Problem 1

The illustrated equilateral triangle is supported by two links. Knowing $d = 0.5$ m,

a) Draw the FBD of each bar and the triangle
b) Find the center of mass of the system knowing the bars have a density of $2 \text{ kg/m}$ and the triangle has a density of $5 \text{ kg/m}^2$
c) Find acceleration of point $C$, $a_c$. 
Problem 2

The 2 m long, 20 kg slender bar is constrained to move in the illustrated guid. Point B is confined to move in the vertical guide, and A moves in the horizontal guide. At the instant shown, the spring is uncompressed, and B has a speed of 2 m/s directed downward. Although the horizontal guide is frictionless, the vertical guide resists motion of B within it with a force of 100N. Knowing $k = 100\text{N/m}$:

a) Draw the FBD of the bar
b) Derive the equation of motion for the bar.
c) Find the spring force at the instant shown
Problem 3

The two blocks shown are released from rest. Neglecting the masses of the pulleys and the effect of friction in the pulleys and knowing that the coefficients of friction between both blocks and the incline is $\mu_s = 0.25$,

a) Draw the FBDs of both blocks as well as the 3 pulleys
b) Find the velocity of block A after it has moved 1.5 ft.
c) Find the tension in the cable

$W_A = 20\text{ lb, } W_B = 16\text{ lb}$
Problem 4

A solid disk of radius $r_s$ is rolling without slip off of another larger disk of radius $R$ in which the larger disk is fixed to the ground. Knowing that the relationship between $r_s$ and $R$ can be given by:

$$(R + r_s)\theta = r_s \phi$$

where $\theta$ is the angular distance to the center of the small disk and $\phi$ defines the orientation of the small disk. Find:

a) The moment of inertia of the system about point $K$

b) The equations of motion in terms of $r$ and $\theta$ of the small disk when the small disk loses contact with the large disk

c) The equations of motion in terms of $r$ and $\theta$ of the small disk when the small disk is in contact with the large disk. (Hint: Use $\frac{dH}{dt} = \mathbf{M}$ of the small disk)