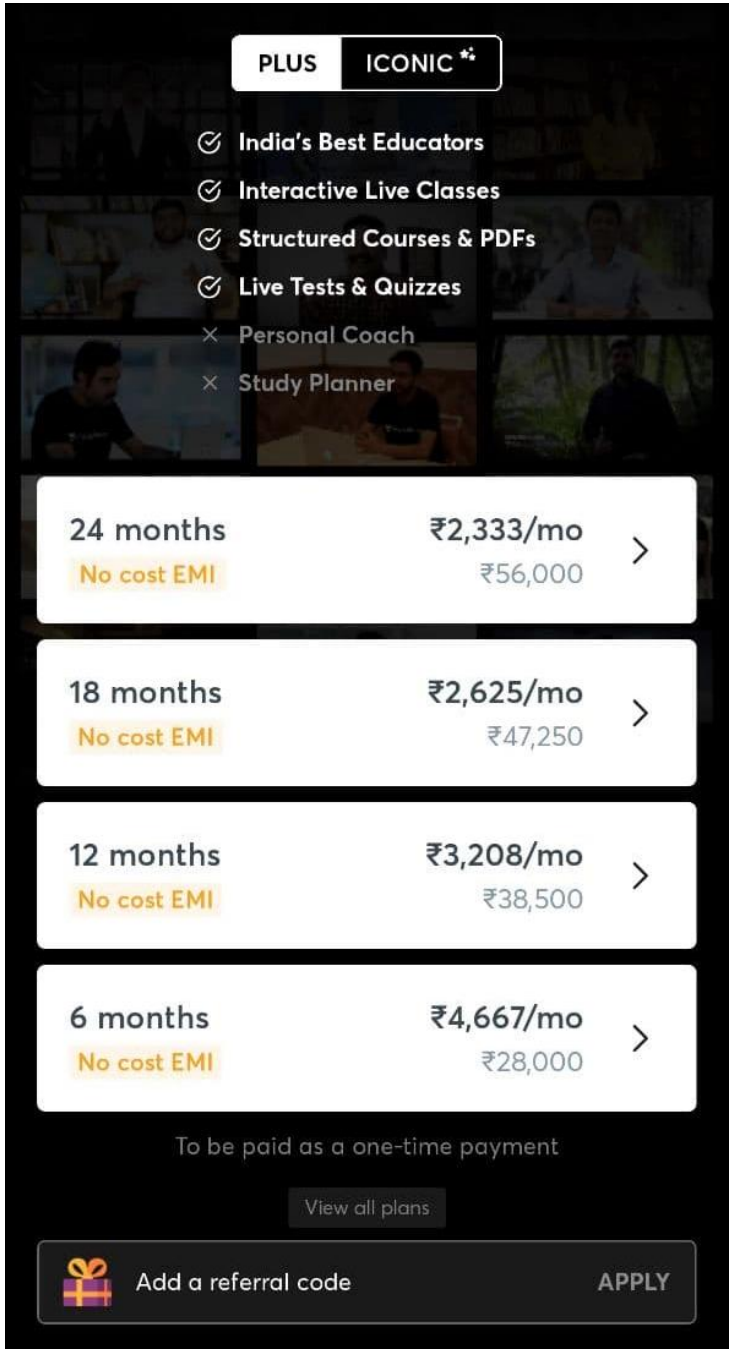
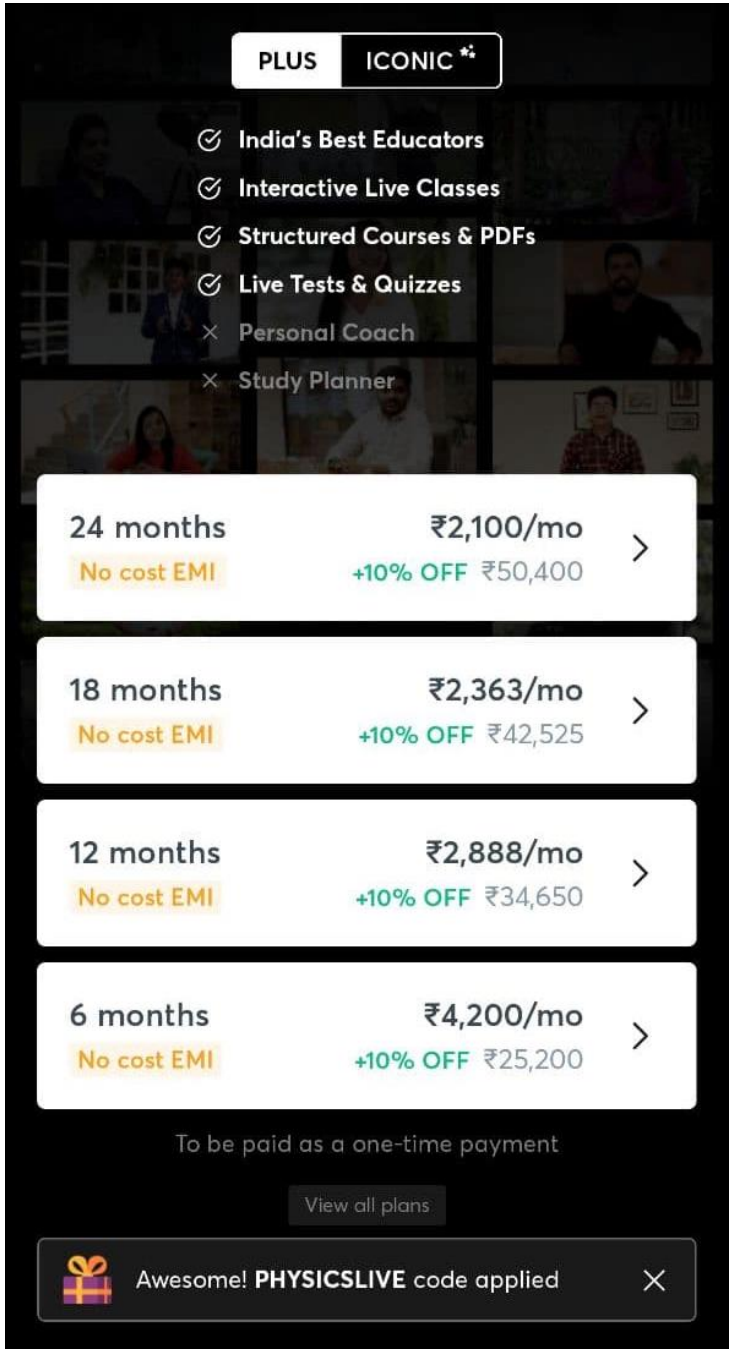
SIR PRATEEK JAIN

