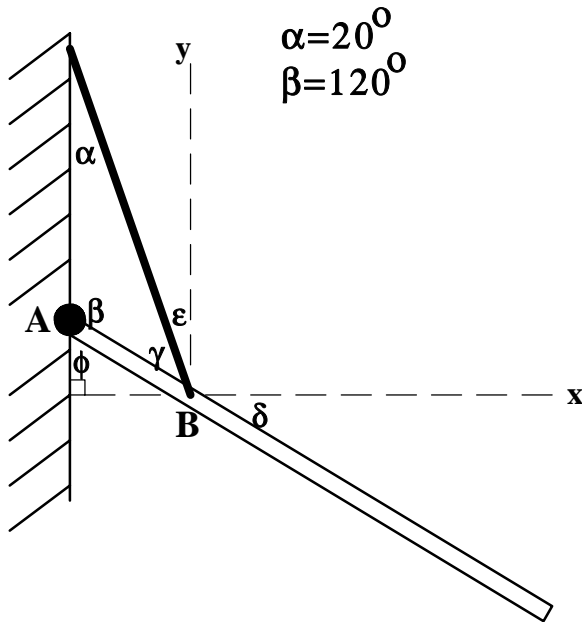


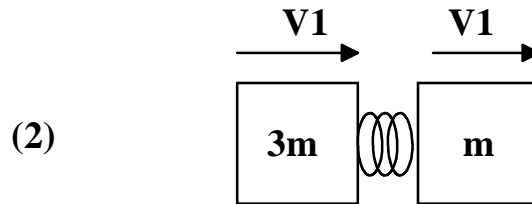
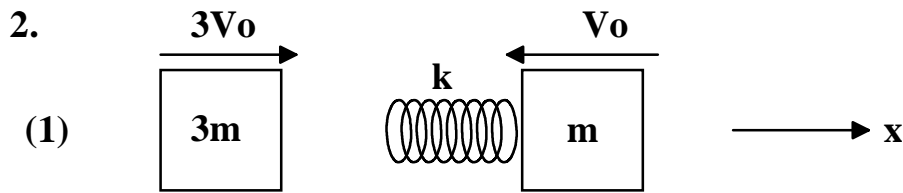
**PHY 1350**  
**EXAM #3**

1.

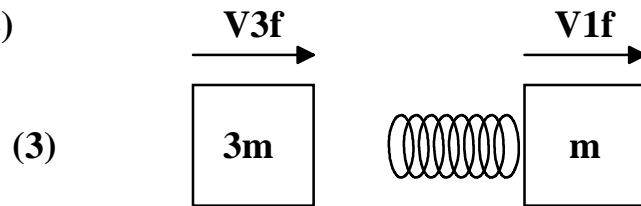


A uniform rod having a weight of 500 Newtons is attached to a wall by a frictionless axel at point A. To keep the rod from rotating, a light, inextensible cord is attached to the wall and to the rod at a point B. The length of segment AB is 1/4th the length of the rod.

- (a.) Determine the values of the angles:  $\gamma, \delta, \epsilon, \phi$ . Don't just report answers, show work or explain how the angles are related.
- (b.) Assume that two forces act on the rod at axel A,  $N_x$  and  $N_y$ . Let the tension in the cord be called T. Write down the x-component force equation for the rod assuming that it is in equilibrium.
- (c.) Write down the y-component force equation for the rod, assuming equilibrium.
- (d.) Write down the equilibrium torque equation using A as your axis.
- (e.) Solve for the tension in the cord and for the forces that the axel exerts on the rod.



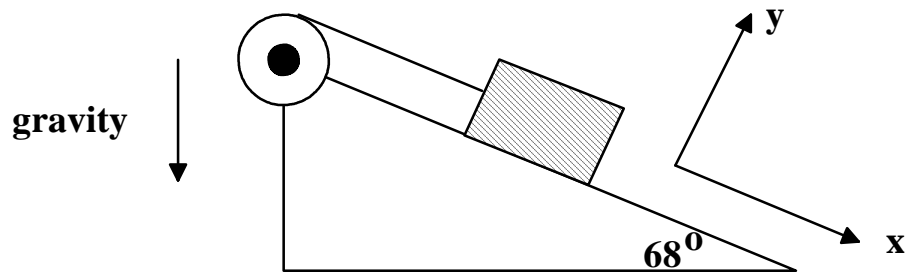
**Event (3) occurs after event (2)  
which occurs after event (1).**



Two blocks, one of mass  $3m$  and one of mass  $m$ , slide along a frictionless, horizontal surface, as shown in event (1) above. Let the system include both blocks and the massless, completely elastic spring, which is attached to the right block. The initial speeds and directions are given in picture (1) above. The velocities for the later events (2) and (3) are unknown. The masses and the spring constant are known.

