Phy131 Fourth Homework Assignment
Due Wednesday February 10

Do as many problems as you like. You recieve one point for each correct, or almost correct, answer. The figures are found next to this assignment on my homework web page.

Question 1

Shaquille, who weighs 300 pounds, wants to swing on a swing in the neighborhood playground. The swing has two ropes, each of length 10 feet. Each rope attached to the swing can withstand a force of 200 pounds before breaking. What is the maximum speed at the bottom of the swing that Shaquille can have without breaking the ropes?

Question 2

A block slides down an inclined plane. The plane makes an angle of 30° with the horizontal. If the acceleration of the block down the plane is $g/3$, what is the coefficient of friction between the block and the surface of the plane?

Question 3

Craig has a large block of wood with a scale attached to it. When the block hangs from the scale, the scale reads 100 units. When he pulls the block along the level ground with the scale at a constant velocity, the scale reads 60 units. What will the scale read when he pulls the block up a 30° incline at a constant velocity? Assume the coefficient of friction is the same for sliding on the ground and up the incline.

Question 4

Consider the set of masses and pulley shown in the figure on the last page. A large mass M hangs over the pulley and pulls the other two blocks. One block has a mass of $4m$, with a smaller block of mass m on top. The coefficient of friction, both static and kinetic, between the surfaces is 0.6. Assume that the string and pulley are massless, and that the pulley spins without friction.

How much mass can the block M have such that the block m accelerates to the right without slipping on the lower block of mass $4m$.

Question 5.

Find the kinetic energies, in Joules, of the following objects:

a) an 80 Kg sprinter running at 10 m/sec.
b) a baseball, mass 255 grams, traveling at 100 mph.
c) a 1500 Kg automobile traveling down the road at 70 mph.

Question 6

A rope is used to vertically lower a block of mass m a distance d. As the rope lowers the block, the acceleration of the block is $g/5$. Find:

a) The work done on the block by the force of gravity.
b) The work done on the block by the force of the rope.

Express your answers in terms of mg and d.

Question 7

Teresa slides down a slide that makes an angle of 20° with the horizontal. The slide is 6 meters long. She starts off at rest, and reaches a speed of 3 m/sec at the bottom of the slide. If her mass is 40 Kg, find:

a) the work done by the force of gravity during her slide.
b) the work done by the force of friction during her slide.

Question 8

A physics book of weight W is thrown vertically upward into the air with an initial speed of v_0. Assume that the force of air resistance is constant throughout the flight and is equal to f. Show:

a) that the maximum height that the book reaches is

$$h = \frac{v_0^2}{2g(1 + f/W)} \tag{1}$$

b) that the speed of the book upon impact with the ground is

$$v = v_0\sqrt{\frac{W-f}{W+f}} \tag{2}$$

Question 9

Henrietta goes skiing. She initially starts from rest and skis down the left hill, which is frictionless. See the figure on the last page. She then skis across the parking lot, where the coefficient of kinetic friction μ is 0.6. After traveling across the parking lot, which is 50 meters long, she slides up the frictionless hill on the right. The hill on the left makes an angle of 53° and the hill on the right makes an angle of 37° with the horizontal. She initially starts a distance of 100 meters up the left hill.

a) How far up the right hill does she travel before coming to rest?
b) If she continues to slide back and forth before coming to rest, where in the parking lot does she finally end up?

Question 10

A ball of mass m is attached to a massless string. It is swinging in a vertical circle. If we neglect any frictional effects, it will swing forever. In this case the tension when it is at the bottom of the circle, T_B, is greater than the tension at the top of the circle, T_T. Show that

$$T_B - T_T = 6mg \tag{3}$$

no matter how fast the ball is going at the bottom of the swing.

Question 11

Using the vector scalar product, find the angle that the diagonal of a cube makes with one of its sides. Hint: consider a vector from one corner of the cube to the opposite corner of the cube.

Question 12

A chain of total mass m and total length L lies on a frictionless table with 3/4 of its length hanging over the edge. How much work does it take to pull the hanging part up onto the table? Express your answer in terms of m, L, and g.