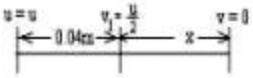
1. A bullet after penetrating 0.04m of a wall loses half of its speed. Haw much will it be penetrated before coming to rest.



Let,
Initial velocity of bullet = u

And finalvelocity of bullet = $\frac{u}{2}$

At the 1st case: We Know,

$$\left(\frac{u}{2}\right)^2 = u^2 - 2a(0.04)$$

$$\Rightarrow 0.08a = u^2 - \frac{u^2}{4}$$

$$\therefore a = \frac{3u^2}{4\times 0.08} = \frac{3u^2}{0.32} \quad \ldots\ldots\ldots\ldots (1)$$

At the 2nd case: Initial velocity of bullet = $\frac{u}{2}$

And final velocity of bullet = 0 and distance x=?
We Know,

$$0^2 = \left(\frac{u}{2}\right)^2 - 2ax$$

$$\Rightarrow 0 = \left(\frac{u}{2}\right)^2 - 2\times\frac{3u^2}{0.32}\times x$$

$$\Rightarrow \frac{6u^2x}{0.32} = \frac{u^2}{4}$$

$$\therefore x = \frac{0.32}{6\times 4} = 0.0133 \text{ m} \quad \text{(Ans.)}$$

2. A body of thrown from 50m height?
(a) Haw long it take to touch the ground?
(b) Find the velocity just at the time of touching the ground.
We know,

(a) $h = ut + \frac{1}{2}gt^2$

$\Rightarrow 50 = 0 + \frac{1}{2}9.8\times t^2$

$\Rightarrow 50 = 4.9t^2$

$\Rightarrow t^2 = \frac{50}{4.9}$

$\Rightarrow t = \sqrt{\frac{50}{4.9}}$

$\therefore t = 3.19$ s (Ans.)

Here,
Height, h =50m
Initial velocity, u = 0
g = 9.8 ms^{-2}
(a) Time, t = ?
(b) Final velocity, v = ?

Again,
(b) v = u + gt
$\Rightarrow$ v = 0 + 9.8 × 3.19
$\therefore$ v = 31.26 ms^{-1} (Ans.)

3. A body moving at the speed of 20ms^{-1} losses its speed by 3ms^{-1}. How far does it travel before it stop.
We Know, $v^2 = u^2 - 2as$

Or, $0 = 20^2 - 2(3)s$
Or, $6s = 400$
or, $s = \frac{400}{6}$
$\therefore s = 66.7$ m (Ans.)

Here,
Initial velocity, u = 20 ms^{-1}
Retardation, a = 3 ms^{-2}
Final velocity, v = 0
Distance travelled, s =?

4. A ball is thrown vertically upward and it touches a telephone wire with velocity with 0.70ms^{-1} at hight 5.1m. Find the initial speed of the ball.
We Know,

$v^2 = u^2 - 2gh$
$\Rightarrow (0.7)^2 = u^2 - 2\times 9.8\times 5.1$
$\Rightarrow u^2 = (0.7)^2 + 2\times 9.8\times 5.1$
$\Rightarrow u^2 = 0.49 + 99.96$
$\Rightarrow u^2 = 100.45$
$\therefore u = \sqrt{100.45} = 10.02$ ms^{-1} (Ans.)

Here,
Height, h =5.1m
g = 9.8 ms^{-2}
Final velocity, v =0.70ms^{-1}
Initial speed, u =?

5. A train is moving with 3ms^{-2} and with initial speed 10 10 ms^{-1}. When it travels 60m, find its speed.
We Know,

$v^2 = u^2 + 2as$
$\Rightarrow v^2 = 10^2 + 2\times 3\times 60$
$\Rightarrow v^2 = 100 + 360$
$\Rightarrow v^2 = 460$
$\therefore v = \sqrt{460} = 21.447 = 21.45 ms^{-1}$ (Ans)

Here,
Acceleration a = 3ms^{-2}
Initial velocity, u =10ms^{-1}
Distance, s = 60m
Speed, v =?

6. If an object is thown vertically upward at speed 98 ms^{-1}. Show that at 3 Sec and 17 Sec, velocities of the object will be same but opposite in direction.
We Know,
Velocity after 3Sec
$v_1 = u - gt_1$
or, $v_1 = 98 - 9.8\times 3$
or, $v_1 = 98 - 29.4$
$\therefore v_1 = 68.6 ms^{-1}$
Again, Velocity after 17Sec
$v_2 = u - gt_2$
or, $v_2 = 98 - 9.8\times 17$
or, $v_2 = 98 - 166.6$
$\therefore v_2 = -68.6$ ms^{-1}
$\therefore$ At 3 Sec and 17 Sec, velocities of the object will be same but opposite in direction. (Showed)

Here,
Initial velocity,
u = 98 ms^{-1}
Time, t_1 = 3S
Time, t_2 = 17S
Final velocity, v_1 =?
Final velocity, v_2 =?

