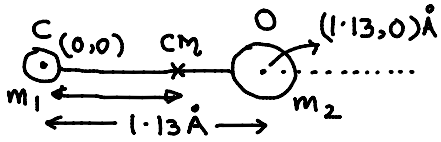
ISC XI

Tuesday, October 12, 2021 8:05 PM

Q7 P412, Nootan



$m_1 = 12$ amu $\quad m_2 = 16$ amu

$$x_{cm} = \frac{m_1x_1 + m_2x_2}{m_1+m_2} = \frac{12\times0 + 16\times1\cdot13}{12+16}$$

$$= \frac{16\times1\cdot13}{28} = \frac{4\cdot52}{7}\,\text{Å} \Rightarrow x_{cm} = 0\cdot645\,\text{Å}$$

Ans.

Note: $m_1, m_2, m_3 \ldots\ldots$ $\quad \vec{r}_1, \vec{r}_2, \vec{r}_3 \ldots\ldots$

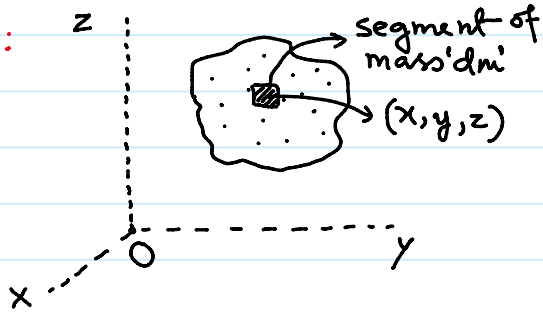
$$\vec{r}_{cm} = \frac{m_1\vec{r}_1 + m_2\vec{r}_2 + \ldots}{m_1+m_2+\ldots} = \frac{1}{M}\cdot\sum m_i\vec{r}_i$$

Co-ordinates of CM

$$x_{cm} = \frac{1}{M}\cdot\sum m_ix_i \Rightarrow x_{cm} = \frac{m_1x_1 + m_2x_2 + \ldots}{m_1+m_2+\ldots} \checkmark$$

$$y_{cm} = \frac{1}{M}\cdot\sum m_iy_i \Rightarrow y_{cm} = \frac{m_1y_1 + m_2y_2 + \ldots}{m_1+m_2+\ldots}$$

CM of a Rigid (continious) Body :



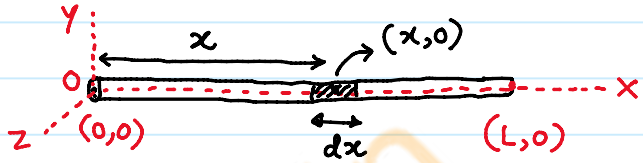
$$x_{cm} = \frac{1}{M}\cdot\int x\cdot dm$$

$$y_{cm} = \frac{1}{M}\cdot\int y\cdot dm$$

$$z_{cm} = \frac{1}{M}\cdot\int y\cdot dm$$

CM of a rigid rod of length L (uniform Rod)

Let there is a uniform rod of length L and mass M



Mass per unit length $\lambda = \frac{M}{L}$ —(1)

Mass of the small segment $dm = \lambda\cdot dx$

$$dm = \frac{M}{L}\cdot dx \quad —(2)$$

$$x_{cm} = \frac{1}{M}\cdot\int_{x=0}^{x=L} x\,dm \qquad \int x^n dx = \frac{x^{n+1}}{n+1}$$

$$= \frac{1}{M}\cdot\int_{x=0}^{L} x\cdot\left(\frac{M}{L}\cdot dx\right) = \frac{1}{L}\cdot\int_0^L x^1 dx$$