightarrow \frac{t_{d1}^2}{t_{d2}^2} = \left(\frac{1}{2}\right)^2 = \frac{1}{4}$$

5)

Given body in FFB : $u=0$: $g=9.8 \text{ m/s}^2$; $n=6^{\text{th}}$

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

$$\Rightarrow s_n = 0 + \frac{g}{2} (2n-1)$$

$$= 0 + \frac{9.8}{2} (12-1) = 4.9 \times 11 = 53.9 \text{ m}$$

6)

Given

$s=10 \text{ m}$ in $t=0.4 \text{ sec}$: $a=g=9.8$

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

$$10 = u(0.4) + \frac{1}{2} \times 9.8 (0.4)^2$$

$$\Rightarrow 10 = u(0.4) + 4.9 \times 0.16$$

$$\Rightarrow 10 = u \times 0.4 + 0.784$$

$$\Rightarrow u \times 0.4 = 9.2 = 23.04 \text{ m/s}$$

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

$$\Rightarrow (23.04)^2 - 0^2 = 2 \times 9.8 \times x$$

$$\Rightarrow (23.04 \times 23.04) = 19.6 x$$

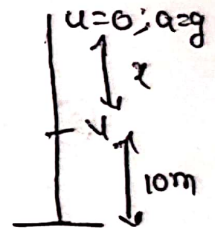
$$\Rightarrow x = \frac{23.04 \times 23.04}{19.6} = 27.08 \text{ m}$$

Total height = $x + 10 = 27.08 + 10 = 37.08 \text{ m}$

Time of descent

$$t_d = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 37.08}{9.8}}$$

$$t_d = 2.8 \text{ sec.}$$



let the required time be t .

For freely falling body we have $s = \frac{1}{2}gt^2$

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

$$= 5t^2$$

For a body thrown downwards with 1 m/s

$$s_2 = ut + \frac{1}{2}gt^2$$

$$= 1t + \frac{1}{2} \times 10t^2$$

$$= t + 5t^2$$

$$\text{Now } s_2 - s_1 = 18$$

$$t + 5t^2 - 5t^2 = 18$$

$$\Rightarrow t = 18 \text{ sec}$$

③

let $u=0$, $a=g$

Given $v = \text{displacement}$.

for a FFB

displacement = h

$$\Rightarrow \sqrt{2gh} = h$$

By squaring on both sides

$$\Rightarrow 2gh = h^2 \Rightarrow h = 2g \text{ m}$$

$$\therefore \text{velocity acquired } v = \sqrt{2gh} = \sqrt{2g \times 2g} = 2g$$

$$v = 2 \times 9.8 = 19.6 \text{ m/s}$$

④

Given time of descent $t_d = 4 \text{ sec}$

$$\Rightarrow \sqrt{\frac{2h}{g}} = 4$$

$$\Rightarrow h = 4^2 \times 4.9$$

$$= 16 \times 4.9$$

$$= 78.4 \text{ m}$$

$$= \sqrt{\frac{2h}{9.8 \times 4.9}}$$



(10)

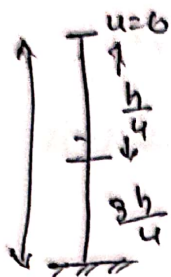
We know that $t_d = \sqrt{\frac{2h}{g}}$

$$t_d \propto \sqrt{h} \Rightarrow \frac{t_1}{t_2} = \sqrt{\frac{h_1}{h_2}} \quad t_2 = \frac{t_1}{2}$$

$$\Rightarrow \frac{t_1}{\frac{t_1}{2}} = \sqrt{\frac{h}{h_2}} \Rightarrow 2 = \sqrt{\frac{h}{h_2}}$$

on squaring both sides

$$\Rightarrow 4 = \frac{h}{h_2} \Rightarrow h_2 = \frac{h}{4}$$

in $\frac{t}{2}$ sec the body covers a distance $\frac{h}{4}$ from top $\therefore$ the body is at a height of $\frac{3h}{4}$ from ground.