. Founder @ Physicsaholics
. Top Physics Faculty on Unacademy (IIT JEE & NEET)
. 8+ years of teaching experience in top institutes like FIITJEE (Delhi, Indore) , CP (KOTA) etc.
. Produced multiple Top ranks.
. Research work with HC Verma sir at IIT Kanpur
. Interviewed by International media.



PHYSICSLIVE

Use code PHYSICSLIVE to get 10% OFF on Unacademy PLUS.



For Video Solution of this DPP, Click on below link

Solution on Website:- https://physicsaholics.com/home/courseDetails/41

Solution on YouTube:- https://youtu.be/2AlCl1cDicI

unacademy

Physics DPP

DPP-3 Motion under gravity

By Physicsaholics Team

Q) A body starts to fall freely under gravity. The distances covered by it in first, second and third second are in ratio:

(a) 1:3:5 (b) 1:2:3 (c) 1:4:9 (d) 1:5:6

Ans. a

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

$$a = g$$

$$u = 0$$

$$n_1 = 1 \,, \quad n_2 = 2 \,, \quad n_3 = 3$$

$$S_1 : S_2 : S_3 = 1 : 3 : 5$$

Q) P, Q and R are three balloons ascending with velocities U, 4U and 8U respectively. If stones of the same mass be dropped from each, when they are at the same height, then:

