Answer on Question #57463-Physics – Mechanics | Relativity

The velocity of a body at a given instant t is given by v = 3i + (4 − 2t)j.

(i) What is the magnitude and direction of the initial velocity of the body?

(ii) At what instant will the body hit the x-axis again?

(iii) What is the shape of the trajectory? why?

(iv) What is the maximum distance moved by the body along the y-axis?

Solution

(A) Initial velocity is when $t = 0$.

Substituting this into the equation above:

$$\overline{V}(0) = 3\bar{\imath} + (4 - 2 \cdot 0)\bar{\jmath} = 3\bar{\imath} + 4\bar{\jmath}.$$

The magnitude of the initial velocity of the body is

$$V = \sqrt{3^2 + 4^2} = 5.$$

The direction of the initial velocity of the body is

$$\theta = \tan^{-1}\frac{4}{3} = 53° \; with \; the \; x \; axis.$$

(B) The body will hit x axis again when $y = 0$.

$$y(t) = \int_0^t (4 - 2s)ds = 4t - 2\frac{t^2}{2} = 4t - t^2 = t(4 - t).$$

The time will be

$$t = 4.$$

(C) $y = 4t - t^2$

$x = 3t \rightarrow t = \frac{x}{3}.$

$$y = 4\left(\frac{x}{3}\right) - \left(\frac{x}{3}\right)^2 = \frac{4}{3}x - \frac{1}{9}x^2.$$

This is equation of parabola.

(D) Maximum distance covered in y axis will be at

$$\frac{dy}{dt} = 4 - 2t = 0 \rightarrow t = 2.$$

$$y_{max} = 2(4 - 2) = 4.$$