(11)

Given $u=0$ $S_n = 25\text{ m}$ in last sec

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

$$\Rightarrow 25 = \frac{a}{2}(2n-1) \rightarrow (1)$$

$$\Rightarrow 50 = 10(2n-1) \Rightarrow 2n-1 = 5 \Rightarrow n = 3 \text{ sec.}$$

$$\therefore \text{height of fall} = h = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 3^2 = 5 \times 9 = 45\text{ m}$$

(14), (15), (16)

Given $h = 49\text{ m}$

$$t_d = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 49}{9.8}} = \sqrt{\frac{2 \times 49}{9.8}} = \sqrt{10} \text{ sec}$$

$$\text{velocity } v = \sqrt{2gh} = \sqrt{2 \times 10 \times 49} = 7\sqrt{20} = 31\text{ m/sec}$$

We know $t_d \propto \sqrt{h}$

$$\Rightarrow \frac{t_{d1}}{t_{d2}} = \sqrt{\frac{h_1}{h_2}} \Rightarrow \frac{\sqrt{10}}{t_{d2}} = \sqrt{\frac{h}{\frac{h}{2}}} \Rightarrow \frac{\sqrt{10}}{t_{d2}} = \sqrt{2} \Rightarrow t_{d2} = \sqrt{5} \text{ sec}$$

~~Task~~

③

17

In 2 sec

distance travelled by 2nd ball

$$h_2 = \frac{1}{2} g t_2^2 \\ = \frac{1}{2} \times 10 (2)^2 \\ = 20 \text{ m}$$

After 2 more sec. means 4 sec. distance travelled by 1st ball

$$h_1 = \frac{1}{2} g (t_2)^2 = \frac{1}{2} \times 10 (4)^2 \\ = \frac{1}{2} \times 10 \times 16 \\ = 80 \text{ m}$$

Separation b/w them $= h_1 - h_2 = 80 - 20 = 60 \text{ m}$

18

$$h = 100 \text{ m}$$

$$\text{Time of fall} = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 100}{10}} = \sqrt{20} = 2\sqrt{5} \text{ sec.}$$

Task

Ques

19

In 1st sec

$$s_1 = \frac{g}{2} (2n-1) = \frac{g}{2} (2(1)-1) = \frac{g}{2}$$

2nd sec

$$s_2 = \frac{g}{2} (2(2)-1) = \frac{g}{2} (4-1) = \frac{3g}{2}$$

3rd sec

$$s_3 = \frac{g}{2} (2(3)-1) = \frac{g}{2} (6-1) = \frac{5g}{2}$$

$$s_1 : s_2 : s_3 = \frac{g}{2} : \frac{3g}{2} : \frac{5g}{2} = 1 : 3 : 5$$

①

in 1st sec $S = 5\text{m}$; $u = gt = v = g \times$

in 4 sec. distance travelled by the body

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

$$\Rightarrow s' = 0 + \frac{1}{2}g(4)^2$$

$$= 0 + \frac{1}{2} \times 9.8 \times 16$$

$$= 78.4 \text{ m} \approx 80\text{m}$$

②

distance travelled by a freely falling body
in 3rd sec

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

$$S_n = 0 + \frac{g}{2}(2(3)-1)$$

$$S_n = 5(5) = 25\text{m} \text{ (or) } 24.5\text{m [if } g=9.8\text{m/s}^2]$$

See main level

①

Given $t = 5\text{ sec}$

distance travelled by freely falling body

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

$$= \frac{1}{2} \times 10 \times (5)^2$$

$$= 5 \times 25$$

$$= 125\text{m}$$

$v = g \cdot t$
 by the body

(4)

Given $n=4$; the body is a freely falling body
 so $u=0$; $a=g$

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

$$= 0 + \frac{10}{2} (2(4)-1)$$

$$= 5(8-1) = 35 \text{ m or } 34.3 \text{ m for } g=9.8 \text{ m/s}^2$$

(3)

Given the body is a freely falling body; Total time of descent = $t_d = n$ $a=g$; $u=0$; $s_n = 2450 \text{ cm}$
 $= 24.5 \text{ m}$

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

$$\Rightarrow 24.5 = 0 + \frac{g}{2} (2n-1)$$

$$\Rightarrow 24.5 = \frac{9.8}{2} (2n-1) \Rightarrow 2n-1 = 5 \Rightarrow 2n = 6 \Rightarrow n = 3 \text{ s}$$

