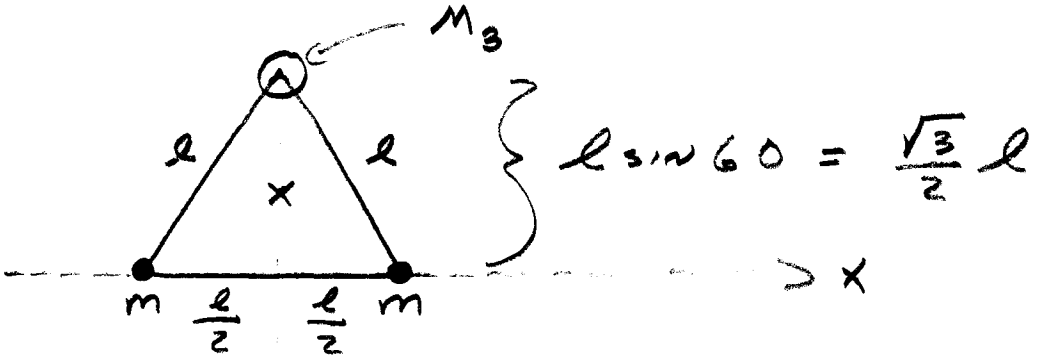
Chapter 10 Even #'s: 2, 16, 38

(2)



$$Y_{cm} = \frac{1}{M_{total}} \sum_{i=1}^{3} m_i y_i$$

$$\frac{1}{2}\left(\frac{\sqrt{3}}{2}\ell\right) = \frac{1}{m+m+M_3}\left(m(0) + m(0) + M_3\frac{\sqrt{3}}{2}\ell\right)$$

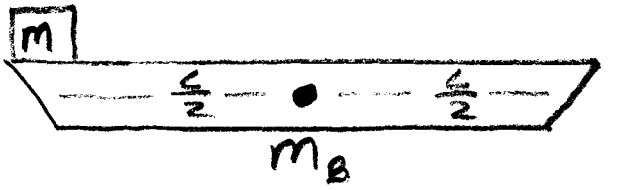
$$\Rightarrow \frac{1}{4}\sqrt{3}\ell = \frac{\sqrt{3}M_3\ell}{2(2m+M_3)}$$

$$\Rightarrow M_3 = \frac{1}{2}(2m + M_3)$$

$$\Rightarrow \boxed{M_3 = 2m}$$

Before

(16)

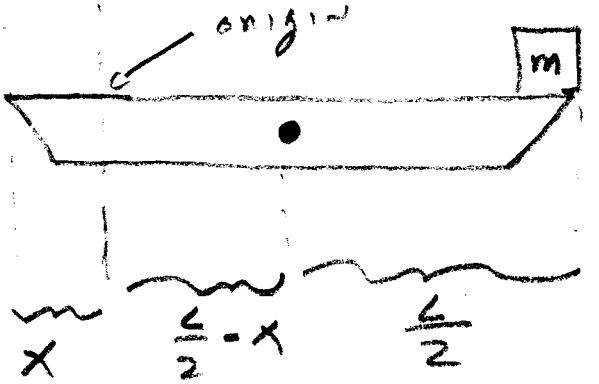


origin

$$X_{cm} = \frac{1}{m+m_B}\left(m(0) + m_B\left(\frac{L}{2}\right)\right)$$

$$X_{cm} = \frac{m_B}{m+m_B}\,\frac{L}{2}$$

After (X_{cm} is unchanged)



$$X_{cm} = \frac{1}{m+m_B}\left(m(L-x) + m_B\left(\frac{L}{2}-x\right)\right.$$

$$\frac{m_B}{m+m_B}\,\frac{L}{2} = \frac{1}{m+m_B}\left(mL - mx + \frac{m_B L}{2} - m_B x\right)$$

$$\Rightarrow \quad 0 = mL - mx - m_b x$$

$$\Rightarrow \quad x = \frac{mL}{m + m_b} = \frac{1500\,(6.5)}{1500 + 12{,}000}$$

$$\Rightarrow \quad x = .72 \text{ m}$$

$\Rightarrow$ The boat shifts .72 m toward the bow.

(38) $M_i = M \qquad M_f = .2M$

$$V_{final} = V_i + V_{ex} \ln\left(\frac{M_i}{M_f}\right)$$

$$= 0 + 2.5 \frac{km}{s} \ln\left(\frac{M}{.2M}\right)$$

$$= 2.5 \ln 5$$

$$\boxed{V_{final} = 4.02 \frac{km}{s}}$$