$$v_{cm} = \frac{m_1\vec{v_1} + m_2\vec{v_2} + \cdots + m_n\vec{v_n}}{m_1 + m_2 + m_3 + \cdots + m_n}$$

$a_{cm} = 0$

$$a_{cm} = \frac{m_1 a_1 + m_2 a_2 + \cdots + m_n a_n}{m_1 + m_2 + \cdots + m_n}$$

$v_{cm} =$ constant.

$m_1\vec{v_1} + m_2\vec{v_2} + m_3\vec{v_3} \cdots + m_n v_n =$ Constant

$p_1 + p_2 + p_3 \cdots + p_n = 0.$

$m\vec{v} =$ Constant

Momentum Conservation.

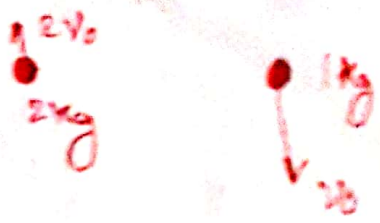
* $a_{cm} = 0$ doesn't mean that net, a_1, a_2, a_3 individually will also be zero.

* If Net force $= 0$ then K.E can also change due to Internal Energy.

* $a_{cm} = 0 \Rightarrow v_{cm}$ is constant but v_1, v_2 & v_3 are also constant. Can not be said

* If the net force on a system is zero then the momentum is conserved.

#



$$v_{cm} = \frac{2 \times 2v_0 + 1 \times (-v_0)}{2+1}$$

$$v_{cm} = \frac{3v_0}{3}$$

$$v_{cm} = v_0$$

$$a_{cm} = \frac{2 \times (-g) + 1 \times (-g)}{3}$$

$$a_{cm} = -g$$

$F_{net} = 0$

$\Rightarrow a_{com} = 0$

$\Rightarrow V_{com}$ = Constant.

$m\vec{v}$ = Constant

★ Special Case

$F_{net} = 0$

$\Rightarrow a_{com} = 0$

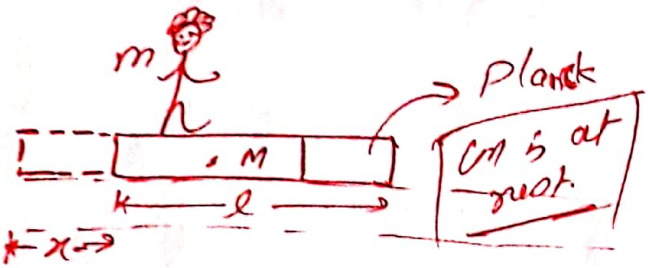
$\Rightarrow V_{com} = 0$ [COM at rest]

$\frac{d}{dt}(r_{cm}) = 0$

$m_1x_1 + m_2x_2 + \cdots + m_n\dot{x}_n$ = Constant

$m_1x_1 = m_2x_2$

Application



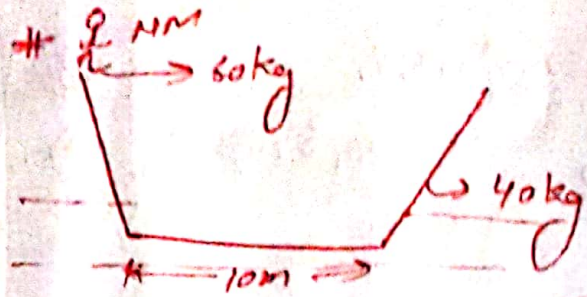
→ Centre of mass ka scheme chalta hai

$Mx = m(l-x)$

$Mx = ml - mx$

$x = \frac{ml}{M+m}$

Q:- Find the displacement of the boad if the nm sir reaches the other end of the boat.



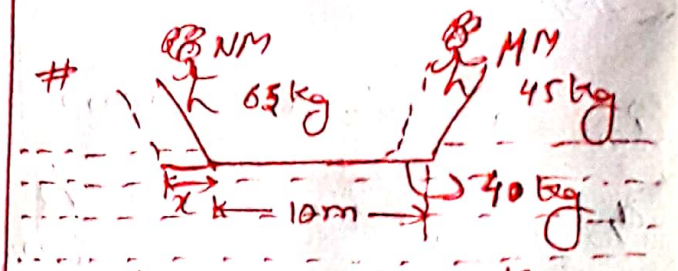
Find the displacement of the boat when nm reaches the other end of the boat.

$MX =$

$40x = 60(10-x)$

$100x = 600$

$x = 6m$



• What would be the displacement of the boat if Nm and MM meet at the Centre of the boat.

$65(5-x) = 40x + 45(5+x)$

$325 - 65x = 40x + 225 + 45x$

$100 = 150x$

$x = 3m$

$x = \frac{2}{3}m$

(ii) If both interchange their positions then what will be the displacement of the boat.

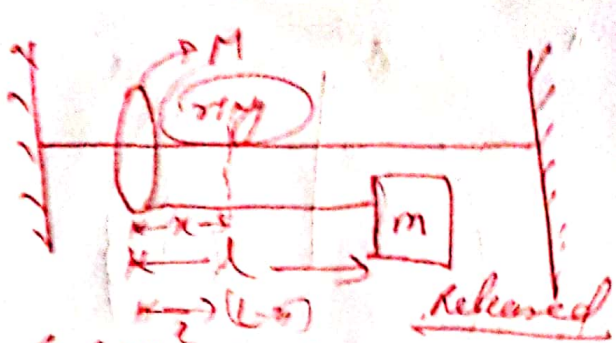
$65(10-x) = 40x + 45(10+x)$

$650 - 65x = 40x + 450 + 45x$

$200 = 150x$

$x = \frac{4}{3}$ m

#



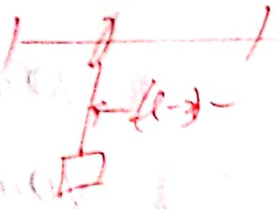
Find the displacement of the ring on the ~~road~~ rod when

(i) The block becomes vertical

(ii) String makes an angle θ with the vertical taken in the ACW sense

$Mx = m(l-x)$

$x = \frac{ml}{m+M}$



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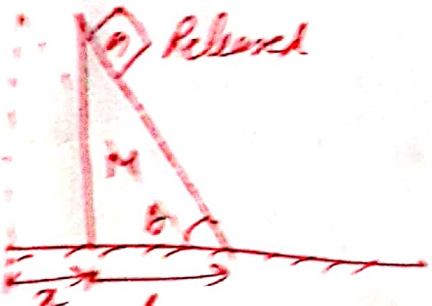
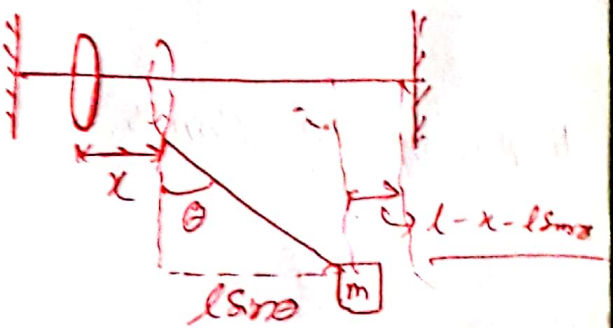


What would be the displacement of the wedge when the ~~lower~~ upper block reaches the bottom of the wedge.

$M.x = m(l-x)$

$x = \frac{ml}{M+m}$

#



$m(l - l\sin\theta - x) = Mx$

$ml - ml\sin\theta - mx = Mx$

$ml(1-\sin\theta) = x$

$M+m$