$\therefore$ The height from which the body dropped $h = \frac{1}{2} g t^2$

$$\Rightarrow h = \frac{1}{2} (9.8) \times 3^2 = 4.9 \times 9 = 44.1 \text{ m}$$

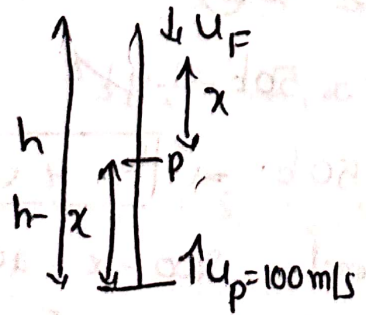
$$= 4410 \text{ cm}$$

(4)

Given

$$h = 400 \text{ m}$$

$$u = 100 \text{ m/s}$$



From $s = ut + \frac{1}{2} at^2$
 $a=g$ From F.P.B $v.P.B$; $a=-g$

$$\Rightarrow x = \frac{1}{2} g t^2 \rightarrow (1)$$

$$h-x = 100t - \frac{1}{2} g t^2 \rightarrow (2)$$

From (1) & (2)

$$\Rightarrow h - \frac{1}{2} g t^2 = 100t - \frac{1}{2} g t^2$$

$$\Rightarrow 400 = 100t \Rightarrow t = 4 \text{ sec}$$

⑤

Here the stone is a freely falling body
 $u=0$; $a=g$.

Let n be the time of descent.

Given Total distance travelled by it in last second is equal to distance covered by it in 5 sec.

$$\therefore S_n = S_5$$

$$\Rightarrow u + \frac{a}{2}(2n-1) = ut + \frac{1}{2}at^2$$

$$\Rightarrow 0 + \frac{g}{2}(2n-1) = 0 \times 5 + \frac{1}{2}g \times 5^2$$

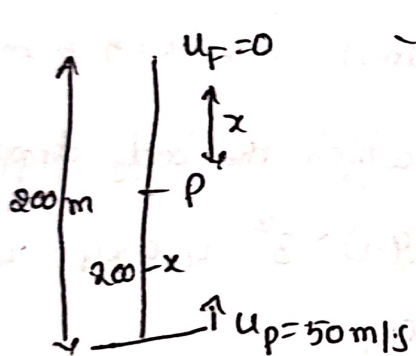
$$\Rightarrow \frac{g}{2}(2n-1) = \frac{g}{2} \times 25$$

$$\Rightarrow 2n-1 = 25$$

$$\Rightarrow 2n = 26 \Rightarrow n = 13 \text{ sec}$$

$\therefore$ The stone remains in air for 13 sec

⑥



P is meeting point

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

FFB: $a=g$; $u=0$ | VPB: $a=-g$; $s=500-x$

$s=x$

$u=50$

$$\therefore x = 0 \times t + \frac{1}{2}gt^2$$

$$\Rightarrow x = \frac{1}{2}gt^2 \rightarrow (1)$$

$$\Rightarrow 200-x = 50t - \frac{1}{2}gt^2$$

From (1) & (2)

$$\Rightarrow 200 - \frac{1}{2}gt^2 = 50t - \frac{1}{2}gt^2$$

$$\Rightarrow 200 = 50t \Rightarrow \boxed{t = 4 \text{ sec}}$$

The meeting point from ground = $200 - x = 200 - \frac{1}{2}gt^2$

$$= 200 - \frac{1}{2} \times 10 \times 4^2$$

$$= 200 - 80 = 120 \text{ m}$$

From Top = $x = \frac{1}{2}gt^2 = \frac{1}{2} \times 10 \times 16 = 80 \text{ m}$



(5)

we know for a freely falling body $u=0$, $a=g$

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

For $n=1$ $S_1 = 0 + \frac{g}{2} (2(1)-1) = \frac{g}{2}$

For $n=2$ $S_2 = 0 + \frac{g}{2} (2(2)-1) = \frac{g}{2} (4-1) = \frac{3g}{2}$

For $n=3$ $S_3 = 0 + \frac{g}{2} (2(3)-1) = \frac{g}{2} (6-1) = \frac{5g}{2}$

$\therefore S_1 : S_2 : S_3 = \frac{g}{2} : \frac{3g}{2} : \frac{5g}{2} = 1 : 3 : 5$

(8)

Given $h = 490\text{m}$. Total time of fall $= t_d = \sqrt{\frac{2h}{g}}$

$\Rightarrow t_d = \sqrt{\frac{2 \times 490}{9.8}} = \sqrt{100} = 10\text{ sec}$

in last second means 10^{th} sec.

