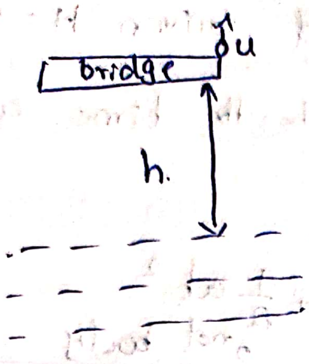
(1)



Here the velocity of projection $u = 3\ m/sec$

time taken to reach ground = 2s.

$\therefore$ Height of bridge

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

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

$$= -6 + (10) \times 2$$

$$= -6 + 20$$

$$h = 14\,m$$

(2) Let u be the velocity with which stone was projected i.e. Given $u = v$

The velocity with which the stone reach ground $v = 2v$.

$\therefore$ From $v^2 - u^2 = 2as$ Here $a = g$; $s = h$

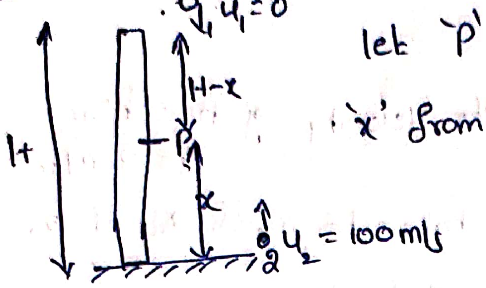
$$\Rightarrow (2v)^2 - v^2 = 2gh$$

$$\Rightarrow 4v^2 - v^2 = 2gh$$

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

$$\Rightarrow h = \frac{3v^2}{2g}$$

(3)



let 'p' is meeting point, whose position is 'x' from the ground. Given $H = 300\,m$

Let 't' be the time after which 2' bodies are meet at P.

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

1 stone (or) body — Freely Falling: $u_1 = 0;\ a_1 = g;\ s_1 = H-x$

2nd body — Vertically Projected: $u_2 = 100\,m/s;\ a_2 = -g;\ s_2 = x$

$\therefore H - x = u_1 t + \frac{1}{2}gt^2$

$\Rightarrow H - x = 0 \times t + \frac{1}{2}gt^2$

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

$x = u_2 t + \frac{1}{2}(-g)t^2$

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

From (1) & (2) we get

$\therefore H - (100t - \frac{1}{2}gt^2) = \frac{1}{2}gt^2$

$\Rightarrow 300 - 100t + \cancel{\frac{1}{2}gt^2} = \cancel{\frac{1}{2}gt^2}$

$\Rightarrow 300 - 100t = 0 \Rightarrow 100t = 300$

$\Rightarrow t = 3\,sec.$

$\therefore$ From (1) $H - x = \frac{1}{2}gt^2$

$\Rightarrow 300 - x = \frac{1}{2} \times 10 \times 3^2$

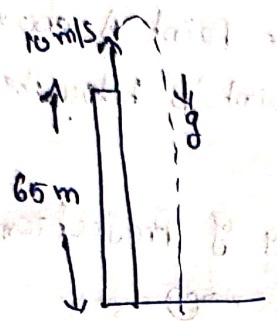
$\Rightarrow 300 - x = 5 \times 9$

$\Rightarrow 300 - x = 45 \Rightarrow x = 300 - 45$

$\Rightarrow x = 255\,m$

Both bodies meet after '3' sec of their start at a height 255m from ground.

4



let the velocity of projection $u = 10$ m/s.

