1. A circus performer of mass M jumps onto a trampoline at a horizontal distance L from her initial position, and at a vertical distance H below it, as shown in the figure..

a) What should the initial velocity v_0 of the performer be (assume that it is in the horizontal direction) so that she lands on the trampoline?

b) The trampoline is supported by a huge spring of spring constant k. What is the maximum displacement h of the trampoline when compressed?

c) How far away will the performer land (from the trampoline) when she hits the ground (ignore the height of the trampoline)?

d) How long will the performer be in flight after she leaves the trampoline?
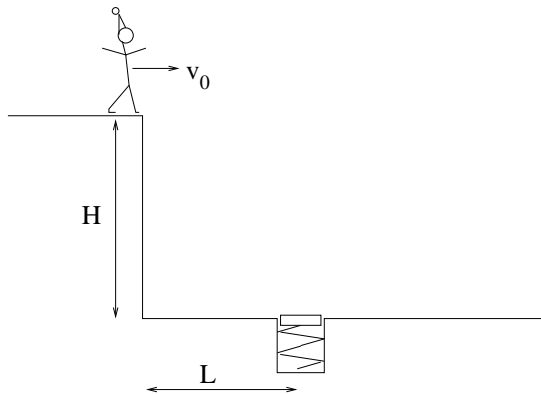
2. As shown in the diagram, two blocks with masses m_1 and m_2 are attached by an unstretchable rope around a frictionless pulley with radius r and moment of inertia I. There is no slipping between the rope and the pulley. The coefficient of kinetic friction between the blocks and between the blocks and the level surface is μ. A horizontal force $\mathbf{F}$ is applied to m_1. Find the acceleration.
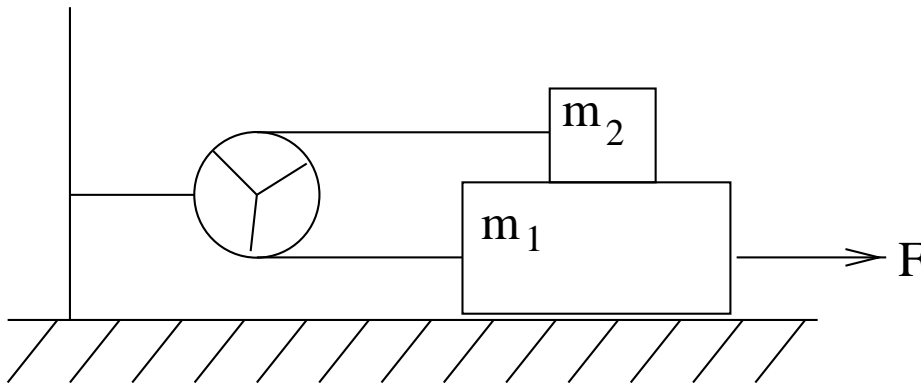
3. A mass m at the end of a string swings in a vertical circle of radius R. The velocity v_{top} of the mass at the top of the circle is the minimum value for vertical circular motion.

a) Find v_{top}.

b) Find the velocity of the mass when the string makes an angle of $120°$ with a vertical line through the center of the circle.

c) Find the tension in the string for the position of part b).

d) Find the acceleration of the mass at the position of part b).

e) What is the angular momentum of the mass about the center of the circle when it is in the position of part b)?

f) What is torque about an axis through the center of the circle when the mass is at the position of part b)?

4. A spring of constant $k = 10$ N/m is attached to a wall and to a block of mass 1 kg. The coefficients of static and kinetic friction between the block and the floor are $\mu_s = 0.25$ and $\mu_k = 0.2$, respectively. The spring is compressed by 0.5 m and the block is released. How far does the block travel before coming to rest for the first time?