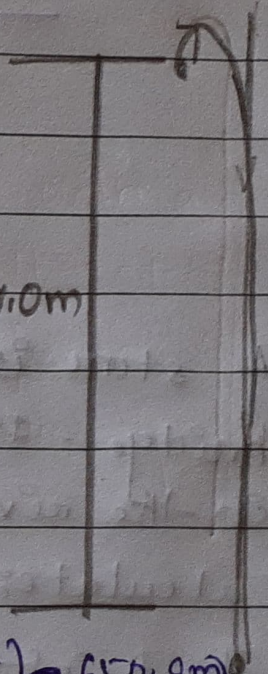
8/7/21

HOME ASSIGNMENT

Q1. A ball is thrown upward with an initial velocity of 10.0 m/s from the top of a 50.0 m tall building.

(a) With what velocity will the ball strike the ground?



Ans) Given: $y = -50.0\ m$ (displacement),

$v_0 = +10.0\ m/s$

Find: (a) v (b) t

The y in the kinematic equations stands for displacement from the launch point.

(a) $v^2 = v_0^2 - 2gy = (+10.0\ m/s)^2 - 2(9.80\ m/s^2)(-50.0\ m)$

$= 1.08 \times 10^3\ m^2/s^2$

So, $v = \sqrt{1.08 \times 10^3\ m^2/s^2} = \pm 32.9\ m/s$

The positive answer is discarded since the ball is falling when it lands (moving downward).

Therefore $v = -32.9\ m/s$

(b) How long does it take the ball to strike the ground.

Ans) from $v = v_0 - gt$, we have

$$t = \frac{v_0 - v}{g} = \frac{(+10.0\,m/s - (-32.9\,m/s))}{9.80\,m/s^2}$$

$$= \frac{42.9\,m/s}{9.80\,m/s^2} = 4.38s.$$

2. A stone is dropped freely in the river from a bridge. It takes 5s to touch the water surface in the river.

Calculate:

(i) The height of the bridge from the water level

(ii) The distance covered by stone on the last second ($g = 9.8\,m/s^2$).

Ans) (i) Given; $u = 0$, $g = 9.8\,m/s^2$, $t = 5s$

From equation of motion, $h = ut + \frac{1}{2}gt^2$; $h = 0 \times 5 + \frac{1}{2} \times 9.8 \times (5)^2 = 9.8 \times \frac{25}{2} = 122.5\,m$

(ii) Distance covered on last second,

$$S(t) = u + \frac{g}{2}(2t - 1) = 0 + \frac{1}{2} \times 9.8 \times (2 \times 5 - 1) = 44.1\,m$$

3. A tennis ball is struck with a rackets forcing it straight upward at 22 m/sec. After how much

time will it be falling at 15 metres per second?

Ans) Case 1:-

Given: $u = 22 m/s$, $v = 0$, $g = -9.8$;

To find: t_1

$\Rightarrow v = u + gt_1$

$\Rightarrow 0 = 22 + (-9.8) \times t_1$

$\Rightarrow 0 = 22 - 9.8 t_1$

$\Rightarrow 9.8 t_1 = 22$

$\Rightarrow t_1 = 22/9.8 = 2.24$ secs

Case 2:-

Given = $u = 0$, $v = 15 m/s$, $g = 9.8$;

To find = t_2

$\Rightarrow v = u + gt_2$

$\Rightarrow 15 = 0 + 9.8 t_2$

$\Rightarrow 15 = 9.8 t_2$

$\Rightarrow \frac{15}{9.8} = t_2$

$\Rightarrow 1.53 = t_2$

$\Rightarrow t_2 = 1.53$ secs

So $t = t_1 + t_2 = (2.24 + 1.53)$ secs

$= 3.77$ secs $= 3.8$ secs.

$\therefore$ After 3.8 secs it will be falling at 15 m/s.