Name ____

Please work the problems on separate sheets of paper and staple these sheets to the front. Read each problem carefully. **Show your work and/or give explanations for *all* answers.** Make sure that your answers are given with a reasonable number of sig figs and that you have included appropriate units. Check your answers for physical *reasonableness*. I do give partial credit, but *only* if I can follow your work, so be as clear as possible about what you are doing.

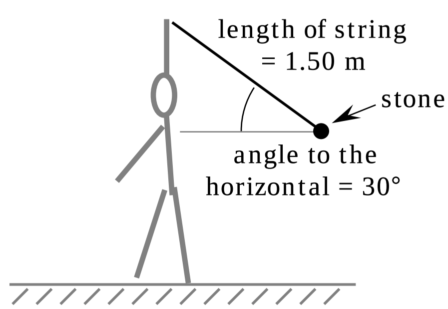
(In all of the following "PP" stands for "physical principle" by which I mean things like conservation of momentum, conservation of energy, Newton's second law, Bernoulli's equation, and so on.)

1. An object that weighs 3.0 N is held *completely submerged* under water where it experiences a buoyant force of 2.0 N. (The density of water is 1.00 g/cm^3.)
   a) [1 pt] What PP will you use to determine the density of the object?
   b) [9 pts] What *is* the density of the object?
   c) [1 pt] What PP will you use to determine the initial acceleration of the object when it is released?
   d) [9 pts] What *is* the initial acceleration of the object when it is released (magnitude and direction)?

2. A disk ($I = \frac{1}{2}MR^2$) is released at rest and then rolls without slipping down a 10 m high hill.

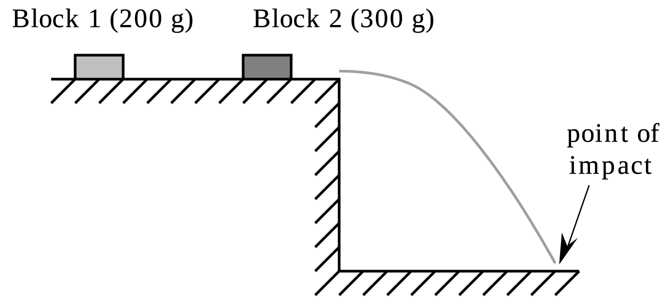
   a) [1 pt] What PP will you use to determine its speed at the bottom of the hill?
   a) [11 pts] What *is* its speed at the bottom of the hill?
   b) [6 pts] What would the answer to part a be for a *block* sliding down a *frictionless* hill the same height?
   c) [2 pts] What is the reason for the difference between the answers to parts a and b?

3. [20 pts] You step out of your spaceship onto the surface of a new planet and perform an experiment to determine the value of *g* (the acceleration due to gravity) on this planet. You whirl a stone on the end of a string about your body as shown at right. It takes 3.40 seconds for the stone to make one complete revolution. What *is* the value of *g* on this planet? (Hint: The PP here is Newton's Second Law. *Use* the method!!)



Score _____/100

4. Two blocks are *initially at rest* on a frictionless platform as shown at right. Now, 5.0 Joules of work is done on *block 1* causing it to begin moving directly toward block 2. Next, block 1 *collides* with block 2 and *sticks* to it. Finally, the two blocks *slide off the end* of the platform and eventually *hit the floor*.



a) [1 pt] What PP will you use to determine the speed of block 1 *just before* the collision?

b) [9 pts] What *is* the speed of block 1 *just before* the collision?

c) [1 pt] What PP will you use to determine the speed of the two (combined) blocks *just after* the collision?

d) [9 pts] What *is* the speed of the two (combined) blocks *just after* the collision?

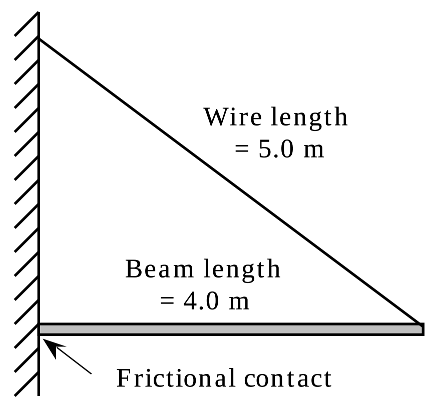
e) [5 pts extra credit] Find the distance from the base of the platform to the point of impact.

5. [20 pts] A uniform beam is held in static equilibrium against a vertical wall by a wire as shown at right. What minimum coefficient of static friction is required to prevent the beam from slipping against the wall?

Hint a) Use the method to obtain the three equations that result from applying $\Sigma\mathbf{F} = 0$ and $\Sigma\tau = 0$ to the beam (12 pts).

Hint b) Use these equations to find the frictional and normal forces *in terms of the weight of the beam* (6 pts).

Hint c) What *minimum* coefficient of static friction is required to *allow* the frictional force that is *required* in order to prevent the beam from slipping? (2 pts)



Score ______/100