

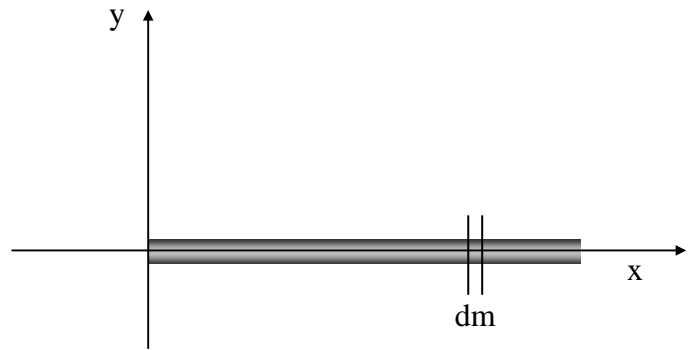
Example On chapter 9

A Rod of mass M and length L as shown in the figure, determine the position of its center of mass from the origin

Solution:

When the rod is placed along the x -axis and by symmetry

$$y_{cm} = z_{cm} = 0$$



choose small part of the rod of mass dm

$$\text{we know that } x_{cm} = \frac{1}{M} \int x dm \quad \dots\dots\dots(1)$$

also we know that for a thin rod a linear mass density per unit length

$$\lambda = \frac{M}{L} \quad \dots\dots\dots(2)$$

$$\text{and the density} = \frac{M}{L} = \frac{dm}{dx}$$

$$dm = \frac{M}{L} dx \Rightarrow dm = \lambda dx$$

From equation (1)

$$x_{cm} = \frac{1}{M} \int_0^L x \lambda dx$$

$$x_{cm} = \frac{\lambda}{M} \int_0^L x dx$$

$$x_{cm} = \frac{1}{M} \frac{M}{L} \left[\frac{x^2}{2} \right] = \frac{1}{2} L \quad \#$$