# HC Verma Solutions Centre of Mass, Linear Momentum, Collision

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Centre of Mass, Linear Momentum, Collision HC Verma Concepts of Physics Solutions

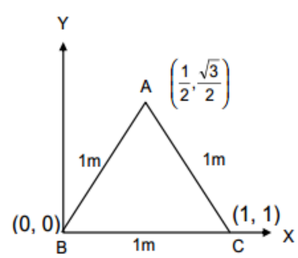
Centre of Mass, Linear Momentum, Collision HC Verma Concepts of Physics Solutions Chapter 9

1. $m_1 = 1\text{kg}$, $m_2 = 2\text{kg}$, $m_3 = 3\text{kg}$,
$x_1 = 0$, $x_2 = 1$, $x_3 = 1/2$
$y_1 = 0$, $y_2 = 0$, $y_3 = \sqrt{3}/2$
The position of centre of mass is

$$\text{C.M} = \left(\frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}, \frac{m_1y_1 + m_2y_2 + m_3y_3}{m_1 + m_2 + m_3}\right)$$

$$= \left(\frac{(1\times 0) + (2\times 1) + (3\times 1/2)}{1+2+3}, \frac{(1\times 0) + (2\times 0) + (3\times(\sqrt{3}/2))}{1+2+3}\right)$$

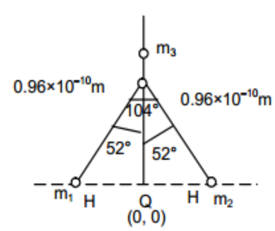
$$= \left(\frac{7}{12}, \frac{3\sqrt{3}}{12}\right)$$ from the point B.




2. Let θ be the origin of the system
In the above figure
$m_1 = 1\text{gm}$, $x_1 = -(0.96\times10^{-10})\sin 52°$ $y_1 = 0$
$m_2 = 1\text{gm}$, $x_2 = -(0.96\times10^{-10})\sin 52°$ $y_2 = 0$
$x_3 = 0$ $y_3 = (0.96 \times 10^{-10}) \cos 52°$
The position of centre of mass

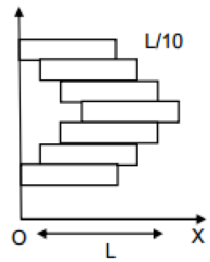
$$\left(\frac{m_1x_1 + m_2x_2 + m_3x_3}{m_1 + m_2 + m_3}, \frac{m_1y_1 + m_2y_2 + m_3y_3}{m_1 + m_2 + m_3}\right)$$

$$= \left(\frac{-(0.96\times10^{-10})\times\sin 52 + (0.96\times10^{-10})\sin 52 + 16\times 0}{1+1+16}, \frac{0+0+16y_3}{18}\right)$$



$= \left(0,\ (8/9)0.96 \times 10^{-10} \cos 52^{\circ}\right)$

3. Let 'O' (0,0) be the origin of the system.
Each brick is mass 'M' & length 'L'.
Each brick is displaced w.r.t. one in contact by 'L/10'
$\therefore$ The X coordinate of the centre of mass

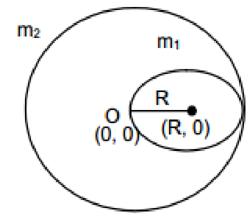



$$\overline{X}_{cm} = \frac{m\left(\frac{L}{2}\right)+m\left(\frac{L}{2}+\frac{L}{10}\right)+m\left(\frac{L}{2}+\frac{2L}{10}\right)+m\left(\frac{L}{2}+\frac{3L}{10}\right)+m\left(\frac{L}{2}+\frac{3L}{10}-\frac{L}{10}\right)+m\left(\frac{L}{2}+\frac{L}{10}\right)+m\left(\frac{L}{2}\right)}{7m}$$

$$= \frac{\frac{L}{2}+\frac{L}{2}+\frac{L}{10}+\frac{L}{2}+\frac{L}{5}+\frac{L}{2}+\frac{3L}{10}+\frac{L}{2}+\frac{L}{5}+\frac{L}{2}+\frac{L}{10}+\frac{L}{2}}{7}$$

$$= \frac{\frac{7L}{2}+\frac{5L}{10}+\frac{2L}{5}}{7} = \frac{35L+5L+4L}{10 \times 7} = \frac{44L}{70} = \frac{11}{35}L$$

4. Let the centre of the bigger disc be the origin.
2R = Radius of bigger disc
R = Radius of smaller disc
$m_1 = \pi R^2 \times T \times \rho$
$m_2 = \pi(2R)^2\, I\, T \times \rho$
where T = Thickness of the two discs
$\rho$ = Density of the two discs
$\therefore$ The position of the centre of mass

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