MECH 211-1

Spring 2009, Prof. Yakobson

Test 2

Due in class 10 am Monday March 23, 2009

Show all work. Any force existing in an equation must also be denoted on an appropriate free body diagram. Clearly indicate (box) final answers.

This test is taken under the Rice Honor Code system. You may consult only the textbook (Bedford and Fowler), and notes that you have personally taken, or classnotes-materials downloaded from the course website. You may use a calculator, including programmable calculators. The test must be taken during a contiguous 3 hour period, with an optional 30 minutes break.

At the conclusion of the test, fold all sheets in half with your name (above) clearly visible, and seal them (staple or tape).

Time started: _____.

Time finished: _____.

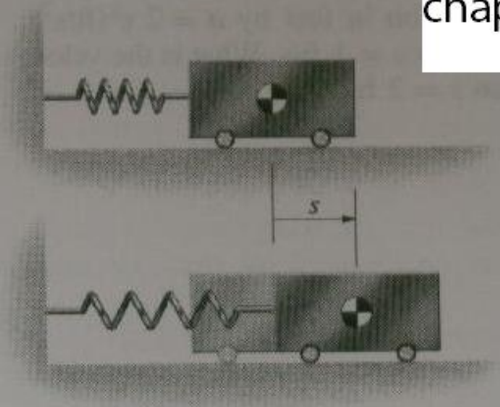
Pledge/signature: _____.

Problem 1

chapter 13

A spring-mass oscillator consists of a mass and a spring connected as shown. The coordinate s measures the displacement of the mass relative to its position when the spring is unstretched. If the spring is linear, the mass is subjected to a deceleration proportional to s. Suppose that $a = -4s$ m/s^2, and that you give the mass a velocity $v = 1$ m/s in the position $s = 0$.

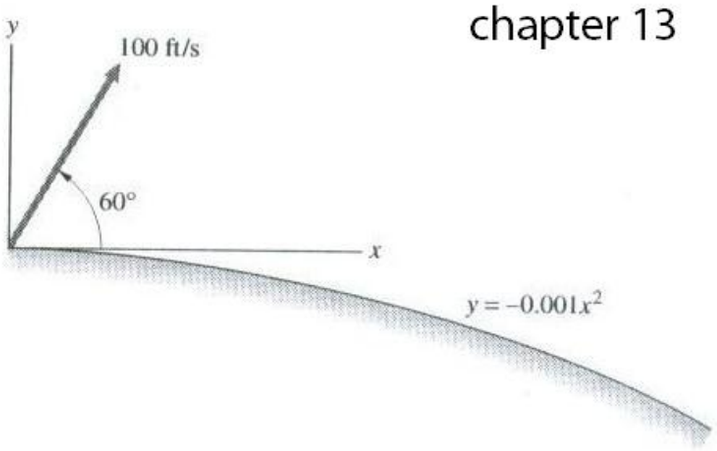
(a) How far will the mass move to the right before the spring brings it to a stop?
(b) What will be the velocity of the mass when it has returned to the position $s = 0$?



chapter 13

Problem 2

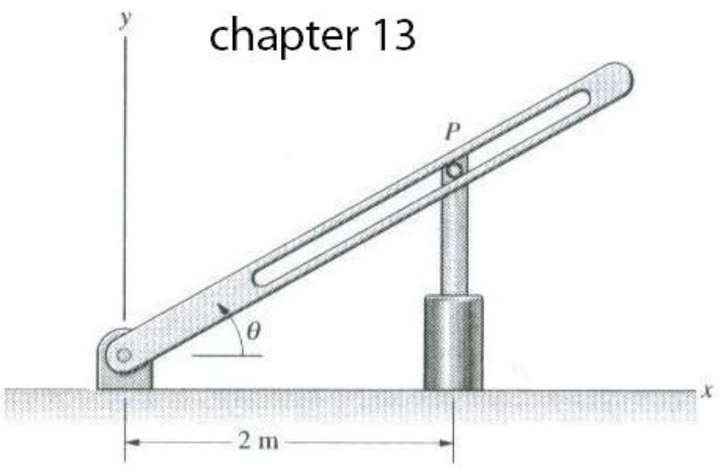
A projectile is launched at 100 ft/s at 60° above the horizontal. The surface on which it lands is described by the equation shown. Determine the point of impact.



chapter 13

Problem 3

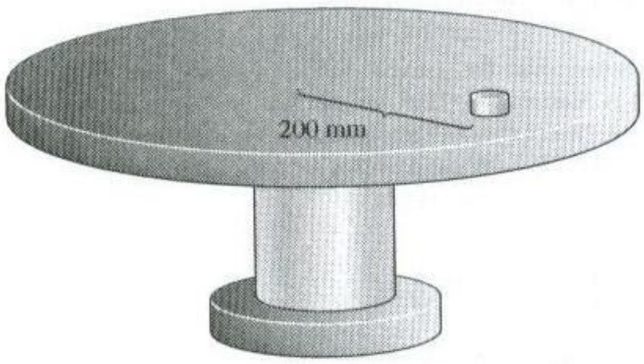
The hydraulic actuator moves the pin P upward with constant velocity $\mathbf{v} = 2\mathbf{j}$ (m/s). Determine the velocity of the pin in terms of polar coordinates and the angular velocity of the slotted bar when $\theta = 35°$.



chapter 14

Problem4

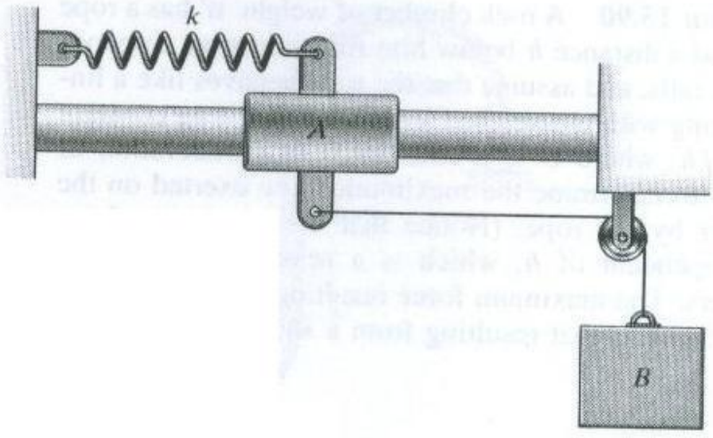
To determine the coefficient of static friction between two materials, an engineer at the U.S. National Institute of Standards and Technology places a small sample of one material on a horizontal disk whose surface is made of the other material and then rotates the disk from rest with a constant angular acceleration of 0.4 rad/s^2. If she determines that the small sample slips on the disk after 9.903 s, what is the coefficient of friction?



Problem 5

chapter 15

The collar A slides on the smooth horizontal bar. The spring constant $k = 40$ lb/ft. The weights are $W_A = 30$ lb and $W_B = 60$ lb. As the instant shown, the spring is unstretched and B is moving downward at 4 ft/s. Use conservation of energy to determine the velocity of B when it has moved downward 2 ft from its current position.



(see example 15.8 5th edition)

(see example 15.9 4th edition)

---

chapter 16

Problem 6

The 10-kg mass A is moving at 5 m/s when it is 1 m from the stationary 10-kg mass B. The coefficient of kinetic friction between the floor and the two masses is $\mu_k = 0.6$, and the coefficient of restitution of the impact is $e = 0.5$. Determine how far B moves from its initial position as a result of the impact.