Height of cliff $= h = 65$ m

The velocity of the stone just before reaching the ground is calculated from

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

$$\Rightarrow v^2 - 10^2 = 2 \times g \times h$$

$$\Rightarrow v^2 - 100 = 2 \times 10 \times 65$$

$$\Rightarrow v^2 - 100 = 1300$$

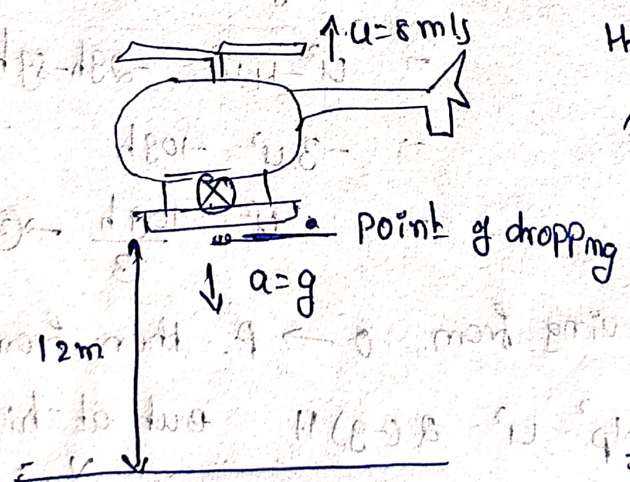
$$\Rightarrow v^2 = 1400$$

$$\Rightarrow v = \sqrt{1400} \approx 37 \text{ m/s}$$

5

Here Given that helicopter is ascending with a speed $u = 8$ m/s.

At the time of dropping the speed of food packet is same as that of helicopter.



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

$$\Rightarrow 12 = -8t + \frac{1}{2} \times 10 \times t^2$$

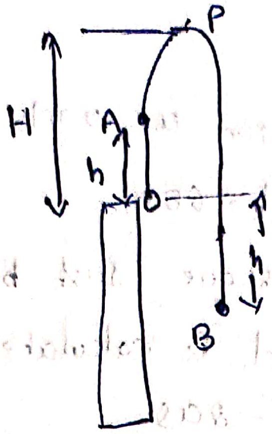
$$\Rightarrow 12 = -8t + 5t^2$$

$$\Rightarrow 5t^2 - 8t - 12 = 0$$

Then the roots for 't' can be calculated by using $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a} = \dfrac{-(-8) \pm \sqrt{(-8)^2 - 4(5)(-12)}}{2 \times 5}$

$$t = \frac{8 \pm \sqrt{64 + 240}}{10} = 2.54 \text{ sec}$$

(6)



let H = Height reached by a ball from 'O'
h = height of the Point 'A' above Top and the point 'B' below the top of a tower.

'u' be the velocity of Projection

From $v^2 - u^2 = 2as \rightarrow (1)$

For 'B' $v_B^2 - u^2 = 2gh$ [Ball is in downward journey]

For 'A' $v_A^2 - u^2 = 2(-g)h$ [Ball is moving up]

$\Rightarrow v_A^2 - u^2 = -2gh$

In the question given $v_B = 2v_A$

$\Rightarrow v_B^2 = 4v_A^2$

$\Rightarrow [u^2 + 2gh] = 4(u^2 - 2gh)$

$\Rightarrow u^2 + 2gh = 4u^2 - 8gh$

$\Rightarrow u^2 - 4u^2 = -2gh - 8gh$

$\Rightarrow -3u^2 = -10gh$

$\therefore u^2 = \frac{10gh}{3} \rightarrow (2)$

As the ball moving from $O \rightarrow P$ then from (1)

$v_P^2 - u^2 = 2(-g)H$ But at highest point P $v_P = 0$

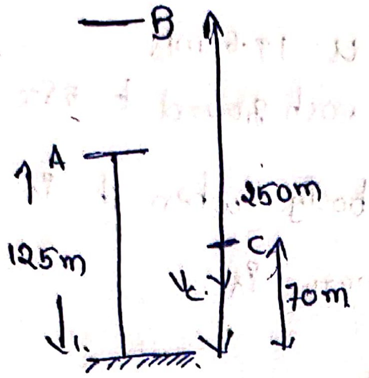
$\Rightarrow 0^2 - u^2 = -2gH$

$\Rightarrow \cancel{-}u^2 = \cancel{-}2gH$

$\Rightarrow \frac{\cancel{10}^{5} \cancel{g} h}{3} = \cancel{2}\cancel{g}H$ [From 2]

$\Rightarrow H = \frac{5h}{3}$

⑦



Let 'B' be the highest point reached by the body.

