

Answer on Question #40896 – Physics – Mechanics

A ROD OF LENGTH 3m AND ITS MASS PER UNIT LENGTH IS DIRECTLY PROPORTIONAL TO DISTANCE X FROM ITS END. THE CENTRE OF MASS OF THE ROD OF FROM THAT END WILL BE AT ?

Solution:

$L = 3\text{m}$ – length of the rod;

Mass per unit length is directly proportional to the distance x from its end:

$$dm = x dx \quad (1)$$

Mass of the rod:

$$M = \int_0^L dm \quad (2)$$

Formula for the centre of mass:

$$x_{cm} = \frac{\int_0^L x \cdot dm}{M} \quad (3)$$

(1) and (2) in (3):

$$x_{cm} = \frac{\int_0^L x^2 dx}{\int_0^L x dx} = \frac{\frac{x^3}{3} \Big|_0^L}{\frac{x^2}{2} \Big|_0^L} = \frac{\frac{L^3}{3}}{\frac{L^2}{2}} = \frac{L^3}{3} \cdot \frac{2}{L^2} = \frac{2}{3} L = \frac{2}{3} \cdot 3\text{m} = 2\text{m}$$

Answer: the center of mass of the rod from it's end will be at the distance 2m.