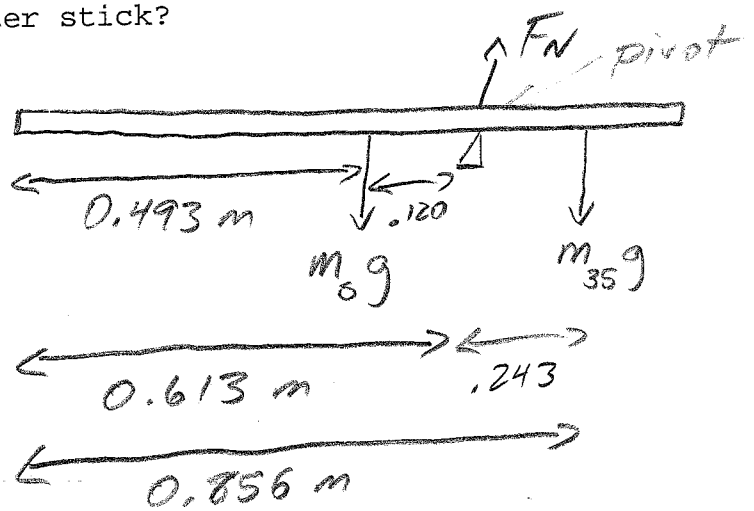
Physics 10154 - Exam #8D

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A meter stick can be balanced on a fulcrum placed at the 49.3 cm mark. If a 35.0 gram mass is hung from the meter stick at the 85.6 cm mark, the fulcrum must be moved to the 61.3 cm mark in order for the stick to remain in equilibrium. What is the mass of the meter stick?



$$\Sigma\tau = \tau_s + \tau_{35}$$

$$= +(.120)\, m_s (9.8) \sin 90 - (.243)(.035)(9.8) \sin 90 = 0$$

$$0.120\, m_s - (.243)(.035) = 0$$

$$m_s = \frac{(.243)(.035)}{.120} = .071 \text{ kg}$$

71 grams

2. A 5.0 kg cylinder of radius 25 cm is initially spinning at a rate of 87 rev/min on a frictionless axle. A 3.0 kg cylinder of radius 18 cm is not spinning by shares an axle with the larger cylinder. If the 3.0 kg cylinder is dropped onto the 5.0 kg cylinder, the two eventually begin rotating together.

a) What is the angular speed of the combined cylinders?

b) How much kinetic energy is lost in the collision?

$$I_5 = \frac{1}{2}(5)(.25)^2 = 0.15625 \text{ kg}\cdot\text{m}^2$$

$$I_3 = \frac{1}{2}(3)(.18)^2 = 0.0486 \text{ kg}\cdot\text{m}^2$$

$$\omega_{5,i} = 87 \frac{\text{rev}}{\text{min}} = 9.11 \text{ rad/s}$$

$$\omega_{3,i} = 0$$

$$I_5 \omega_{5,i} + I_3 \omega_{3,i} = (I_5 + I_3)\omega_f$$

$$(.15625)(9.11) + 0 = .20485\,\omega_f$$

$$\omega_f = \left(\frac{0.15625}{0.20485}\right)(9.11) = \boxed{6.9 \text{ rad/s}}$$

$$K_i = \frac{1}{2}(.15625)(9.11)^2 + \frac{1}{2}(.0486)(0)^2$$

$$= 6.4838 \text{ J}$$

$$K_f = \frac{1}{2}(.15625 + .0486)(6.9)^2 = 4.8765 \text{ J}$$

$$\boxed{\Delta K = -1.6 \text{ J}}$$