For the journey $A \to B$:

Initial velocity $= u$.

Displacement $s = 250-125$
$= 125m$.

Acceleration $a = -g = -10\ m/s^2$

Final velocity $V_B = 0$

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

$\Rightarrow 0^2 - u^2 = 2(-10)(125)$

$\Rightarrow u^2 = 2500$

$\Rightarrow u = \sqrt{2500} = 50\ m/s$

Now for $A \to C$:

$u = 50\ m/s$; $V_c = V_c$

Displacement $= S_{AC} = -(125-70)$
$= -55\ m$.

Acceleration $a = -g = -10\ m/s^2$

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

$\Rightarrow V_c^2 - (50)^2 = 2(-10)(-55)$

$\Rightarrow V_c^2 - 2500 = 1100$

$\Rightarrow V_c^2 = 3600 \Rightarrow V_c = \sqrt{3600} = 60\ m/s$

(8) let the velocity of projection $u = 19.6$ m/s

Time taken by the body to reach ground $t = 5$ sec

$\therefore$ The displacement of the body when it is projected from top of a tower is

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

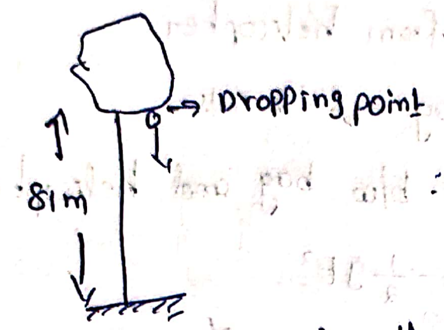
$$\Rightarrow h = -19.6(5) + \frac{1}{2}(\overset{4.9}{\cancel{9.8}})(5)^2$$

$$\Rightarrow h = -98.0 + 122.5$$

$$= 24.5 \text{ m}$$

(9)

(10)



At the time of dropping

$V_{Body} = V_{Balloon} = 12\ m/s$

∴ The displacement of the body = Height from which it is dropped

∴ the height can be calculated by using

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

$$\Rightarrow 81 = -12t + \frac{1}{2} \times 10\,t^2$$

$$\Rightarrow 81 = -12t + 5t^2$$

$$\Rightarrow 5t^2 - 12t - 81 = 0$$

This is in the form of quadratic equation $ax^2+bx+c=0$

∴ Roots for $x = \frac{-b \pm \sqrt{b^2-4ac}}{2a}$. Here $x = t$

$$= \frac{-(-12) \pm \sqrt{(-12)^2 - 4(5)(-81)}}{2 \times 5}$$

$$= \frac{12 \pm \sqrt{144 + 1620}}{10}$$

$$= \frac{12 \pm \sqrt{1764}}{10} = \frac{12 \pm 42}{10}$$

$$= \frac{12+42}{10} \text{ (or) } \frac{12-42}{10}$$

$$= \frac{54}{10}$$

There is No '-ve' value for time.

$t = 5.4$ sec

(15) For (i) (ii)

Here the bag is dropped from helicopter.

So the velocity of bag $u = 2$ m/s.

Then the seperation b/w bag and helicopter after '2' sec is $h = ut - \frac{1}{2}gt^2$

$$= 2\times2 - \frac{1}{\cancel{2}}(9.8)2^{\cancel{2}}$$

$$= 4 - (9.8)2$$

$$= 4 - 19.6\ m$$

$$= -15.6m$$ Because the bag is moving in downward direction it's displacement is -ve.

