\[ F_1 = 800 \, N = \frac{6 \, M_e \, M_{\text{student}}}{R_e} \]
\[ F_2 = \frac{6 \, M_e \, M_{\text{student}}}{R_e + 9500 \, m} = \frac{6 \, M_e \, M_{\text{student}}}{R_e} \left[ 1 + \frac{1}{9500 \, m \over R_e} \right] \]
\[ = 800 \, N \left[ 1 \frac{1}{1 + \frac{9500 \, m}{R_e}} \right] \]
\[ \times 800 \, N \left[ 1 - \frac{9500 \, m}{R_e} \right] \]
\[ \therefore \Delta F \approx 800 \, N \left( \frac{9500 \, m}{6378 \, Km} \right) = 1.2 \, N \]

\[ \Delta U = \frac{1}{2} \, m \, v^2 (4 \, \text{km/s})^2 = \frac{6 \, M_e \, m}{R_e} \left[ \frac{1}{R_e} - \frac{1}{R_{\text{max}}} \right] \]
\[ \therefore \frac{1}{R_{\text{max}}} = \frac{1}{R_e} - \frac{1}{2} \left( 16 \times 10^6 \, m^2/s^2 \right) \frac{1}{6 \, M_e} \]
\[ \Rightarrow R_{\text{max}} = 7303 \, \text{km}. \]
\[ \therefore h_{\text{max}} = R_{\text{max}} - R_e = 933 \, \text{km}. \]

\[ V_e = \sqrt{\frac{2 \, 6 \, M_e}{R_e}} \]
\[ \frac{1}{2} \, m \, v_e^2 = k = \frac{1}{2} \, U = \frac{6 \, M_e \, m}{2 \, R_e} \]
\[ \therefore v_e = \sqrt{\frac{6 \, M_e}{R_e}} \]
\[ \therefore V_e = \sqrt{2} \, v_e \]
\( dm = 20 \text{kg} \left( \frac{d\theta}{\pi} \right) \)

\[ d \vec{F} = \frac{-G \left(0.1 \text{kg} \right) dm \hat{r}_z}{R^2} \]

\[ = \frac{-G \left(0.1 \text{kg} \right) 20 \text{kg} \left( \frac{d\theta}{\pi} \right)}{(\frac{5 \text{m}}{\pi})^2} \hat{r}_z \]

\[ = \frac{-G \left(0.1 \text{kg} \right) 20 \text{kg} \left( \frac{d\theta}{\pi} \right) \hat{r}_z}{(\frac{5 \text{m}}{\pi})^2} \]

\[ \therefore d \vec{F} = \left( -1.68 \times 10^{-11} \text{ N} \right) \hat{r}_z \ d\theta \]

\( F_x = 0 \) by symmetry

\[ dF_x = |d \vec{F}| \sin(\theta) \]

\[ = \left(1.68 \times 10^{-11} \text{ N} \right) \sin(\theta) \ d\theta . \]

\[ \therefore F_x = \left[ \int_{0}^{\pi} \sin(\theta) \ d\theta \right] \ 1.68 \times 10^{-11} \text{ N} \]

\[ = 2 \left[ \left(-\cos(\theta)\right) \right]_{0}^{\pi} \ 1.68 \times 10^{-11} \text{ N} \]

\[ = \left[ -(-1) + 1 \right] \ 1.68 \times 10^{-11} \text{ N} \]

\[ F_x = 3.4 \times 10^{-11} \text{ N} \]

\[ F_x = 0 \]
FALSE - E.g. maximum density

23. \[ T_2 \]

\[ T_1 = 80 \text{ N} \] by inspection

(a) \[ \vec{T}_1, \vec{T}_2, \vec{F} \text{ from hinge} \]

(b) \[ \sum \vec{F}_{\text{about}} = (T_2 \text{ vertical} - T_1) L = 0 \]

\[ \Rightarrow T_2 \text{ vertical} = 80 \text{ N}. \]

(c) \[ \vec{F}_{\text{hinge}} = \vec{T}_2 \cos(30^\circ) = 69.28 \text{ N to the right.} \]

\[ \frac{80 \text{ N}}{\sin(30^\circ)} = 160 \text{ N} \]

46. \[ F_{\text{floor}} = M_g \] by \[ \sum F_z = 0. \]

\[ F_{\text{wall}} \sin(\theta) - M_g \frac{h}{\tan(\theta)} = 0 \]

\[ F_{\text{wall}} = \frac{M_g h \cos(\theta)}{L \sin^2(\theta)} \]

\[ F_{\text{friction}} \] floor = \[ \frac{M_g h \cos(\theta)}{L \sin^2(\theta)} \]

\[ h_{\text{max}} = \mu_s M_g L \frac{\sin^2(\theta)}{\cos(\theta)} \] at slip.
Strain 1 = Strain 2

\[ \frac{\text{Stress 1}}{Y_1} = \frac{\text{Stress 2}}{Y_2} \]

\[ \frac{M_1 \cdot 9}{\frac{1}{2} (0.7)^2 \pi} \frac{70}{70} = \frac{M_2 \cdot 9}{\frac{1}{2} (0.5)^2 \pi \cdot 200} \]

\[ \therefore \frac{M_1}{M_2} = \left( \frac{0.7}{0.5} \right)^2 \frac{70}{200} = 0.69 \]

\[ W_1 = \frac{3}{4} \cdot 2N = \frac{3}{2} N \]

\[ W_2 = \frac{3}{4} \left( \frac{7}{4} + \frac{7}{4} \right) N = \frac{3}{4} \left( \frac{7}{4} + \frac{7}{4} \right) N \]

\[ W_3 = \frac{1}{3} \left( \frac{7}{4} + \frac{8}{4} + \frac{6}{4} \right) N = \frac{7}{4} N \]