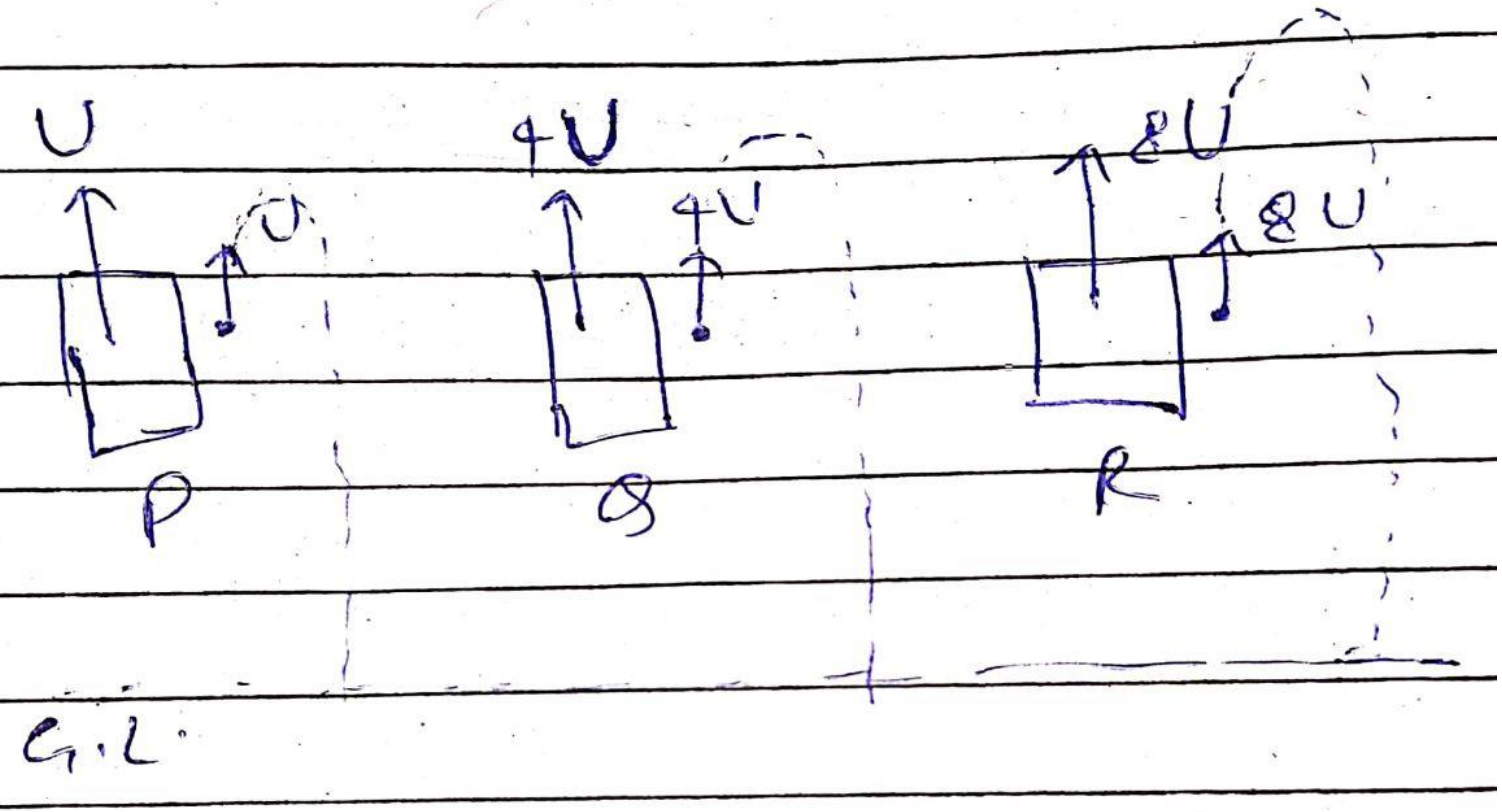
(a) They reach the ground at the same time

(b) Stone from P reaches the ground first

(c) Stone from Q reaches the ground first

(d) Stone from R reaches the ground first

Ans. b



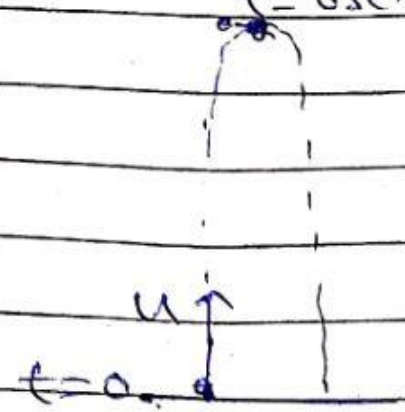
Stone from P has lesser initial upward velocity.
∴ it will take less time to reach the ground.

