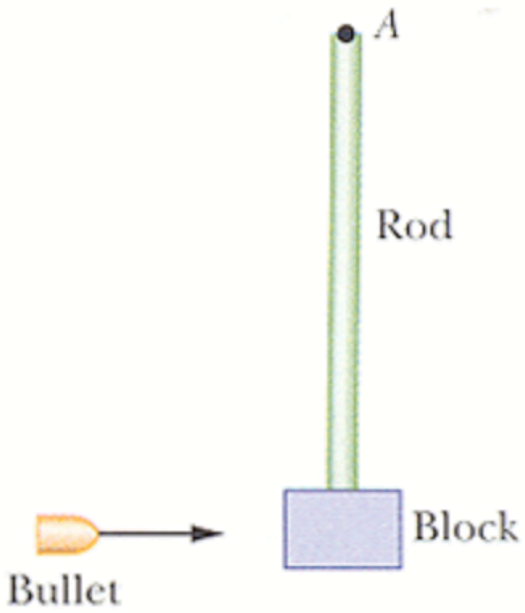
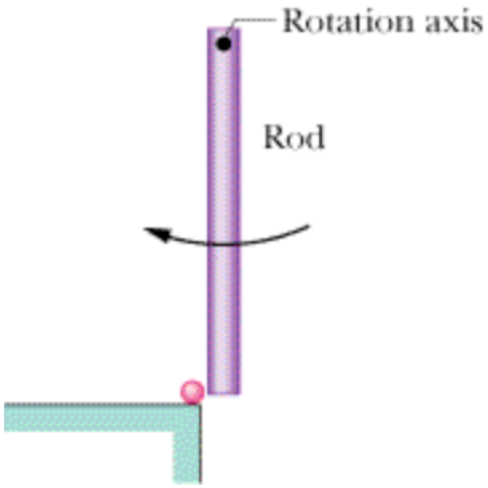
1. **In the figure below, a 1.0 [g] bullet is fired into a 0.80 [kg] block attached to the end of a 0.60 [m] non-uniform rod of mass 0.50 [kg]. The block-rod-bullet system then rotates in the plane of the figure about a fixed axis at A. The rotational inertia of the rod alone about that axis at A is 0.060 [kg m^2]. Treat the block as a particle.**



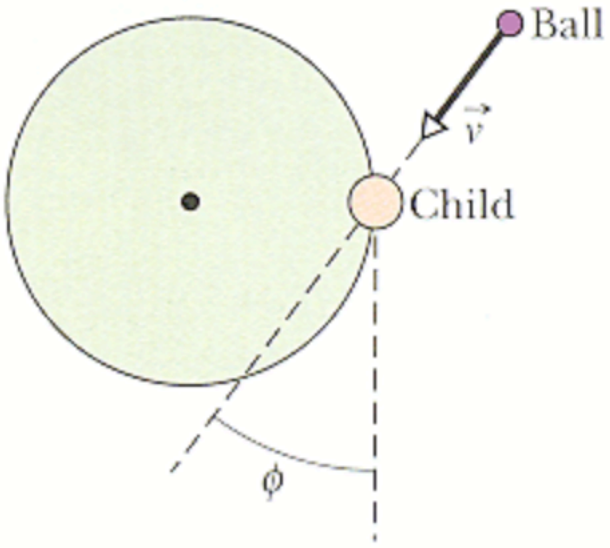
a. **What then is the rotational inertia of the block-rod-bullet system about point A?**

b. **If the angular speed of the system about A just after impact is 4.5 [rad/s], what is the bullet's speed just before impact?**

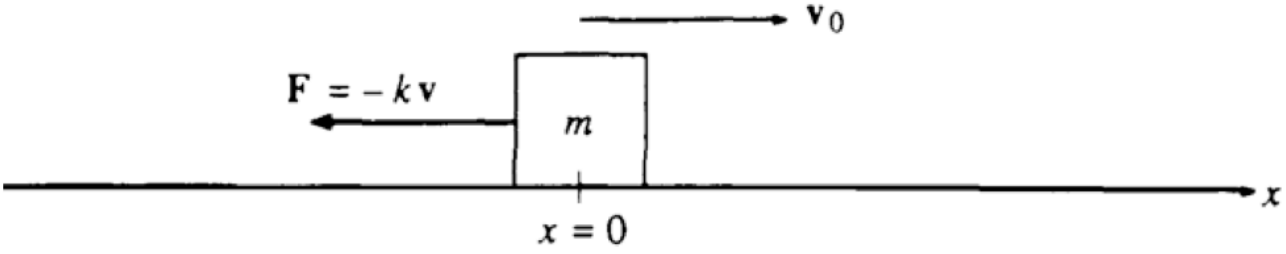
2. **The uniform rod (length 0.60 [m], mass 1.0 [kg]) in the figure below rotates in the plane of the figure about an axis through one end, with a rotational inertia of 0.12 [kg·m^2]. As the rod swings through its lowest position, it collides with a 0.1 kg putty wad that sticks to the end of the rod. If the rod's angular speed just before collision is 2.4 [rad/s], what is the angular speed of the rod-putty system immediately after collision?**



3. **In the figure below, a 30 [kg] child stands on the edge of a stationary merry-go-round of mass 100 kg and radius 2 [m]. The rotational inertia of the merry-go-round about its rotation axis is 150 [kg m^2]. The child catches a ball of mass 1.9 [kg] thrown by a friend. Just before the ball is caught, it has a horizontal velocity v of magnitude 12 [m/s], at angle ϕ = 37° with a line tangent to the outer edge of the merry-go-round, as shown. What is the angular speed of the merry-go-round just after the ball is caught?**



4. **An object of mass m moving along the x-axis with velocity v is slowed by a force F = -kv, where k is a constant. At time = 0, the object has velocity v_0 at position x = 0, as shown below.**



   a. **What is the initial acceleration (magnitude and direction) produced by the resistive force?**
   b. **Derive an equation for the object's velocity as a function of time t, and sketch this function. Let velocity directed to the right be considered positive.**
   c. **Derive an equation for the distance the object travels as a function of time t and sketch this function.**
   d. **Determine the total distance the object travels (i.e., distance traveled from t = 0 to t = infinity)**

AP FRQs

6. **2010 #3 (Skier)**

7. **2016 #2 (Non-linear spring collision)**

8. **2004 #3 (Throwing object off of frictionless disk)**

1a. 0.348 [kg m^2]
1b. 2610 [m/s]

2. 1.85 [rad/s]

3. 0.131 [rad/s]

4a. $a_0 = kv_0$
4b. $v = v_0 e^{-kt/m}$ (graph will be discussed in class)
4c. $x = mv_0/k\,(1 - e^{-kt/m})$ (graph will be discussed in class)
4d. $x = mv_0/k$

6. Will discuss in class

7. Will discuss in class

8. Will discuss in class