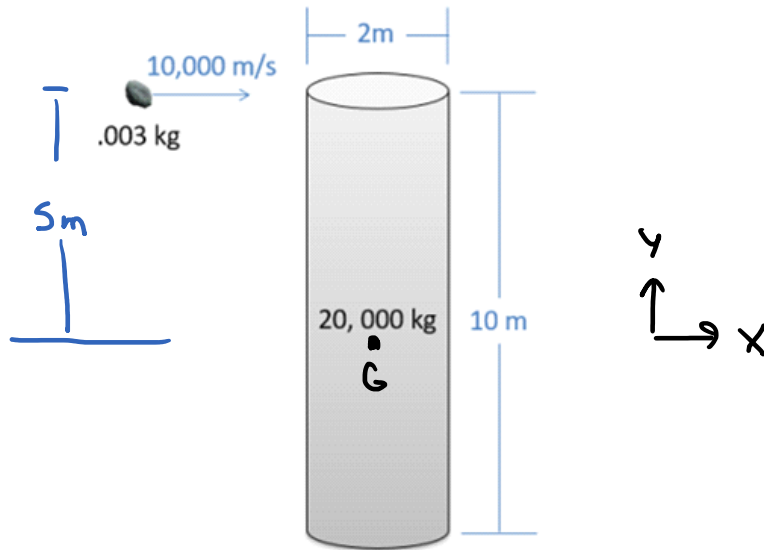


Problem 1

A space telescope with a mass of 20,000 kg (approximate as a cylinder with a length of 10 m and a diameter of 2 m) is struck on one end with a micrometeorite with a mass .003 kg and a velocity of 10,000 m/s (model as a point mass). Assuming the micrometeorite becomes lodged in to space telescope, What is the expected velocity and angular velocity for the space telescope after impact?



inelastic impact

linear momentum conserved

$$\sum m \vec{v}_i = \sum m \vec{v}_f \quad \text{everything in } x \text{ direction}$$

$$(3 \text{ kg})(200 \text{ m/s}) + (20,000 \text{ kg})(0 \text{ m/s}) = (20,003 \text{ kg})(v_{GF})$$

$$v_{GF} = .02999 \text{ m/s to the right}$$

Angular momentum conserved

$$\sum I \omega_i = \sum I \omega_f$$

$$I_{\text{point mass}} = m r^2$$

$$I_{\text{cylinder}} = \frac{1}{12} m (3r^2 + h^2)$$

$$(3h_s)(5m)^2 \left(-\frac{200 \text{ m/s}}{5m}\right) + 0 = \left(\frac{1}{12}(29,000h_s)(3(1m)^2 + (10m)^2) + (3h_s)(5m)^2\right) \omega_f$$

$$-3000 \frac{h_s m^2}{s} = (171741.67 h_s m^2) (\omega_f)$$

$$\omega_f = -.0175 \text{ rad/s}$$

clockwise rotation