Q) A body, thrown vertically upwards with an initial velocity u, reaches maximum height in 6 seconds. The ratio of the distance travelled by body in the first second and the eleventh second is:

(a) 1:9 (b) 11:9 (c) 1:2 (d) 9:11

Ans. b

t = 6 sec (max height)



$v = u + at$

at ; $t = 6$ sec $\Rightarrow v = 0$

$0 = u - g(6)$

$\boxed{u = 6g \text{ m/s}}$

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

$u = 6g$; $a = -g$

$n = 1$

$S_1 = 6g - \frac{g}{2}(2\times1-1)$

$S_1 = 6g - \frac{g}{2} = \frac{11g}{2}$

$S_{11} = 6g - \frac{g}{2}(22-1)$

$S_{11} = 6g - \frac{21g}{2} = -9g/2$

$|S_{11}| = 9g/2$

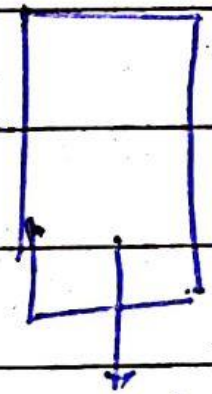
$S_1 : S_2 = \frac{11g}{2} : \frac{9g}{2}$

$\boxed{S_1 : S_2 = 11 : 9}$

Q) A stone falls from a balloon that is descending at a uniform rate of 12 m/s. The displacement of the stone from the point of release after 10 sec is:($g = 9.8\ m/s^2$)

(a) 490 m (b) 510 m (c) 610 m (d) 725 m

Ans. c



12 m/s = u ; t = 0

a = g ↓

12 m/s

d

t = 10 sec

v

$$S = ut + \frac{1}{2}at^2 = 12 \times (10) + \frac{1}{2}(9.8)(10)^2$$

$$S = 120 + 490$$

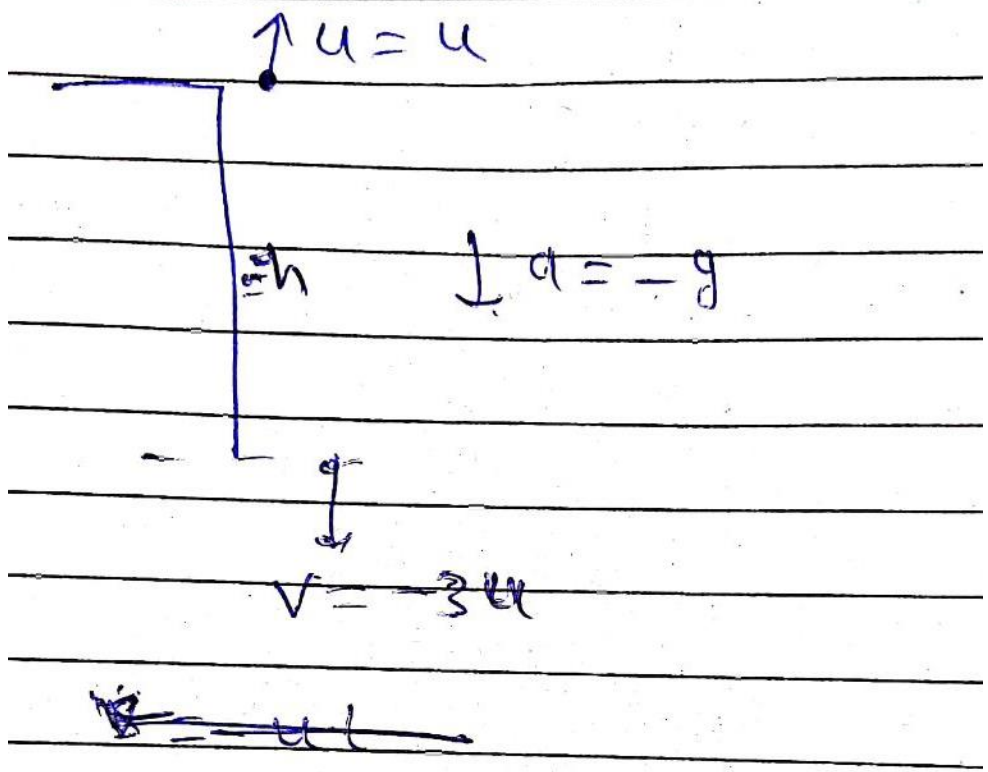
$$\boxed{S = 610 \text{ m}}$$

unacademy

Q) A stone thrown upward with a speed 'u' from the top of the tower reaches the ground with a velocity '3u'. The height of the tower is :-

