1. One end of a spring is anchored to a stationary wall. The other end is attached to a mass that is at rest on a frictionless horizontal surface. The spring constant is 50 N/m, the spring is initially at its relaxed length and the mass is initially at rest. Assume that the spring lies along the x-axis, the mass is initially at the origin and +x is in the direction of spring extension. Now, a constant force $F = 3.0N$ that points in the positive x-direction acts on the mass stretching the spring until the block stops. When that stopping point is reached, what are (a) the position of the block, (b) the work that has been done on the block by the applied force, and (c) the work that has been done on the block by the spring force? During the block's displacement, what are (d) the block's position when its kinetic energy is maximum and (e) the value of that maximum kinetic energy?

2. A 250 g block is dropped onto a relaxed vertical spring that has a spring constant of $k = 2.5$ N/cm. The block becomes attached to the spring and compresses the spring 12 cm before momentarily stopping. While the spring is being compressed, what work is done on the block by (a) the gravitational force on it and (b) the spring force? (c) What is the speed of the block just before it hits the spring? (Assume that friction is negligible.) (d) If the speed at impact is doubled, what is the maximum compression of the spring?

3. A constant force of magnitude 10 N makes an angle of 150° (measured counterclockwise) with the positive x direction as it acts on a 2.0kg object moving in an x-y plane. How much work is done on the object by the force as the object moves from the origin to the point having position vector $(2.0m \hat{i} - (4.0 m) \hat{j})$?

4. You push a crate of mass $M$ up a ramp that is inclined by an angle $\theta$ from the horizontal by applying a force of magnitude $F$ that is directed horizontally. If the ramp is $L$ long, the coefficient of kinetic friction between the mass and the ramp is $\mu$ and the crate moves with constant velocity, find (a) the total work done on the crate, (b) the work done on the mass by its weight, (c) the work done by kinetic friction, (d) the work you do on the crate and (e) the work the normal force does on the crate. What do you get if you add your answers (b) -(e).

5. If a ski lift raises 100 passengers averaging 660 N in weight to a height of 150 m in 60.0 s, at constant speed, what average power is required of the force making the lift?
6. A mass $M$ is at rest on a horizontal plane. One end of a spring with constant $k$ is anchored to a vertical wall and the other end of the spring is in contact with the mass so that the spring is compressed by an amount $\Delta x$. The coefficient of static friction between the mass and plane is $\mu_s$ and the coefficient of kinetic friction between the mass and plane is $\mu_k$. (a) Find the smallest $\Delta x$ (call it $\Delta x_{\text{min}}$) so that the mass will slide. (b) If $\Delta x > \Delta x_{\text{min}}$, find how far the mass slides before coming to rest. Note that there are 2 cases, one where the spring does not completely relax before the mass comes to rest and one where the mass comes to rest after leaving contact with the spring.

7. The picture shows a box sliding rightward across a frictionless floor through a distance $d = 20.0$ cm while three forces act on the box. Two of them are horizontal and have the magnitudes $F_1 = 5.00$ N and $F_2 = 1.00$ N; the third is angled down by $\theta = 60.0^\circ$ and has the magnitude $F_3 = 4.00$ N. (a) For the 20.0 cm displacement, what is the net work done on the box by the three applied forces, the gravitational force on the package, and the normal force on the package? (b) If the package has a mass of 2.0 kg and an initial kinetic energy of 0, what is its speed at the end of the displacement?

8. A spring with constant $k$ is attached to a stationary ceiling. You attach a mass $m$ to its free end and slowly lower it from rest so that it is motionless the instant it leaves your hand. How much work do you do lowering the mass?

9. The picture shows a thin rod, of length $L = 2.00$ m and negligible mass, that can pivot about one end to rotate in a vertical circle. A ball of mass $m = 5.00$ kg is attached to the other end. The rod is pulled aside to angle $\theta_0 = 30.0^\circ$ and released with initial speed $v_0 = 0$. As the ball descends to its lowest point, (a) how much work does the gravitational force do on it and (b) what is the change in the gravitational potential energy of the ball-Earth system? (c) If the gravitational potential energy is taken to be zero at the lowest point, what is its value just as the ball is released? (d) Do the magnitudes of the answers to (a) through (c) increase, decrease, or remain the same if angle $\theta_0$ is increased?

10. The small mass $m = 0.032$ kg can slide on the frictionless loop-the-loop, with loop radius $R = 12.0$ cm. If the mass is released from rest at point $P$ with $h = 5.0R$ what are the magnitudes of (a) the horizontal component and (b) the vertical component of the net force acting on the block at point $Q$? (c) At what height $h$ should the block be released from rest so that it is on the verge of losing contact with the track at the top of the loop? (On the verge of losing contact means that the normal force on the block from the track has just then become zero.) (d) Graph the magnitude of the normal force on the block at the top of the loop versus initial height $h$ for the range $h = 0$ to $h = 5R$. 