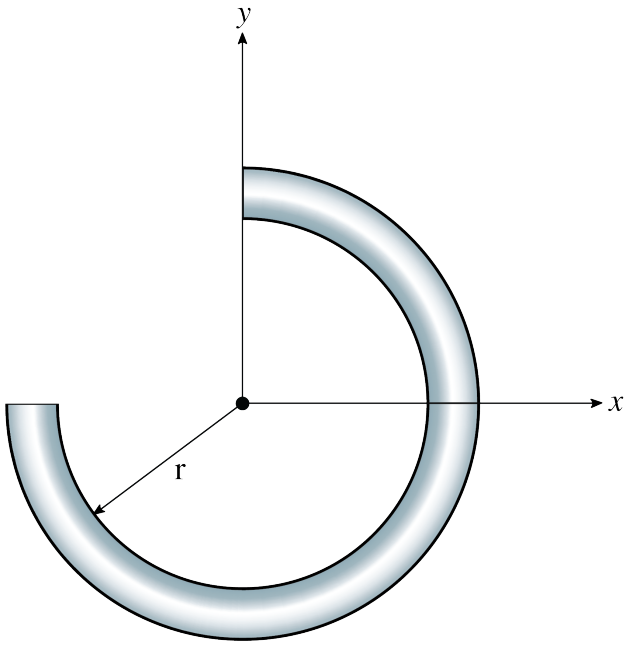
21-R-KIN-MS-54



Determine the moment of inertia of this ring about the z axis, pointing out of the page at the centre of the ring. The ring has mass $m = 50g$ inner radius $r = 10cm$. Its cross-section is circular with a radius $r_c = 1cm$. $\frac{1}{4}$ of the ring has been cut out.

Note: the drawing may not be to scale.

Solution:

Find the density:

$$\rho = \frac{m}{V} = \frac{m}{(\pi r_c^2)(2\pi(r + r_c))(\frac{3}{4})} = \frac{dm}{dV}$$

Solve for dm:

$$dm = \rho dV$$

Integrate:

$$I_z = \int_V (r + r_c)^2 dm = \rho \int_V (r + r_c)^2 dV$$

$$dV = dAdl = Adl = (\pi(r + r_c)^2)(2\pi(r + r_c))d\theta$$

$$I_z = \rho \int_0^{3\frac{\pi}{2}} 2\pi^2 (r + r_c)^4 d\theta$$

$$I_z = 418.1 \ kgcm^2$$