1) A 18kg block is at rest on a table with a coefficient of kinetic friction \( \mu_k = 0.2 \). A 2kg ball on a string swings down from rest and collides with the block. The ball bounces back and returns to one half its original height.

a) How far does the block slide on the table before coming to a stop?

b) Is the collision completely elastic?
2) An ingenious friend, with way too much free time, has designed a spring based launcher to send 2.0 kg balls of clay up vertically into the sky. The ends of the spring are designed to pivot around their respective attachment points so that the spring always behaves in a linear Hooke's Law fashion. The equilibrium length of the unstretched spring is just 2.0 m. Its spring constant is 100. N/m. The launcher starts with the spring 8.0 m below the release point and then the springs movement is stopped, as shown, with the spring length, now horizontal, a distance of 6.0 m. Each clay ball is placed in a massless cup and there are no frictional forces. Gravity acts downward with an acceleration of 10. m/s²

Questions a-b pertain to the starting position

a) How much energy is stored in the spring?

b) What is the acceleration of the ball?

(c-d) Answer a & b again, but when the cup is at the release position.
e) What is the velocity of the ball at the release position?

f) What is the power that gravity provides at this position?

3) The graph, below and at right, shows the potential energy curve of a particle moving along the x-axis under the influences of a conservative force.

a) In which interval(s) of \( x \) are the forces on the particles to the right?

b) At what value(s) of \( x \) is the magnitude of the force a minimum?

c) At what value(s) of \( x \) is the magnitude of the force a maximum?
4) Two masses, 1.0 kg and 2.0 kg, are anchored at positions 3.0 m and 6.0 m, respectively, from the end of a very, very light 6.0 m long straight rigid rod. The end of the rod is anchored to a frictionless pivot. Initially the masses are horizontal, but after releasing them, they swing in a vertical plane.

a) How far from the pivot is the center-of-mass?

b) If all of the mass is placed at the center-of-mass, then how much work is done by gravity on this mass after the rod rotates down 90 degrees?

c) How much work was done by gravity on the 1.0 kg mass; on the 2.0 kg? How does this compare to your answer in part b?

d) What is the angular velocity at the bottom of the swing?

e) What is the rotational kinetic energy of each mass?