$S_n = u + \frac{a}{2} (2n-1) = 0 + \frac{g}{2} (2(10)-1)$

$S_n = \frac{9.8}{2} (20-1) = 4.9 \times 19 = 93.1\text{m}$

(9)

we know for a freely falling body

distance travelled in t sec $S = \frac{1}{2} g t^2$

For successive sec means $t = 1, 2, 3, 4 \dots$

$S_1 \propto \frac{1}{2} g (1)^2$; $S_2 \propto \frac{1}{2} g (2)^2$; $S_3 \propto \frac{1}{2} g (3)^2$

$\Rightarrow S_1 : S_2 : S_3 = \frac{g}{2} (1)^2 : \frac{g}{2} (2)^2 : \frac{g}{2} (3)^2$

$= 1 : 4 : 9$



(10)

For a Freely falling body distance travelled

$$S_n = x \text{ in } n^{\text{th}} \text{ sec}$$

$$\therefore S_n = \frac{g}{2} (2n-1) \Rightarrow x = \frac{g}{2} (2n-1) \rightarrow \text{①}$$

The distance travelled in $(n+1)^{\text{th}}$ sec

$$S_{n+1} = \frac{g}{2} (2(n+1)-1) = \frac{g}{2} (2n+2-1)$$

$$S_{n+1} = \frac{g}{2} (2n+1)$$

$$\Rightarrow S_{n+1} = \frac{g}{2} (2n+1) - g + g$$

$$\Rightarrow \frac{g}{2} (2n) + \frac{g}{2} - g + g$$

$$\Rightarrow \frac{g}{2} (2n) - \frac{g}{2} + g \Rightarrow \frac{g}{2} (2n-1) + g$$

$$S_{n+1} \Rightarrow \underline{x+g}$$

(14)

$$\text{Given } h = 20\text{m}$$

Time taken by 1st stone to reach ground

$$t_1 = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 20}{10}} = \sqrt{4} = 2\text{sec.}$$

Here both stones are reaching ground at a time.

$$\therefore t_{d2} = 2\text{sec} = \frac{u}{g} \Rightarrow u = 2g = 2 \times 10 = 20\text{m/s}$$

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

$$\Rightarrow 20 = 2u + \frac{1}{2} \times 10 \times 2$$

$$\Rightarrow \frac{10}{10} = 2u + 10 \Rightarrow 10 = 2u + 10$$

$$t_d = \sqrt{\frac{2h}{g}}$$

$$20 = 3u + 5 \times 9$$

$$3u = 25$$

$$t_d = \frac{3}{2} = \frac{4}{g}$$



14th continuation

time of descent for 2nd stone = 1 sec

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

$$\Rightarrow 20 = u \times 1 + \frac{1}{2} \times 10(1)^2$$

$$\Rightarrow 20 = u + 5 \Rightarrow u = 15 \text{ m/s}$$

(15)

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

$$u = 2v ; u = v$$

$$\Rightarrow (2v)^2 - v^2 = 2(g)x$$

for a Freely falling body

$$s = h$$

$$v^2 = 2gh$$

$$\Rightarrow 3v^2 = 2gx$$

$$\Rightarrow 3(2gh) = 2gx$$

$$x = 3h$$

(16)

Given body is a Freely falling body $u = 0 ; a = g$

Given displacement in last second = displacement in 3 sec

$$\Rightarrow u + \frac{g}{2}(2n-1) = ut + \frac{1}{2}at^2$$

$$\Rightarrow 0 + \frac{g}{2}(2n-1) = 0 \times 3 + \frac{1}{2}g(3)^2$$

$$\Rightarrow \frac{g}{2}(2n-1) = \frac{g}{2} \times 9$$

$$\Rightarrow 2n-1 = 9$$

$$\Rightarrow 2n = 10$$

$$\Rightarrow n = 5 \text{ sec}$$