7. A body is moving in a straight line following the equation, $s = \frac{1}{3}t^3 + 3t$. Calculate the velocity after 2 sec.

We Know,

$v = \frac{ds}{dt}$

$\Rightarrow v = \frac{d}{dt}\left(\frac{1}{3}t^3 + 3t\right)$

$\Rightarrow v = \frac{1}{3} \times 3t^2 + 3$

$\Rightarrow v = t^2 + 3$

$\Rightarrow v = 2^2 + 3$ [t=2sec.]

$\therefore v = 7$ Unit(Ans.)

Here,
Time, t = 2 Sec
Velocity, v =?

8. A ball is thrown vertically upward from the ground with a velocity 40ms^{-1} and at the same time another ball is realised from a heihgt 40cm. When and where the balls will meet each other? [g=10m ms^{-2}]

Let, after t sec and at a height x from the earth's surface the balls meet each other. During that time the 2nd Ball falls (40–x)m

For the first ball, we get,

$h = v_0 t - \frac{1}{2}gt^2$

$\Rightarrow x = 40t - \frac{1}{2} \times 10 \times t^2$

$\therefore x = 40t - 5t^2$ .... *(1)*

For the second ball,

$h = v_0 t + \frac{1}{2}gt^2$

$\Rightarrow 40 - x = 0 + \frac{1}{2} \times 10 \times t^2$

$\Rightarrow 40 - x = 5t^2$

$\therefore x = 40 - 5t^2$ .... *(2)*

From equations (1) and (2)

We get, $40t - 5t^2 = 40 - 5t^2$

$\Rightarrow 40t = 40 \ \therefore t = 1$ Sec

From equation (2)

We get, $x = 40 - 5t^2$

$\Rightarrow x = 40 - 5 \times 1^2$

$\therefore x = 35m$

Ans. Height from the ground =35m. and time 1 Sec

9. A body travelled 2 km in 1st second from rest. If the acceleration is uniform. Find the time required to travel the next 1m.

$s_1 = ut_1 + \frac{1}{2}at_1^2$

$\Rightarrow 1 = 0 + \frac{1}{2}a(1)^2$

$\Rightarrow 1 = \frac{a}{2}$

$\therefore a = 2ms^{-2}$

Here,
Initial velocity, u = 0
Time, t_1 = 1s
Displacement, s_1 =1m
Acceleration, a =?

Now, distance from first, s_2 = (1m+1m) =2m.

Then time required = t_2

$s_2 = ut_2 + \frac{1}{2}at_2^2$

$\Rightarrow 2 = 0 + \frac{1}{2} \times 2 \times t_2^2$

$\Rightarrow t_2^2 = 2$

$\therefore t_2 = \sqrt{2} = 1.414s$

The time required to travel the last 1m = t

$\therefore t = t_2 - t_1 = (1.414 - 1)s = 0.414s$ (Ans.)

10. A train starts from rest with uniform acceleration 10ms^{-2}. Prallel to the train a car starts at the same time with uniform velocity100ms^{-1}. When will the train overtake the car?

Let, after t sec the train will pass the distance x

$x = 0 + \frac{1}{2}at^2$

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

$\therefore x = 5t^2$ ... ...(1)

Here,
Uniform velocity of car, V = 100ms^{-1}
Acceleration of the train, a = 10ms^{-2}
Time, t =?

After t sec car will pass the distance x'

$x' = Vt$

$\therefore x' = 100t$ ... ...(2)

Now, form eqtn. (1) And (2) we gate, $x = x'$

$5t^2 = 100t$

$\Rightarrow t = \frac{100}{5} \ \therefore t = 20s$ (Ans.)

11. A body starting from rest travels 625m. When its velocity becomes 125ms^{-1}, find the acceleration.

We Know,

$v^2 = u^2 + 2as$

$\Rightarrow 125^2 = 0 + 2 \times a \times 625$

$\Rightarrow a = \frac{125^2}{2 \times 625} ms^{-2}$

$\therefore a = 12.5ms^{-2}$ (Ans.)

Here,
Initial velocity, u = 0
Distance, s = 625m
Final velocity, v = 125 ms^{-1}
Acceleration, a =?

12. How long will it take to reach the ground of a stone of mass 5 kg thrown from the top of a building of 64m height?

We Know,

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

$\Rightarrow 64 = 0 + \frac{1}{2} \times 9.8 \times t^2$

$\Rightarrow 64 = 4.9t^2$

$\Rightarrow t = \sqrt{\frac{64}{4.9}} \ \therefore t = 3.61s.$ (Ans.)

Here,
Initial velocity, u = 0
Distance, h = 64m
Mass, m= 5kg
Time, t =?