(a) $\frac{3u^2}{g}$ (b) $\frac{4u^2}{g}$ (c) $\frac{6u^2}{g}$ (d) $\frac{9u^2}{g}$

Ans. b



~~$v = -u$~~

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

$(-3u)^2 - (u)^2 = -2gs$

$9u^2 - u^2 = -2gh$

$8u^2 = -2gh$

$h = \frac{-8u^2}{2g} = -\frac{4u^2}{g}$

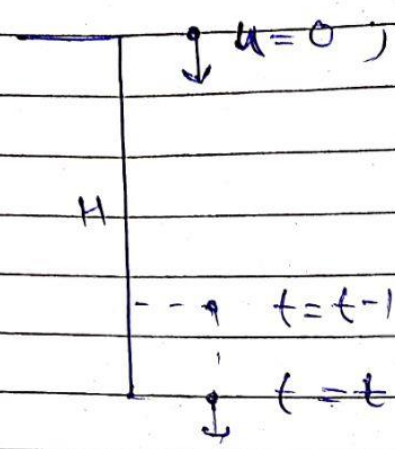
$|h| = \frac{4u^2}{g}$

unacademy

Q) A ball is dropped from a tower. In the last second of its motion it travels a distance of 15 m. Find the height of the tower. [take $g = 10 m/s^2$]

(a) 10 m (b) 20 m (c) 30 m (d) 40 m

Ans. b



in last second
distance travelled = 15 m.

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

$n = t$, $a = g$, $u = 0$

$$15 = 0 + \frac{g}{2}(2t-1)$$

$$30 = 10(2t-1)$$

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

$$t = \sqrt{\frac{2H}{g}} \Rightarrow t^2 = \frac{2H}{g}$$

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

$$\boxed{H = 20 \text{ m}}$$

Q) A,B,C and D are points in a vertical line such that AB=BC=CD. If a body falls from rest from A, then the times of descend through AB, BC and CD are in the ratio:

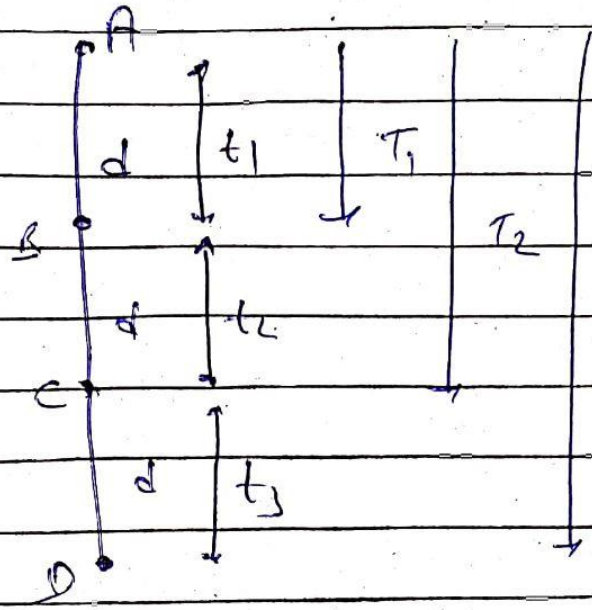
(a) $1:2:\sqrt{3}$

(b) $\sqrt{2}:\sqrt{3}:1$

(c) $\sqrt{3}:1:\sqrt{2}$

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

Ans. d



$$T_1 = \sqrt{\frac{2d}{g}} \; ; \quad T_2 = \sqrt{\frac{2(2d)}{g}}$$

$$T_3 = \sqrt{\frac{2(3d)}{g}}$$

$$t_1 = T_1 \; ; \quad t_2 = T_2 - T_1, \quad t_3 = T_3 - T_2$$

$$t_1 : t_2 : t_3 = \sqrt{\frac{2d}{g}} : \left(\sqrt{\frac{2(2d)}{g}} - \sqrt{\frac{2d}{g}}\right) : \left(\sqrt{\frac{3(2d)}{g}} - \sqrt{\frac{2(2d)}{g}}\right)$$

$$\boxed{t_1 : t_2 : t_3 = 1 : (\sqrt{2} - 1) : (\sqrt{3} - \sqrt{2})}$$

Q) Two stones of different masses are dropped simultaneously from the top of a building

