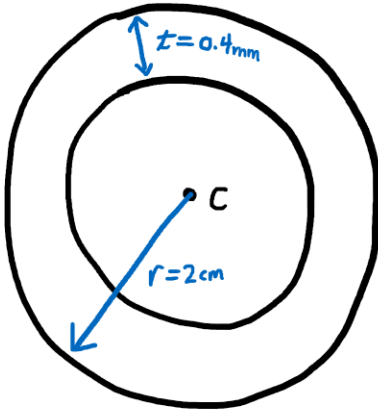


## 22-R-KIN-TW-41

A standard ping pong ball is hollow with an outer radius of 2 cm, thickness of 0.4 mm, and a mass of 2.7 g. Given this, what is the radius of gyration of a ping pong ball about some axis running through the ball's center?

**Solution:**



$$r_o = 0.02 \text{ [m]}$$

$$t = 0.0004 \text{ [m]}$$

$$r_i = r_o - t = 0.0196 \text{ [m]}$$

$$m = 0.0027 \text{ [kg]}$$

$$V_{\text{shell}} = \frac{4}{3}\pi(r_o^3 - r_i^3) = 1.97 \times 10^{-6} \text{ [m}^3\text{]}$$

$$\rho_{\text{shell}} = \frac{m}{V_{\text{shell}}} = 1370 \text{ [kg/m}^3\text{]}$$

$$m = \rho V$$

$$\begin{aligned} (I_C)_z &= \frac{2}{5}\rho_{\text{shell}}V_or_o^2 - \frac{2}{5}\rho_{\text{shell}}V_ir_i^2 \\ &= \frac{8}{15}\pi\rho_{\text{shell}}(r_o^5 - r_i^5) = 7.06 \times 10^{-7} \text{ [kg} \cdot \text{m}^2\text{]} \end{aligned}$$

$$I = mk^2$$

$$k = \sqrt{\frac{(I_C)_z}{m}} = 0.01617 \text{ [m]}$$