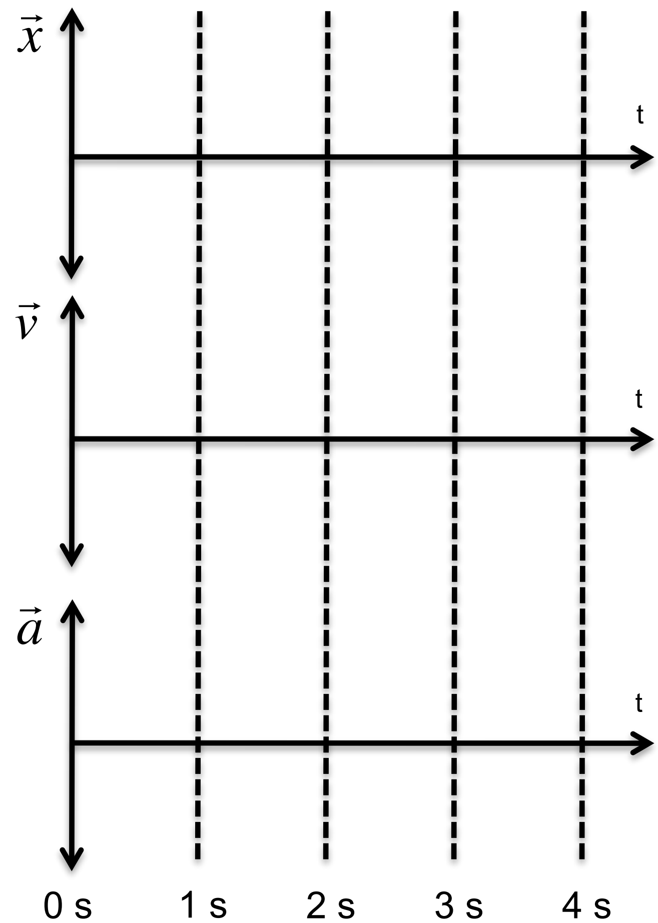
Graded on ***<u>COMMUNICATION</u>*** of physics

1) Two blocks: 1 kg and 4 kg, have a coefficient of friction, μ= 0.2 with the floor. A spring (K = 500 N/m) rests on the floor with one end connected to a wall. I press the 1 kg block against the free end of the spring, compressing the spring 20 cm against the wall. Then I let it go! The 1 kg block skids 180 cm (including the 20 cm being pushed by the spring) across the floor. Then it hits and sticks to the 4 kg block. How fast are the blocks moving immediately after the collision? *You are* ***<u>not</u>*** *going to solve this problem* to find a numerical answer. Instead, please set up the problem and explain your strategy with complete sentences. Establish the equations and explain how you will find each term, but don't solve the equations or substitute in any numbers. I think this was the question most people did the best on. It is complicated and requires you to think it through completely in 3 steps: spring potential energy, loss of mechanical energy to heat through frictional interaction, and the collision. The collision requires you to use the momentum lens because there is thermal energy lost in the inelastic collision, so an energy lens won't work here. Go ahead!!! **<u>For the corrections, please find the final speed of the two blocks!</u>**

2) I run up some stairs at constant speed. My mass is 70 kg and I run a distance of 20 m, increasing my elevation only 10 m. It takes me 5 s. I want to know how powerful I am
   a) Find my power output please! Remember to reflect on whether this makes sense.
   b) I stated "constant speed". How would the problem be different if I had started from rest?
      Most students wrote $P=E/t = E_K/t$ and then divided my kinetic energy by 5s. However, $P=W/t$ and work is *not* energy, it's the *change in energy.* So if my kinetic energy doesn't change, then there is no work being done and the power output would be zero. However, there is other changes in energy. We motivate the energy lens by identifying the different energy forms. If there was only constant kinetic energy that didn't change over time, then there would be no change in energy. Are there other energy forms? I ran 19 stairs, 6.75" per stair.

3) Off a balcony, I throw a 2 kg rock directly upwards. At t = 0s, the rock leaves my hand at 15 m elevation, with upward velocity 10 m/s. It lands on the ground (elevation = 0), but when its velocity is 10 m/s *downward*, a parachute opens. In 0.3 s, the rock evenly slows to 4 m/s and subsequently continues downward at 4 m/s until it hits the ground. Please graph the velocity, displacement, and acceleration from when I throw the rock until 4 seconds afterwards. If possible, estimate when the rock hits the ground or its elevation at 4s. Direction is profoundly important here. When is the velocity positive? Negative? When is the acceleration positive? Negative? Did you make a good drawing and visualize the action. Does your displacement graph correspond to the height over time that you imagine? Is the velocity the slope of this graph? Is the acceleration the slope of the v ⇔ t graph?



4) In the previous question, the parachute is connected to the rock with a single string.
   a) When is the string under the greatest tension? Why do you know?
   b) Please find the maximum tension that the string must sustain clearly supporting your reasoning.
   Many misconceptions about this problem. Is there a normal force involved? What causes a normal force? The tension in the string acts between the parachute and the rock, providing equal and opposite forces to each. Which body do we want to look at? How many forces act on the rock? Most students said the string was under the most tension in the 0.3 s immediately after the parachute opens. However, most people said that this was when the acceleration of the rock was downward.
      - Identify Dynamics (most people did this)
      - Write $\sum \vec{F} = m\vec{a}$ (some people did this… few people added the vector hats – this is important… not to *write* them, but to know that this is a vector quantity… to write it is to be aware of it.
      - Draw a FBD (some people did this)
      - Put acceleration on the FBD *very few people did this*
      - Establish the + direction in the FBD *very few people did this… yes, it's important.*
      - Add the forces like vectors to make sure that the vector sum is in the same direction as the acceleration. … *very few people did this*
      - Put the values in $\sum \vec{F} = m\vec{a}$ and solve.

   Many people just multiplied the acceleration and mass… but this is the *resultant* force. The tension is only one of the forces on the object. So writing and living $\sum \vec{F} = m\vec{a}$ is important.

Name ____