Physics I with Calculus
Exam 2
March 30, 1999

Name:

You have 75 minutes to complete the exam. Choose 3 problems out of numbers 1 through 4. Circle below the three you wished graded. Problems 5 and 6 are required.

1   2   3   4

Good Luck!

$W = Fd\cos\theta$

$K = \frac{1}{2}mv^2$

$U_{gravity} = mgy$

$U_{spring} = \frac{1}{2}kx^2$

One-dimensional elastic collision

$$v_{1f} = \frac{m_1 - m_2}{m_1 + m_2}v_{1i} \qquad v_{2f} = \frac{2m_1}{m_1 + m_2}v_{1i}$$

$a_c = v^2/r$

$\mathbf{p} = m\mathbf{v}$

$x - x_0 = v_0 t + \frac{1}{2}at^2$
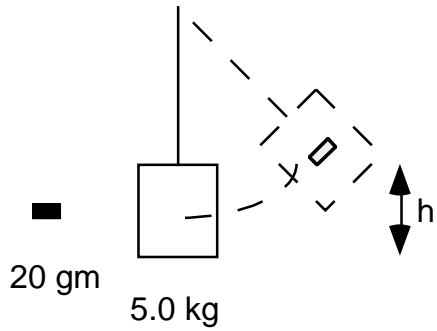
$v = v_0 + at$

$v^2 - v_0^2 = 2a(x - x_0)$

static friction

$F_{friction} \leq \mu_s F_N$

kinetic friction

$F_{friction} = \mu_k F_N$

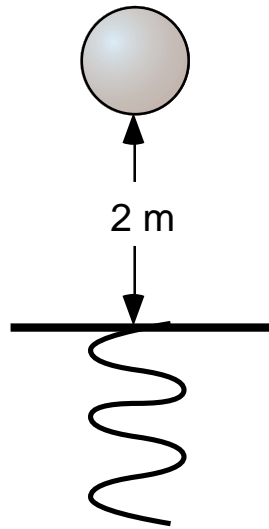1. A bullet of mass 20 gm and speed of 200 m/s becomes embedded in a block which has a mass of 5.0 kg. The block hangs from a string.

20 gm

5.0 kg

(a) What is the speed of the block after the bullet hits the block?

(b) What is the height h the block travels?

2.

2 m

A 1-kg ball is dropped 2 m above a spring whose spring constant is 30 N/m.
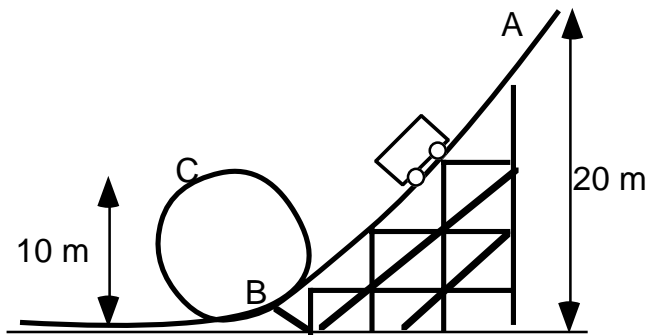
(a) What are the possible components of the energy in this problem?

(b) What is the maximal compression of the spring?

(c) What is the kinetic energy of the ball just before it hits the spring?

(d) How high will the ball go after it has compressed the spring?

3. You are designing a roller coaster. The coaster starts from rest at the top (point A). The coaster has a mass of 1000 kg.


(a) What is the speed at point B?

(b) What is the speed at point C?

(c) What is the centripetal force at point C?

(d) What is the magnitude and direction of the normal force at point C?

(e) Is the ride safe?

5. A cardboard box with a weight of 5 N is placed on a wooden ramp. The ramp is inclined at 30° with respect to horizontal. The coefficient of static friction μ_s is 0.60, and the coefficient of kinetic friction μ_k is 0.50.
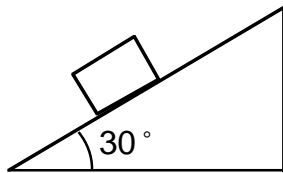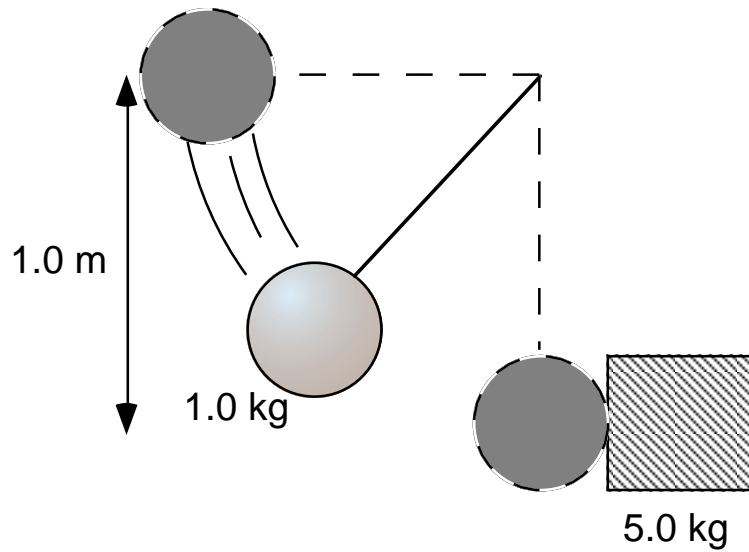

a.) Draw the free body diagram. What is the magnitude of the normal force?

b.) What is the net force on the box along the surface of the ramp?

c) Does the box move, and if so, what is its acceleration?

4.

A 1-kg ball on a 1.0-m string is dropped from rest and collides elastically with a block, as shown above.

(a) What is the kinetic energy of the ball just before it hits?

(b) After the collision, what is the speed of the box?

(c) What is the speed of the ball after the collision?

(d) How high does the ball go after the collision?

6.
True or False
If false, explain why.

(a) Momentum is always conserved. T F

(b) Total energy is always conserved. T F

(c) Normal force is always opposite the direction of gravity. T F

(d) An object can move at constant speed and still accelerate. T F

(e) The center of mass of high jumper follows a parabola during a jump.
T F