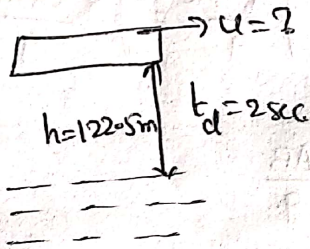


Task

①



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

$$\Rightarrow \frac{u}{g} = \sqrt{\frac{2 \times 122.5}{10}}$$

$$\Rightarrow \frac{u}{g} = \sqrt{25} = 5$$

$$\Rightarrow u = 5g = 5 \times 9.8$$

$$= 49 \text{ m/s (or 50 m/s)}$$

②

From given data

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

$$\text{Time of flight } T = \frac{2u}{g}$$

$$\Rightarrow T = \frac{2 \times 100}{10}$$

$$= 20 \text{ sec}$$

③

Given $t = 1 \text{ sec}$

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

$$= g \times 1$$

$$\Rightarrow u = g$$

$$h = \frac{u^2}{2g} = \frac{g^2}{2g} = \frac{g}{2} = \frac{9.8}{2} = 4.9 \text{ m}$$

④

Given height of top of cap from ground $h = 5 \text{ m}$

As the 3rd drop releasing from top, 1st drop touches the ground, means distance travelled by 1st drop is 5 m

$$\therefore t_d = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2 \times 5}{10}} = 1 \text{ sec}$$

Time gap between 1st and 3rd drop is 1 sec. so between

1st and 2nd drop it is 0.5 sec.

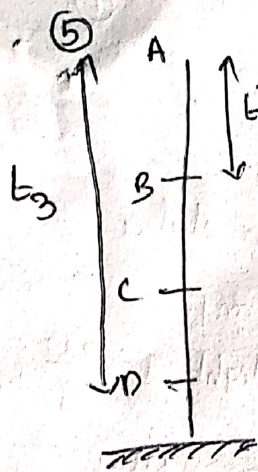
velocity of 2nd drop after 0.5 sec $v = u + at = 0 + at$

$$v = 10 \times 0.5 = 5 \text{ m/s}$$

$$\text{From } s = ut + \frac{1}{2} at^2 \Rightarrow h = vt + \frac{1}{2} g t^2$$

$$= 5 \times 0.5 + \frac{1}{2} \times 10 \times (0.5)^2$$

$$= 3.75 \text{ m}$$



From A $\rightarrow$ B

$$t_1 = t_{AB} = \sqrt{\frac{2h}{g}} = \sqrt{\frac{2AB}{g}}$$

A $\rightarrow$ C

$$t_2 = t_{AC} = \sqrt{\frac{2AC}{g}} = \sqrt{\frac{2(2AB)}{g}} \quad [AC = AB + BC, AB = BC]$$

$$\therefore t_2 = \sqrt{2} \sqrt{\frac{2AB}{g}}$$

$$h_{AD} = h_{AB} + h_{BC} + h_{CD} \quad \text{Given } AB = BC = CD$$

$$h_{AD} = 3h_{AB} = 3(AB)$$

$$t_3 = \sqrt{\frac{2h_{AD}}{g}} = \sqrt{\frac{2(3AB)}{g}} = \sqrt{3} \sqrt{\frac{2AB}{g}}$$

$$t_{C \rightarrow D} = t_3 - t_2 = \sqrt{3} \sqrt{\frac{2AB}{g}} - \sqrt{2} \sqrt{\frac{2AB}{g}} = (\sqrt{3} - \sqrt{2}) \sqrt{\frac{2AB}{g}}$$

$$t_{B \rightarrow C} = t_{AC} - t_{AB} = \sqrt{2} \sqrt{\frac{2AB}{g}} - \sqrt{\frac{2AB}{g}} = (\sqrt{2} - 1) \sqrt{\frac{2AB}{g}}$$

$$\therefore t_{AB} : t_{BC} : t_{CD} = \sqrt{\frac{2AB}{g}} : (\sqrt{2} - 1) \sqrt{\frac{2AB}{g}} : (\sqrt{3} - \sqrt{2}) \sqrt{\frac{2AB}{g}}$$