The velocity of bag after '2' sec

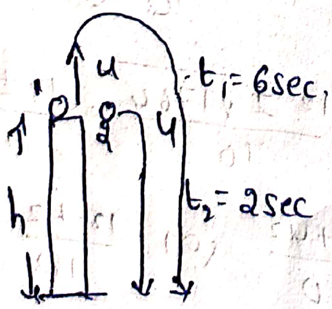
$$V = u - gt$$

$$= 2 - (9.8)\times2$$

$$= 2 - 19.6$$

$$= -17.6\ m/s$$

(16)



For Ist body $h = -ut_1 + \frac{1}{2}gt_1^2$

$$\Rightarrow h = -6u + \frac{g}{2}(6)^2$$

$$h = -6u + 18g \rightarrow (1)$$

For 2nd stone $h = ut_2 + \frac{1}{2}gt_2^2$

$$\Rightarrow h = 2u + \frac{1}{2}g(2)^{\cancel{2}}$$

$$\Rightarrow h = 2u + 2g \rightarrow (2)$$

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From ① and ② we get

$\Rightarrow 2u+2g = -6u+18g$

$\Rightarrow 8u = 16g$

$\Rightarrow u = 2g$

sub 'u' value in ② we get

$\Rightarrow h = 2(2g)+2g$

$= 4g+2g$

$= 6g$

$h = 60\,m$

(17)

Given balloon starts from rest i.e $u=0$

It's acceleration $a = \frac{g}{8}$, After 8 sec from start

The velocity of balloon is $v = u+at$

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

$\Rightarrow v = g\ m/s$

The height to which balloon was rised is 'h'. From this height the stone was released from balloon.

$\therefore h = ut+\frac{1}{2}at^2 \Rightarrow h = 0\times 8+\frac{1}{2}\times\frac{g}{8}(8)^2$

$\Rightarrow h = \frac{1}{\cancel{2}}\times\frac{g}{\cancel{8}}\times \cancel{64}\,8\,4$

$\Rightarrow h = 4g.$

$\therefore$ For stone $h = -ut+\frac{1}{2}gt^2$ [Here $u=v$]

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

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

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

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

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

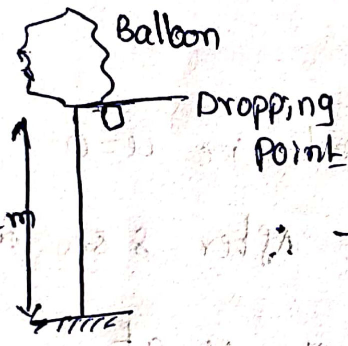
$\Rightarrow (t-4)(t+2) = 0$

i.e $t = 4$ (or) -2 but No -ve' values for time

. So correct ans is $t = 4$ sec.

1 Task SAQ's

(1)



The velocity of the packet = velocity of Balloon at the time of dropping.

∴ The displacement of package = Height from which it was dropped. It can be. calculated by using $h = -ut + \frac{1}{2}gt^2$

$\Rightarrow 39.2 = -9.8t + \frac{1}{2}(\overset{4.9}{\cancel{9.8}})t^2$

$\Rightarrow \overset{8}{\cancel{39.2}} = -\overset{2}{\cancel{9.8}}t + \cancel{4.9}t^2$

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

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

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

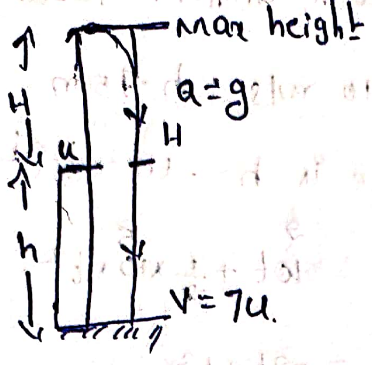
$\Rightarrow t(t-4) + 2(t-4) = 0$

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

(i.e) $t = 4s$ (or) -2 sec

No -ve' values for time so 4s is correct

(2)