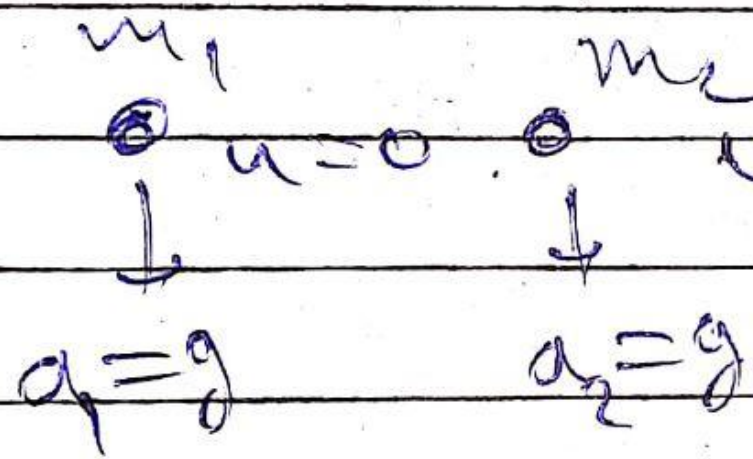
(a) Smaller stone hit the ground earlier

(b) Larger stone hit the ground earlier

(c) Both stones reach the ground simultaneously

(d) Which of the stones reach the ground earlier depends on the composition of the stone

Ans. c



acceleration of both particle is same

$$s = \cancel{ut}^{0} + \frac{1}{2}at^2$$

$$s = \frac{1}{2}gt^2$$; does not depend on mass

$\therefore$ t will be same for Both.

Q) If a ball fallen freely from 'h' height reaches in time 't' at ground, then what will be the time when it reaches at height h/2?

(a) $\frac{t}{2}$ (b) $\frac{t}{\sqrt{2}}$ (c) $\sqrt{2}t$ (d) $\frac{t}{\sqrt{2}-1}$

Ans. b

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

$$t_2 = \sqrt{\frac{2(h/2)}{g}}$$

$$t_2 = \sqrt{\frac{1}{2}\left(\frac{2h}{g}\right)}$$

$$\boxed{t_2 = \frac{t}{\sqrt{2}}}$$

Q) Two particles A and B having different masses are projected from a tower with same speed. A is projected vertically upward and B vertically downward. On reaching the ground:

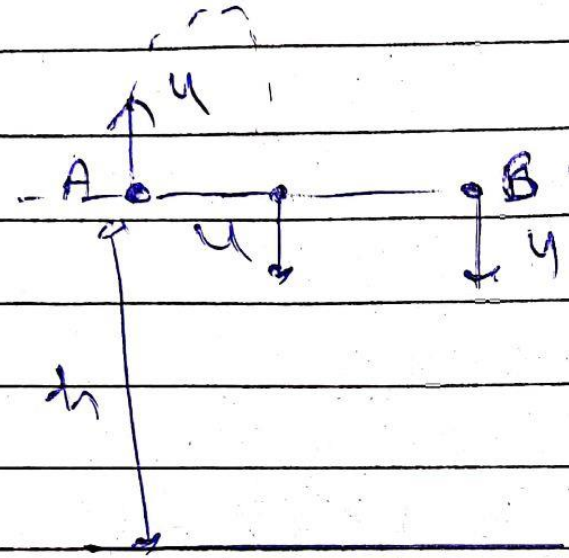
(a) Velocity of A is greater than that of B