$$= 1 : (\sqrt{2} - 1) : (\sqrt{3} - \sqrt{2})$$

⑥

$$\text{For } u_1 = u \rightarrow H_1 = h$$

$$u_2 = 2u \rightarrow H_2 = ?$$

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

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

$$\Rightarrow \frac{H_1}{H_2} = \left[\frac{u_1}{u_2} \right]^2$$

$$\Rightarrow \frac{h}{H_2} = \left[\frac{u}{2u} \right]^2 = \frac{1}{2^2} = \frac{1}{4}$$

$$\Rightarrow H_2 = 4h$$

⑦

From given Body

$$u=0 ; a=g$$

For 1st sec

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

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

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

$$\text{For 4th sec ; } x = 7h = 7 \frac{g}{2}$$

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

$$\Rightarrow 7 \frac{g}{2} = 0 + \frac{g}{2}(2n-1)$$

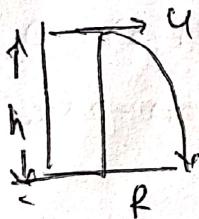
$$\Rightarrow 7 \frac{g}{2} = \frac{g}{2}(2n-1)$$

$$\Rightarrow 7 = 2n-1$$

$$\Rightarrow 2n = 7+1$$

$$\Rightarrow n = 4$$

⑧



$$R = u \sqrt{\frac{2h}{g}}$$

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

$$\textcircled{10} \quad u=0 ; a=g$$

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

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

For $n=1, 2, 3, \dots$

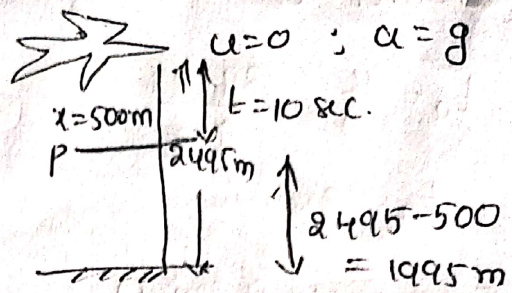
$$S_1 : S_2 : S_3 = \frac{g}{2}(2(1)-1) : \frac{g}{2}(2(2)-1) : \frac{g}{2}(2(3)-1)$$

$$= (2-1) : (4-1) : (6-1)$$

$$= 1 : 3 : 5$$

⑨

⑧



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

$$\Rightarrow v_p = 0 + g \times 10 \Rightarrow v_p = 10g = 100 \text{ m/s}$$

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

$$x = 0 \times t + \frac{1}{2} \times g (10)^2$$

$$= \frac{1}{2} \times 10 \times 100$$

$$x = 500 \text{ m}$$

$$\therefore y = 2495 - 500 = 1995 \text{ m}$$

$$\text{From } v^2 - u^2 = 2as \quad [u = v_p]$$

$$\Rightarrow v^2 - (100)^2 = 2(-2.5)(1995)$$

$$\Rightarrow v^2 - 10000 = -9975$$

$$\Rightarrow v^2 = 25 \Rightarrow v = 5 \text{ m/sec.}$$

(11)

Given $u = 29.43 \text{ m/s}$

$$t_a = \frac{u}{g} = \frac{29.43}{9.8}$$

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

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

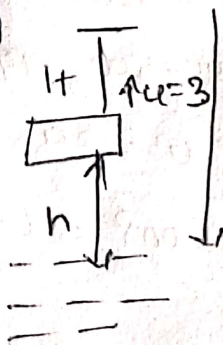
$$s = 29.43 + \left(\frac{-9}{2}\right) (2(1)-1)$$

$$= 29.43 - \frac{9 \times 8}{2} (2-1)$$

$$= 29.43 - 40.9$$

$$= 84.53 \text{ m}$$

(18)



$$t = 2 \text{ sec.}$$

$$\text{From } h = -ut + \frac{1}{2} g t^2$$

$$\Rightarrow h = -3(2) + \frac{1}{2} 10(2)^2$$

$$= -6 + 20$$

$$= 14 \text{ m}$$

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

$$= 0.45 \text{ m}$$

$$\text{Displacement} = F \cdot P - I \cdot P = \text{water - Bridge}$$

$$= 0 - h = 14 \text{ m}$$

(12)