Here H = Maximum height reached by the body from top of tower

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

The displacement of the body = h, this can be calculated by using $v^2 - u^2 = 2as$

$$\Rightarrow (7u)^2 - u^2 = 2gh$$

$$\Rightarrow 49u^2 - u^2 = 2gh$$

$$\Rightarrow 48u^2 = 2gh$$

$$\Rightarrow h = \frac{48}{2g}u^2$$

$\therefore$ The total distance travelled by the body

$$= H + H + h$$

$$= \frac{u^2}{2g} + \frac{u^2}{2g} + \frac{48 \cdot u^2}{2g}$$

$$= \frac{50}{2g}u^2 = 25\frac{u^2}{g}$$

(3)

Given initial velocity $u = 20$ m/s

$h = 80$ m ; $a = g = 10$ m/s^2

The speed with which the stone reach the ground is calculated by using $v^2 - u^2 = 2as$

$$\Rightarrow v^2 - (20)^2 = 2(10)(80)$$

$$\Rightarrow v^2 - 400 = 1600$$

$$\Rightarrow v^2 = 2000 \Rightarrow v = \sqrt{2000}$$

$$\Rightarrow v = 20\sqrt{5} \text{ m/s.}$$

(4)

Here the balloon is moving with uniform velocity

The velocity of stone = 10 m/s ; $h = 75$ m

The displacement of stone is $h = -ut + \frac{1}{2}gt^2$

$\Rightarrow \cancel{75}^{15} = -\cancel{10}^{2}t + \frac{1}{\cancel{2}} \times \cancel{10}^{5} \times t^2$

$\Rightarrow 15 = -2t + t^2$

$\Rightarrow t^2 - 2t - 15 = 0$

$\Rightarrow t^2 - 5t + 3t - 15 = 0$

$\Rightarrow t(t-5) + 3(t-5) = 0$

$\Rightarrow (t-5)(t+3) = 0$

$\Rightarrow t = 5$ sec (or) -3 sec.

NO '-ve' values for time, so time is 5 sec correct.

(5)

The velocity of helicopter = velocity of food packet = 2 m/s

After 2 sec velocity of food packet = $v = u - gt$

$= 2 - 9.8 \times 2$

$= 2 - 19.6$

$= -17.6$ m/s

'-ve' sign shows the direction of motion is downwards.

(6)

Here Given Acceleration of balloon is $a = \frac{g}{8}$

$u = 0$

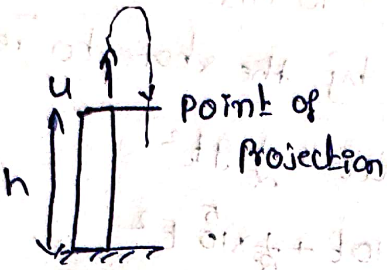
∴ The time taken by the stone to reach ground can be calculated by using $h = -ut + \frac{1}{2}at^2$

$\Rightarrow h = -0 \times t + \frac{1}{2}\frac{g}{8}t^2 \Rightarrow h = \frac{g}{16}t^2$

$\Rightarrow t^2 = \frac{16h}{g} \Rightarrow t = 4\sqrt{\frac{h}{g}}$

(7)

Here the Body was Projected up with a velocity $u = 19.6\ m/s$



The Body Crosses point of Projection After time of flight

i.e) $T = \frac{2u}{g} = \frac{2 \times 19.6}{9.8} = 4\ sec$

(8)

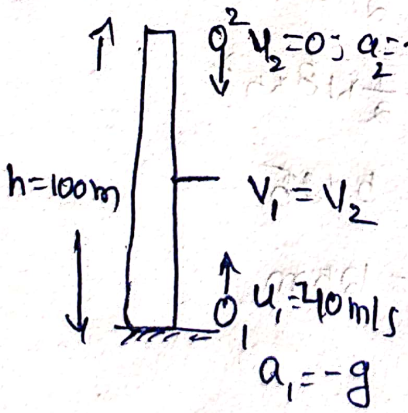
After an object was dropped, the distance between balloon and object after '2' sec is

