Ch. 9 Student Supplied Problems

A uniform solid sphere has a moment of inertia, I, about an axis tangent to its surface. What is the moment of inertia of this sphere about an axis through its center?

Use parallel axis theorem:

$$I_p = I_{com} + Md^2$$

for uniform solid sphere, $I_{com} = \frac{2}{5} MR^2$

$R = d$

$$I_p = I = \frac{2}{5} Md^2 + Md^2 = \frac{7}{5} Md^2$$

$$I_{com} = \frac{2}{5} Md^2 = X\, I = X\left(\frac{7}{5}\right) Md^2$$

$$X = \left(\frac{5}{7}\right)\left(\frac{2}{5}\right) = \frac{2}{7}$$

So $\boxed{I_{c.o.m.} = \frac{2}{7} I}$

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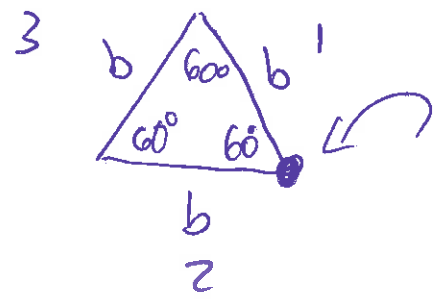
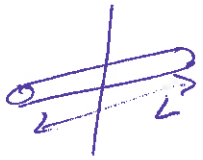


Uniform wire, mass = m

Find Moment of inertia I for rotation around a vertex of equilateral triangle.

From Text, $I_{com\ rod\ axis\ in\ center}: I = \frac{1}{12}mL^2$



for rod, axis on one end: $I = \frac{1}{3}mL^2$

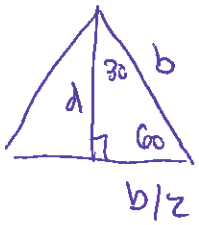
Here, $L = b$, $M = \frac{m}{3}$ for each piece.

Parallel axis theorem: $I_p = I + md^2$

$$I = I_{TOT} = I_1 + I_2 + I_3$$

$$I_1 = I_2 = \frac{1}{3}\left(\frac{m}{3}\right)b^2 = \frac{1}{9}mb^2$$

$$I_3 = \frac{1}{12}\left(\frac{m}{3}\right)b^2 + \left(\frac{m}{3}\right)d^2$$



$$d = \frac{\sqrt{3}}{2}b$$

$$I_3 = \left(\frac{1}{36} + \frac{3}{12}\right)mb^2$$

$\frac{18}{36} = \frac{1}{2}$

$$I_{TOT} = \left(\frac{2}{9} + \frac{1}{36} + \frac{3}{12}\right)mb^2 = \left(\frac{8}{36} + \frac{1}{36} + \frac{9}{36}\right)mb^2$$

$$\boxed{I_{TOT} = \frac{1}{2}mb^2}$$