$$u = 0; a = \frac{g}{8}; t = 8 \text{ sec}$$

$$v_{\text{balloon}} = u + at$$

$$= 0 + \frac{g}{8} \times 8$$

$$v_{\text{balloon}} = g$$

$$v_{\text{stone}} = v_{\text{balloon}}$$

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

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

$$s = \frac{1}{2} g \times 8 = 4g$$

$$\text{From } h = -ut + \frac{1}{2} g t^2$$

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

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

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

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

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

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

$$t = 4 \text{ (or)} -2 \text{ sec.}$$

①

$$l_{\text{max}} = 20 \text{ m}$$

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

$$t_a = \frac{u}{g}$$

$$\begin{aligned} \Rightarrow u &= t_a \times g \\ &= 4 \times 10 \\ &= 40 \text{ m/s} \end{aligned}$$

②

$$h_1 = 5 \text{ m} ; h_2 = 108 \text{ m}$$

$$v_1 = \sqrt{2gh_1} = v_2 = \sqrt{2gh_2}$$

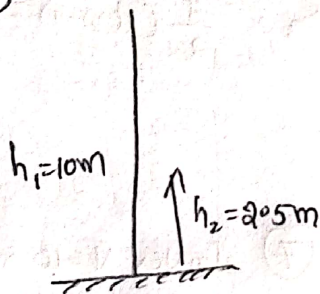
Loss of velocity on bouncing

$$\frac{v_2 - v_1}{v_1} = \frac{\sqrt{2gh_2} - \sqrt{2gh_1}}{\sqrt{2gh_1}}$$

$$= \frac{\sqrt{2g} [\sqrt{h_2} - \sqrt{h_1}]}{\sqrt{2g} \sqrt{h_1}} = \frac{\sqrt{108} - \sqrt{5}}{\sqrt{5}}$$

$$= \frac{10.34 - 2.23}{2.23} = \frac{-2}{5}$$

③



$$v_1 = \sqrt{2gh_1} ; v_2 = \sqrt{2gh_2}$$

$$t = 0.01 = 10^{-2} \text{ sec}$$

$$a = \frac{v_2 - v_1}{t} = \frac{\sqrt{2gh_2} - \sqrt{2gh_1}}{t}$$

$$= \frac{\sqrt{2g} (\sqrt{h_2} - \sqrt{h_1})}{10^{-2}}$$

$$= \frac{\sqrt{2 \times 9.8} [\sqrt{10} + \sqrt{20.5}]}{10^{-2}}$$

$$= 2106 \text{ m/s}^2$$

④

$$\text{No. of stairs} = 25 \uparrow$$

$$h = nx$$

$x \rightarrow$ height of each stair



$$u = 0$$

$$a = g$$

$$t = 5 \text{ sec}$$

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

$$\Rightarrow 5 = \sqrt{\frac{2 \times h}{10.5}}$$

$$\Rightarrow 5 = \sqrt{\frac{h}{5}}$$

$$\Rightarrow h = 125$$

$$\Rightarrow nx = 125$$

$$\Rightarrow 25x = 125$$

$$\Rightarrow x = 5 \text{ m}$$

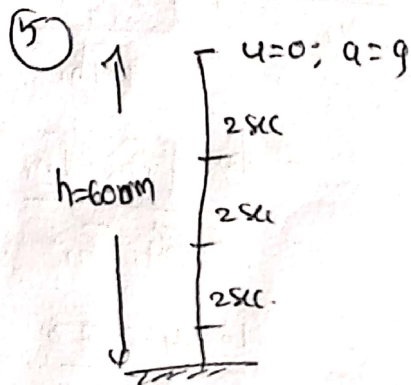
(4)th continuation

let p be the no. of stairs crossed.

in $t = 1$ sec.

