System Dynamics Exam 1 Fall 2013

The FE reference book and 1 formula sheet may be used during this exam. 10 points each.

1. .

1.15 The distance a spring stretches from its "free length" is a function of how much tension is applied to it. The following table gives the spring length y that was produced in a particular spring by the given applied force f. The spring's free length is 4.7 in. Find a functional relation between f and x, the extension from the free length ($x = y - 4.7$).

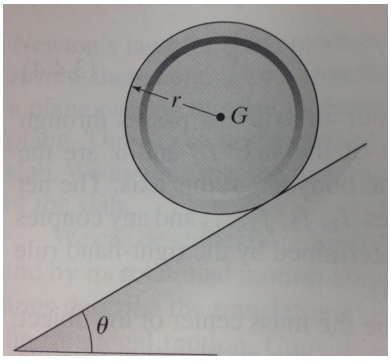
Force f (pounds)	Spring length y (inches)
0	4.7
0.47	7.2
1.15	10.6
1.64	12.9

2. A uniform cylinder of mass m rolls down an incline as shown below. Determine the friction force and acceleration/s for the cases of:

   (a) Rolling *without* slipping

   (b) Rolling *with* slipping

   How do you determine if the cylinder is rolling without slipping, or rolling while slipping?



3. A mechanically powered windlass is shown. A torque T drives gear C, which in turn drives gear B and drum A. A mass D of 800 kg is being raised by the windlass. The torque is given as $T = 300 + 15t$ N-m (where t is in seconds). Write the acceleration of the mass D as a function of time. The combined radius of gyration of drum A, gear B, and the shaft connecting them is 300 mm, and the combined mass if 100kg. The

radius of gyration of gear C and associated shaft is 80mm, with corresponding mass of 10kg.