Answer on Question #83663 Physics / Classical Mechanics

An object of mass $m = 1$ kg travels to east with a uniform velocity $v_{0x} = 2\,\frac{\text{m}}{\text{s}}$. A force of $F_y = 2$ N is applied on it along north direction. What's the displacement of object after $t = 2$ seconds?

Solution:

Let the x-axis is directed toward to the east, and y-axis is directed toward to the north. The Newton's second law gives

$$a_x = \frac{F_x}{m} = 0\ \frac{\text{m}}{\text{s}^2}$$

$$a_y = \frac{F_y}{m} = \frac{2\text{ N}}{1\text{ kg}} = 2\,\frac{\text{m}}{\text{s}^2}$$

So, components of the displacement

$$s_x = v_{0x}t + \frac{a_x t^2}{2} = 2\,\frac{\text{m}}{\text{s}} \times 2\text{ s} + \frac{0 \times (2\text{ s})^2}{2} = 4\text{ m}$$

$$s_y = v_{0y}t + \frac{a_y t^2}{2} = 0 \times 2\text{ s} + \frac{2\,\frac{\text{m}}{\text{s}^2} \times (2\text{ s})^2}{2} = 4\text{ m}$$

The magnitude of displacement

$$s = \sqrt{s_x^2 + s_y^2} = \sqrt{4^2 + 4^2} = 4\sqrt{2}\text{ m} = 5.7\text{ m}$$

The direction of the displacement

$$\theta = \tan^{-1}\frac{s_y}{s_x} = \tan^{-1}\frac{4}{4} = \tan^{-1} 1 = 45° \text{ north of east}$$

Answer: 5.7 m, 45° north of east