(1) A force in the xy plane is given by $\vec{F} = \left(\frac{F_0}{r}\right)\left(y\hat{i} - x\hat{j}\right)$, where F_0 is a constant and $r = \sqrt{x^2 + y^2}$.

(a) Show that the magnitude of this force is F_0 and that its direction is perpendicular to $\vec{r} = x\hat{i} + y\hat{j}$

(b) Find the work done by this force on a particle that moves once around a circle of radius 5m centered at the origin. Is this force conservative ?

(2) A simple Atwood's machine (as in figure) uses two masses m_1 and m_2. Starting from rest, the speed of the two masses is 4.0 m/s at the end of 3.0 sec. At that time, the kinetic energy of the system is 80 J and each mass has moved a distance of 6.0 m. Determine the values of m_1 and m_2
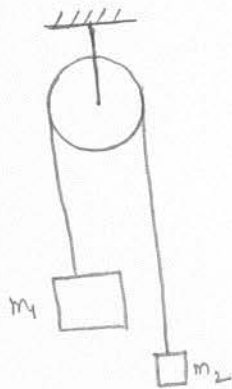
(3) A sky diver falls through the air toward the ground at a constant speed of 120 km/hr, her terminal velocity, before opening her parachute

(a) If her mass is 55 kg, calculate the magnitude of the power due to the drag force

(b) After she opens her parachute, her speed slows to 15 km/hr. What is the magnitude of the power due to the drag force now?

(4) A roller coaster car of mass 1500 kg starts at a distance $H = 23$ m above the bottom of a loop 15 m in diameter. If friction is negligible, find the downward force of the rails on the car when it is upside down at the top of the loop?
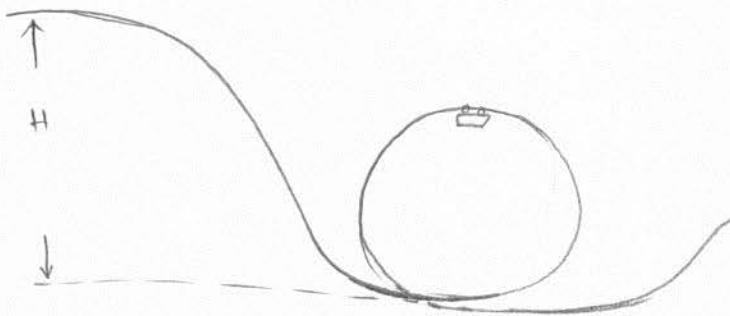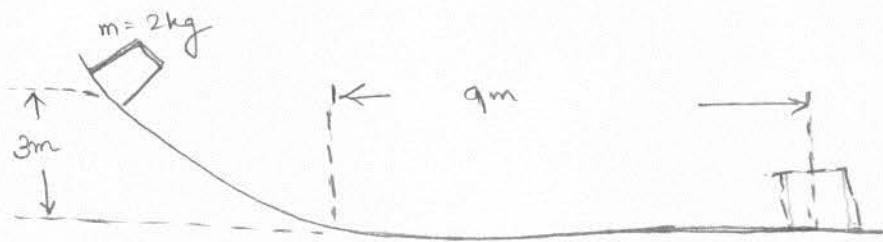

(5) A 2 kg block slides down a frictionless curved ramp, starting from rest at a height of 3m. The block then slides 9m on a rough horizontal surface before coming to rest.

(a) What is the speed of the block at the bottom of the ramp?

(b) What is the energy dissipated by friction?

(c) What is the coefficient of friction between the block and the horizontal surface?

(6)(a) Find the position of center of mass of a semi-circular wire of radius R and mass M.

(b) Find the position of center of mass of a semi-circular disc of radius R and mass M

(7) A 40 kg skateboarder on a 3 kg board is training with two 5 kg weights. Beginning from rest she throws the weights horizontally, one at a time from her board. The speed of each weight is 7 m/s relative to her and the board after it is thrown. Assume the board rolls without friction (a) How fast is she propelled in the opposite direction after throwing the first weight (b) the second weight.

(8) A uniform rope of mass M and length L is held with its lower end just touching the surface of a scale. The rope is released and begins to fall. Find the force of the scale on the rope just as the midpoint of the rope first touches the scale.
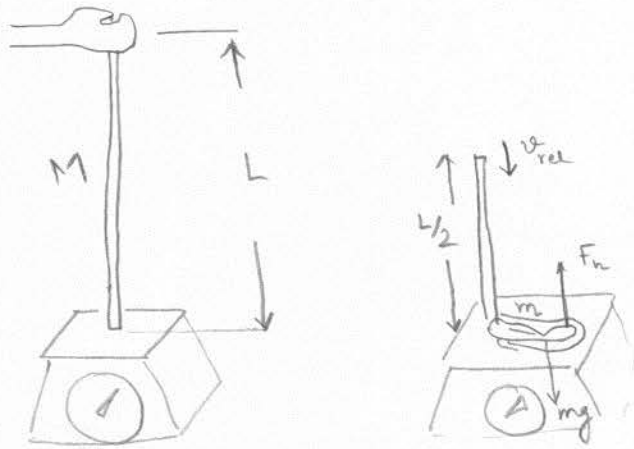
(9) A puck of mass 5 kg moving at 2 m/s approaches an identical puck that is stationary on frictionless ice. After the collision, the first puck leaves with a speed v_1 at 30° to the original line of motion, the second puck leaves with a speed v_2 at 60°, as in figure

(a) Calculate v_1 and v_2
(b) was the collision elastic.