$$t = \sqrt{\frac{2px}{g}} \Rightarrow 1 = \sqrt{\frac{2 \times p \times 5}{10}}$$

$$\Rightarrow p = 1$$



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

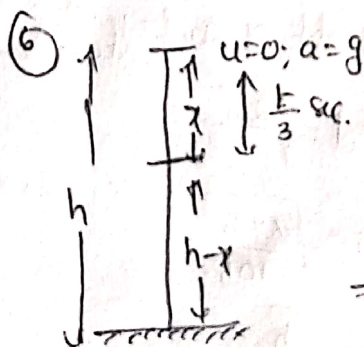
$$\therefore s_n = \frac{g}{2} (2n-1)$$

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

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

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

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



$$\frac{h}{x} = \left(\frac{t}{\frac{t}{3}}\right)^2$$

$$\Rightarrow \frac{h}{x} = 9$$

$$\Rightarrow x = \frac{h}{9}$$

$$t_1 \rightarrow t \Rightarrow h_1 = h$$

$$t_2 = \frac{t}{3} \rightarrow h_2 = x$$

$$h \propto t^2$$

$$\frac{h_1}{h_2} = \left(\frac{t_1}{t_2}\right)^2$$

Position from ground

$$= h - x$$

$$= h - \frac{h}{9}$$

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

(7) Given $v = 10 \text{ m/sec}$, $s = \frac{H}{2}$

$$H_m = \frac{u^2}{2g} = \frac{u^2}{2 \times 9.8}$$

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

$$\Rightarrow 10^2 - u^2 = 2(9.8)\left(\frac{H}{2}\right)$$

$$\Rightarrow 100 - 2gH = -gH$$

$$\Rightarrow 100 = -gH + 2gH$$

$$\Rightarrow 100 = gH$$

$$\Rightarrow H = \frac{100}{g} = \frac{100}{10} = 10\text{m}$$

(4)

(8)

Given $m = 100 \text{ gm} = 10^{-1} \text{ kg}$

$u = 5 \text{ m/s}$

$W = mgh \cos \theta$
 $\theta = 180^\circ$

$W = 10^{-1} \times 10 \times \frac{u^2}{2g} (-1)$

$= -\frac{5^2}{2 \times 10} = -1.25 \text{ J}$

(9)

$H = 5 \text{ m} \quad T_a = \frac{u}{g}$

$\Rightarrow t_a = \frac{10}{10} = 1 \text{ sec}$

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

$\Rightarrow 5 = \frac{u^2}{2 \times 10} \Rightarrow u^2 = 2 \times 10 \times 5$

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

(11)

$u_1 = u \quad ; \quad u_2 = \frac{u}{3}$

$H_1 = h \quad ; \quad H_2 = x$

$H \propto u^2$

$\Rightarrow \frac{H_1}{H_2} = \left[\frac{u_1}{u_2} \right]^2$

$\Rightarrow \frac{h}{x} = \left[\frac{u}{\frac{u}{3}} \right]^2$

$\Rightarrow \frac{h}{x} = 3^2$

$\Rightarrow x = \frac{h}{9}$

(12)

$A \quad u=0; a=g$
 $5 \text{ m} \quad x, t=1 \text{ sec}$

P, v_p

$15 \text{ m} \quad (20-x)$

From $A \rightarrow P$

$v_p = u + at$
 $= 0 + g(1)$

$v_p = 10 \text{ m/s}$

From

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

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

$\Rightarrow x = \frac{g}{2} = \frac{10}{2} = 5$

$t = \frac{s}{v_p} = \frac{15}{10} = 1.5 \text{ s}$

(17), (18), (19)

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

$n = 6$

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

$\Rightarrow s_6 = 50 - \frac{10}{2} (2(6)-1)$

$= 50 - 5(11)$

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

(20)

$\downarrow s_1 = -5 \text{ m} = s_6$

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

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

$= 50 - 5$

$= 45$

$\frac{s_1 \uparrow}{s_6 \downarrow} = \frac{45}{5} = \frac{9}{1}$

(21)

$H = \frac{u^2}{2g}$

$= \frac{(50)^2}{2 \times 10}$

$H = 125 \text{ m}$