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

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

$= 10 \times 2 = 20m$

(9)



Here $g = 10\ m/s^2$

For Vertically Projected body velocity after 't' sec is $v = u + at$

$\Rightarrow V_1 = u_1 + a_1 t$

$\Rightarrow V_1 = 40 - gt \rightarrow (1)$

For Freely Falling body $V_2 = u_2 + a_2 t$

$\Rightarrow V_2 = 0 + gt$

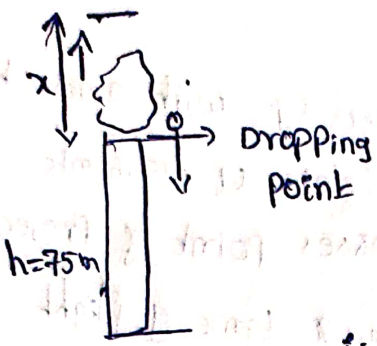
$\Rightarrow V_2 = gt \rightarrow (2)$

Given $V_1 = V_2 \Rightarrow gt = 40 - gt$

$\Rightarrow 2gt = 40$

$\Rightarrow t = \frac{40}{...} = 2\ sec.$

(10)



The velocity of stone = velocity of balloon at the time of dropping

$u = 10\ m/s$

Time taken by the stone to reach ground is

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

$$\Rightarrow 75 = -10t + \frac{1}{2} \times 10\, t^2$$

$$\Rightarrow 75 = -10t + 5t^2$$

$$\Rightarrow 15 = -2t + t^2 \Rightarrow t^2 - 2t - 15 = 0$$

$$\Rightarrow t^2 - 5t + 3t - 15 = 0$$

$$\Rightarrow t(t-5) + 3(t-5) = 0$$

$$\Rightarrow (t-5)(t+3) = 0 \quad \text{i.e.) } t = 5 \text{ (or) } -3\text{sec}$$

No −ve values for time. so $t = 5$sec

∴ The height of the balloon from ground when stone reaches the ground is $h = \frac{1}{2} g t^2$

$$\Rightarrow h = \frac{1}{2} \times 10 \times 5^2$$

$$\Rightarrow h = 5 \times 25$$

$$h = 125\ m.$$

(16)

(i) For a Freely falling body $u=0$; $a=g$

∴ The ratio of distance travelled by the body in successive sec. is $= 1:3:5: --- (2n-1)$.

(ii)

Given $x =$ distance travelled in n^{th} sec.

∴ From

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

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

In $(n+1)^{th}$ sec let s be the distance travelled by a freely falling body.

$$\therefore \quad s = u + \frac{g}{2}(2(n+1)-1) \quad [u=0]$$

$$\Rightarrow s = 0 + \frac{g}{2}[2n+2-1]$$

$$\Rightarrow s = \frac{g}{2}(2n+1) \rightarrow (2)$$

$$\Rightarrow s = ng + \frac{g}{2}$$

From (1) $x = \frac{g}{2}(2n) - \frac{g}{2} \Rightarrow x = ng - \frac{g}{2}$

$$\Rightarrow x + \frac{g}{2} = ng$$

From (2) By sub 'ng' value we get

$$\Rightarrow S = x + \frac{g}{2} + \frac{g}{2}$$

$$\Rightarrow \boxed{S = x + g}$$

$\Rightarrow$ &

(iii) let 'x' be the distance travelled by a FFB in n^{th} sec

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

Here $u=0$; $a=g$

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

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

$\Rightarrow x = ng - \frac{g}{2} \rightarrow (2) \Rightarrow x + \frac{g}{2} = ng$