- What is the total momentum of the system in terms of the given quantities in event (1)?
- In event (2) the spring has been compressed to its maximum value before it begins to decompress. At the instant of maximum compression, the velocities of the two blocks must be the same. Determine the value of this common velocity.
- Use energy to determine the compression distance in the spring when it is at maximum compression in event (2)?
- Determine the final velocities of the blocks when they have finally parted, (event (3)).

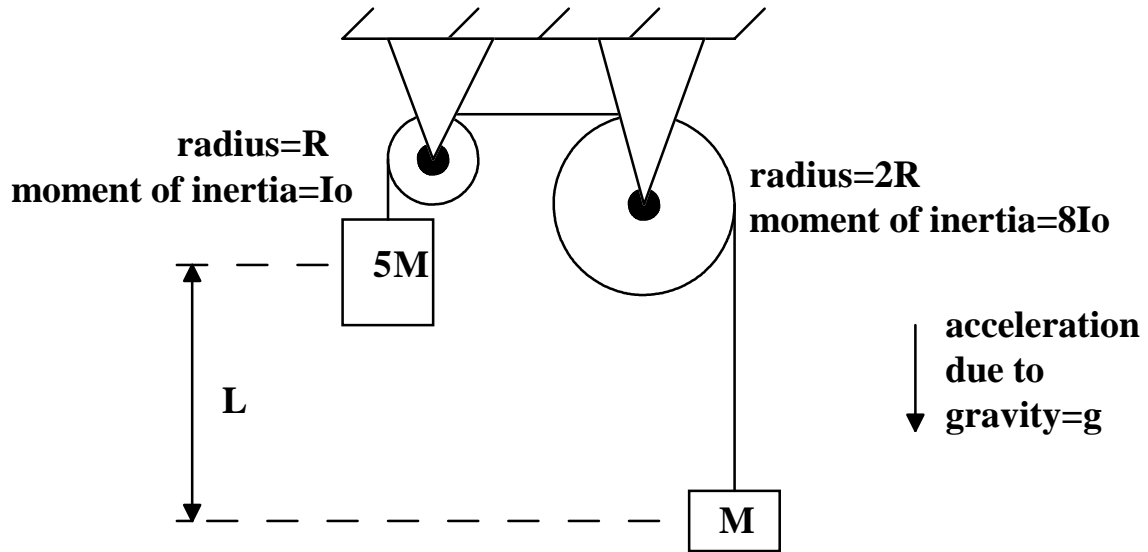
3.



A 50 kg block slides with constant acceleration down a rough incline plane. The coefficient of kinetic friction between block and plane is 0.2. The block is attached to a pulley by a cord which is parallel to the plane surface. The pulley turns on a frictionless axel and has a radius of 20 centimeters and a moment of inertia of  $0.8 \text{ kg m}^2$ .

- Draw a free body diagram for the block.
- Draw a free body diagram for the pulley.
- Write down Newton's 2nd law equation for the x direction for the block.
- Write down Newton's 2nd law equation for the y direction for the block.
- Write down the appropriate torque equation which describes the motion of the pulley.
- Use (c.), (d.), and (e.) to determine the numerical value of the tension in the cord.

4.



A light, inextensible cord connects an object of mass  $M$  to an object of mass  $5M$  by wrapping over two pulleys whose axels are frictionless. The cord does not slip on the pulleys, but causes them to turn as the heavier mass falls and the lighter mass rises. The moments of inertia of the pulleys, as given in the diagram above are calculated with respect to each pulley's axel.

(a.) As the pulleys turn, how is the angular velocity of one related to the angular velocity of the other?

(b.) If the system starts from rest, how fast will the object of mass  $M$  be moving when it has risen a distance  $L$ ? Use energy concepts.