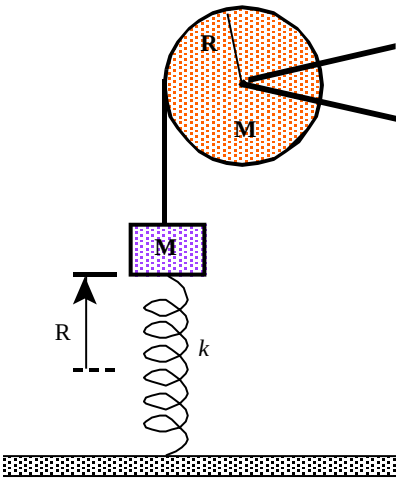
Physics 1135 **Test Preparation HW #3**

The following three problems have been selected from previous exams. When you see "OSE" in front of a task, it means you must begin your solution with an Official Starting Equation.

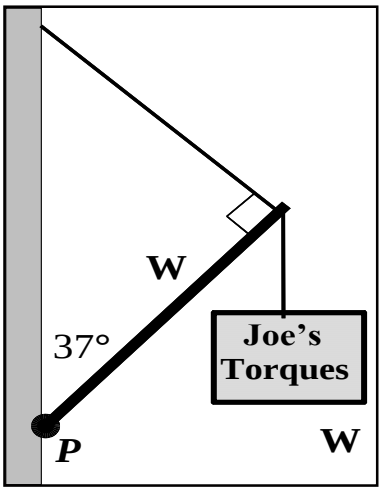
1. A string is wound tightly around a freely rotating disk of mass *M* and radius *R*, with moment of inertia ½ MR^2. The free end of the string is then attached to a block of mass *M*, which itself is attached to a vertical spring of spring constant *k*. The disk is rotated clockwise by some external agent until the spring is stretched from its equilibrium length by a distance *R* equal to the radius of the disk. It is held in this position until it is released.



(OSE) a) Derive an expression for the linear acceleration magnitude of the block at the moment that the system is released, in terms of appropriate system parameters and physical constants.

(OSE) b)What is the block's speed when the spring is again at its natural length?

2. A beam of length *L* and weight *W* is attached to a wall at its base by pivot ***P***. A thin cable is attached to the rod and the wall in such a way that the cable and beam are perpendicular. The rod makes an angle of 37° with respect to the vertical. A sign with weight *W* is hung from the end of the beam.

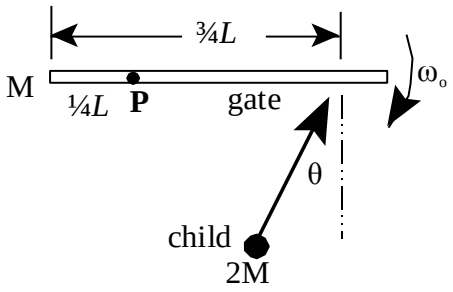


(OSE) a) Determine the tension the cable in terms of *W* by taking the torques about the pivot ***P***.

(OSE) b) Determine the horizontal and vertical components of the reaction force that the pivot exerts on the beam in terms of *W*.

3. A entrance gate into a petting zoo has mass M and width L. It is pivoted at point **P** that is $\frac{1}{4}L$ from one end. A parent has just gone through the gate and it is swinging back. An unruly child of mass $2M$ enters the zoo by leaping onto the gate with speed V and angle θ at a point that is $\frac{3}{4}L$ from its end. **Just before** the child hits and clings to it, the gate's angular speed is ω_o as shown in the diagram. The moment of inertia of the gate about its center of mass is $\frac{1}{12}ML^2$ and about an end is $\frac{1}{3}ML^2$.

OSE



(OSE) a) What is the moment of inertia of the gate about its pivot **P**?

(OSE) b) Derive an expression of the angular speed of the gate-child system just after the child has leaped onto it.