let 's' be distance travelled in $(n-1)^{th}$ sec

$\therefore$ From (1) $S = 0 + \frac{g}{2}[2(n-1)-1]$

$\Rightarrow S = \frac{g}{2}[2n-2-1]$

$\Rightarrow S = \frac{g}{2}(2n-3)$

$\Rightarrow S = ng - \frac{3g}{2} \rightarrow (3)$

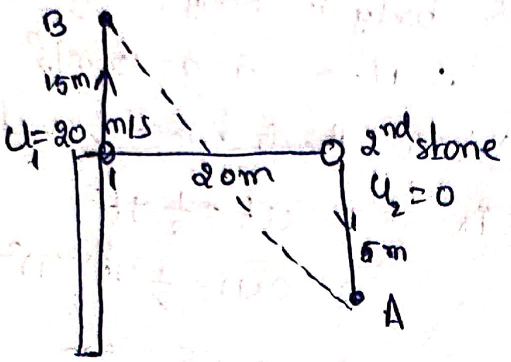
sub 'ng' value in (3) we get

$\Rightarrow S = x + \frac{g}{2} - \frac{3g}{2}$

$\Rightarrow S = x - \frac{2g}{2}$

$\Rightarrow \boxed{S = x - g}$

17



2nd stone is clearly FFB

so $u_2 = 0$; $a_2 = g$

After '1' sec velocity

$V_2 = u_2 + a_2 t$

$V_2 = 0 + g(1)$

$\Rightarrow V_2 = g = 10$ m/s

After '1' sec 2nd stone is at A, S_2 is distance travelled by it

$\therefore S_2 = u_2 t + \frac{1}{2} a_2 t^2$

$\Rightarrow S_2 = 0 \times t + \frac{1}{2} \times g t^2 = \frac{1}{2} g t^2$

$\Rightarrow S_2 = \frac{1}{2} \times 10 \times 1^2 = 5$ m.

let the first stone is at 'B', and it covers a distance of S_1

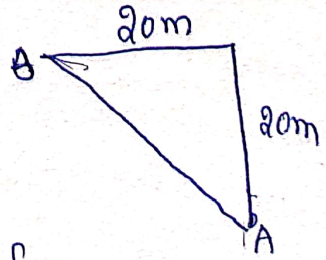
$\therefore S_1 = u_1 t + \frac{1}{2} a_1 t^2$ $[a_1 = -g]$

$S_1 = 20(1) + \frac{1}{2}(-g)(1)^2$

$= 20 - \frac{1}{2} \times 10$

$S_1 = 15$ m

$\therefore$ After '1' sec the distance between two stones is AB.

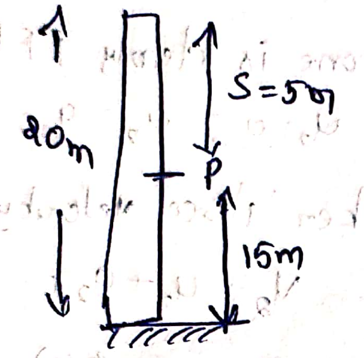


Acc to pythagorous theorem

$AB^2 = 20^2 + 20^2$

$AB = \sqrt{20^2 + 20^2} = 20\sqrt{2}$ m

(18)



clearly the body is freely falling body

$\therefore u = 0 ;\ a = g = 10\ m/s^2$

In '1' sec the distance travelled by a FFB is

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

$S = 0 \times (1) + \frac{1}{2}(10)(1)^2$

$S = 0 + 5 = 5\ m.$

$\therefore$ The velocity of a FFB after '1' sec is

$v = u + gt$

$= 0 + (10)(1)$

$v = 10\ m/s$

$\therefore$ After '1' sec the body reaches P with a velocity 10 m/s. From here onwards gravity disappears. so the body travells further 15m without gravity

$\therefore$ From the defination of velocity

$$v = \frac{\text{displacement}}{\text{time}}$$

$\Rightarrow\ 10 = \frac{15}{t}$

$\Rightarrow\ t = \frac{15}{10} = 1.5\ sec$