(b) Velocity of B is greater than that of A

(c) Both A and B attain the same velocity

(d) The particle with the larger mass attains higher velocity

Ans. c



$v^2 - u^2 = 2as \Rightarrow v^2 = u^2 + 2as$

for A, $u = u$, $a = -g$, $s = -h$

$$v_A^2 = u^2 + 2(-g)(-h) = u^2 + 2gh \quad \text{---(1)}$$

for B; $u = -u$, $a = -g$, $s = -h$

$$v_B^2 = (-u)^2 + 2(-g)(-h) = u^2 + 2gh \quad \text{---(2)}$$

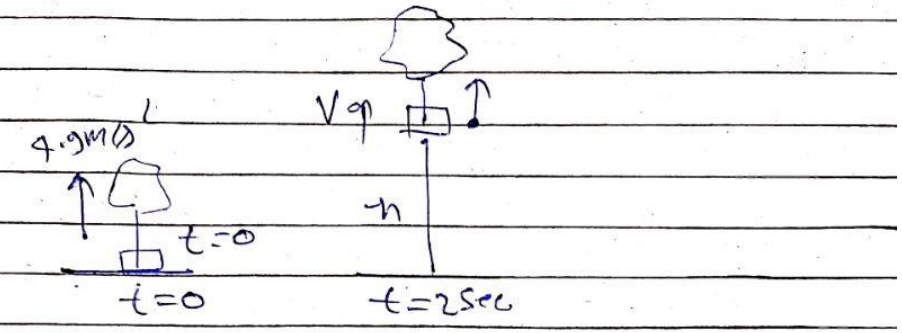
from eq^n (1) & (2)

$$\boxed{v_A = v_B}$$

Q) A man in a balloon rising vertically with an acceleration of $4.9\ m/s^2$ releases a ball 2 sec after the balloon is let go from the ground. The greatest height above the ground reached by the ball is: ($g = 9.8\ m/s^2$)

(a) 14.7 m (b) 19.6 m (c) 9.8 m (d) 24.5 m

Ans. a



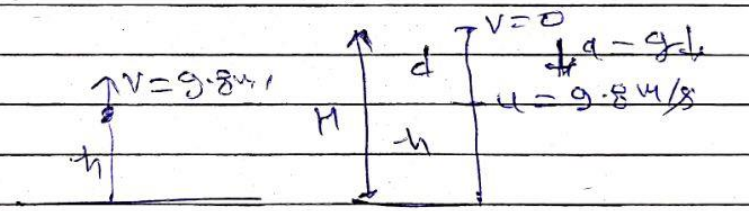
$$V = u + at = 0 + 4.9(2)$$

$$\boxed{V = 9.8\ m/s}$$

$$h = ut + \frac{1}{2}at^2 = 0 + \frac{1}{2}(4.9)(2)^2$$

$$\boxed{h = 9.8\ m}$$

(ii)



$$V = u + at$$

$$0 = 9.8 - 9.8t$$

$$t = 1\ sec$$

$$d = ut + \frac{1}{2}at^2 = 9.8(1) - \frac{1}{2}(9.8)(1)^2$$

$$d = 9.8 - 4.9 = 4.9\ m.$$

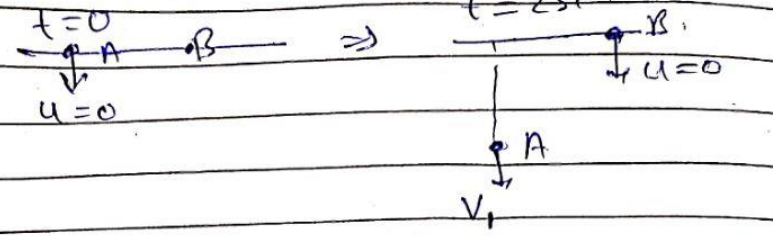
$$H = h + d = 9.8 + 4.9$$

$$\boxed{H = 14.7\ m}$$

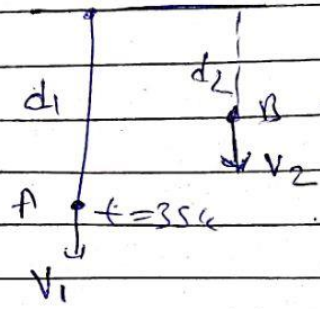
Q) A stone is dropped from a building and 2 seconds later another stone is dropped. How far apart are these two stones by the time the first one reaches a speed of 30m/s:($g = 10\ m/s^2$)

(a) 80 m (b) 100 m (c) 60 m (d) 40 m

Ans. d



at $t = t$



$v_1 = 0 + gt$; $V_2 = g(t-2)$

$v_1 = 30 m/s$

$30 = gt$ — (1)

$t = \frac{30}{10}$

$t = 3 m/s$

$d_1 = \frac{1}{2} g (3)^2$ $\quad d_2 = \frac{1}{2} g (1)^2$

$d_1 = 45 m$ $\quad d_2 = 5 m$

$\Delta d = 40 m$.

For Video Solution of this DPP, Click on below link

Solution on Website:- https://physicsaholics.com/home/courseDetails/41

Solution on YouTube:- https://youtu.be/2AlCl1cDicI

Chalo Niklo