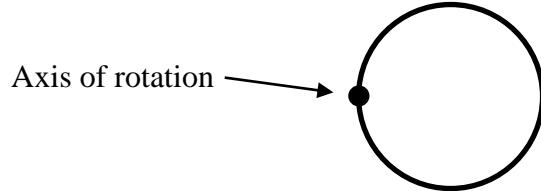


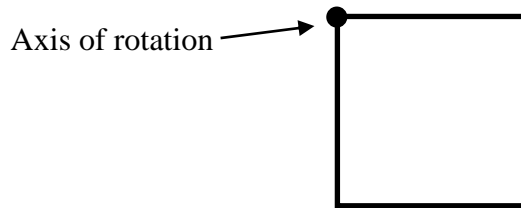
### Problem 1

Find the rotational inertia of each object about the indicated axis of rotation in terms of  $M$  and  $R$  or  $M$  and  $L$ :

a) A uniform, circular, hollow ring with mass  $M$  and radius  $R$ . Axis of rotation is perpendicular to the page and goes through the rim of the ring, as shown.



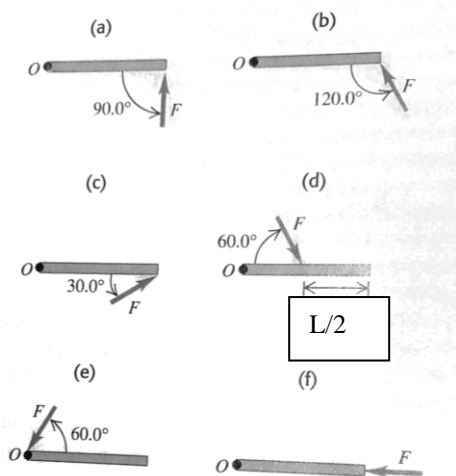
b) A uniform, square, hollow loop with total mass  $4M$  and the length of each side  $L$ . Axis of rotation is perpendicular to the page and through the corner of the square, as shown.



c) A non-uniform rod with density given by,  $\lambda = \alpha x^2$ , in units of  $\text{kg/m}$ ,  $x$  is measured in meters from the end of the rod, and  $\alpha$  is a positive constant. The rod has total mass  $M$  and length  $L$ . The axis of rotation is perpendicular to the page and located at the end of the rod where  $x=0$ .

### Problem 2

Calculate the torque (magnitude and direction) about point  $O$  due to force  $F$ . Give your answer in terms of  $F$  and  $L$  (the length of the rod). The force  $F$  and the rod both lie in the plane of the page.



### Problem 3

A physical pendulum consists of a rod of mass  $m_r$  and length  $L$  and is free to rotate about its top end. A block,  $m_b$ , slides down a frictionless incline and sticks to the end of the rod. Find the maximum angle the rod makes with the vertical after the collision.

Rod

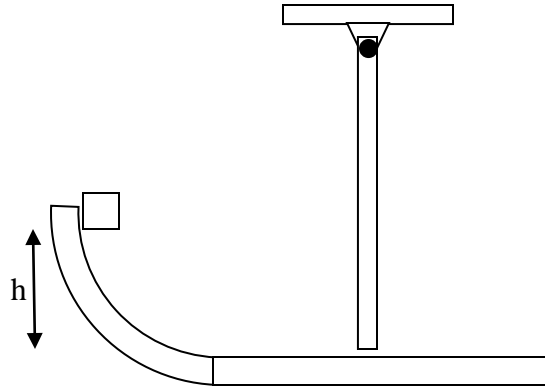
$$m_r = 0.7 \text{ kg}$$

$$L = 1.1 \text{ m}$$

Block

$$m_b = 0.6 \text{ kg}$$

$$h = 0.8 \text{ m}$$



### Problem 4

Write out the equations needed to solve for the acceleration of the blocks and the tensions in the strings in terms of the following known quantities:  $m_1$ ,  $m_2$ ,  $m_3$ ,  $m_{\text{pulley}}$ ,  $R_{\text{pulley}}$ ,  $g$ ,  $\mu_s$ ,  $\mu_k$ ,  $\theta$ . There is friction. Box 2 is moving to the right (block 1 goes up and block 3 goes down). The two pulleys are identical and are solid disks.

