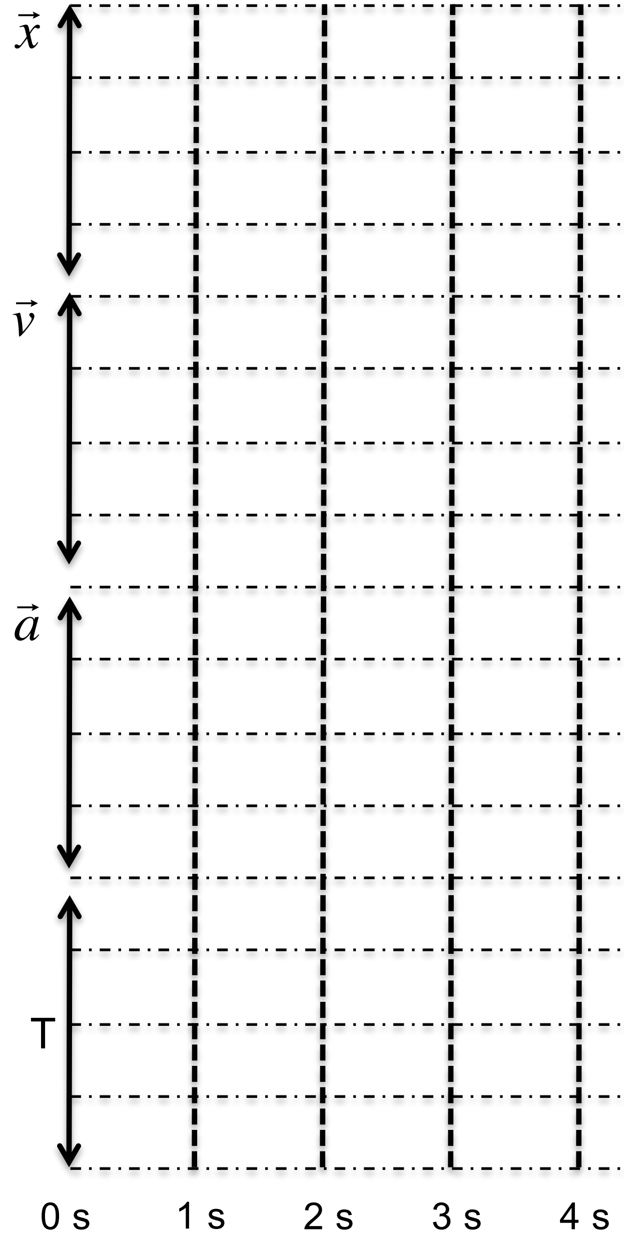
MT1, 141, Schwartz Name___________________________ ***provide lens for each part of each question***

1. You fire a 5g bullet into a 1 kg mass which embeds itself into the block. The bullet is well known to have a speed of 400 m/s. The mass slides 2.0 meters on a frictionless surface, and then compresses a spring as shown. The spring constant is 1000 N/m. We want to find the speed of the block immediately after the collision with the bullet and the compression of the spring. – more room on back of pg2 if you need it.
   a) Using the lens approach, explain how you will go about finding the compression of the spring.
   b) $\vec{v}_{Block} =$ 2 m/s
   c) $\Delta x_{Spring} =$ ~ 6 cm
   d) What if the bullet and the block instead had a perfectly elastic collision? Please estimate best you can how this would have changed your answers above. For this question, you don't need to solve it explicitly. You can estimate it by assuming the block has very large mass compared to the bullet, so how would an elastic collision look?

For all answers, please estimate your answer in decimal form. Please don't leave answers in fractional, square root or with trig functions or anything like that.

2. A crane lifts a 1000 kg mass off the ground directly upward with a cable. The mass accelerates 2 m/s^2 upward for 2 s, then continues at constant velocity for 2 s, then comes to rest in 1 s and stays there. Please draw as a function of time, the displacement, velocity and acceleration of the box. Also graph the tension in the cable. Final displacement is 14 m, Tension has three different forces between 6 kN and 12 kN. Many people recognized that to find Tension, you have to use the dynamics lens because you have acceleration and you need force… when you realize that there is dynamics involved, what do you do?

   Probably the most dead giveaway that we need to use kinematics is when there is an explicit reference to time. You can have displacement velocity and acceleration in the other lenses…



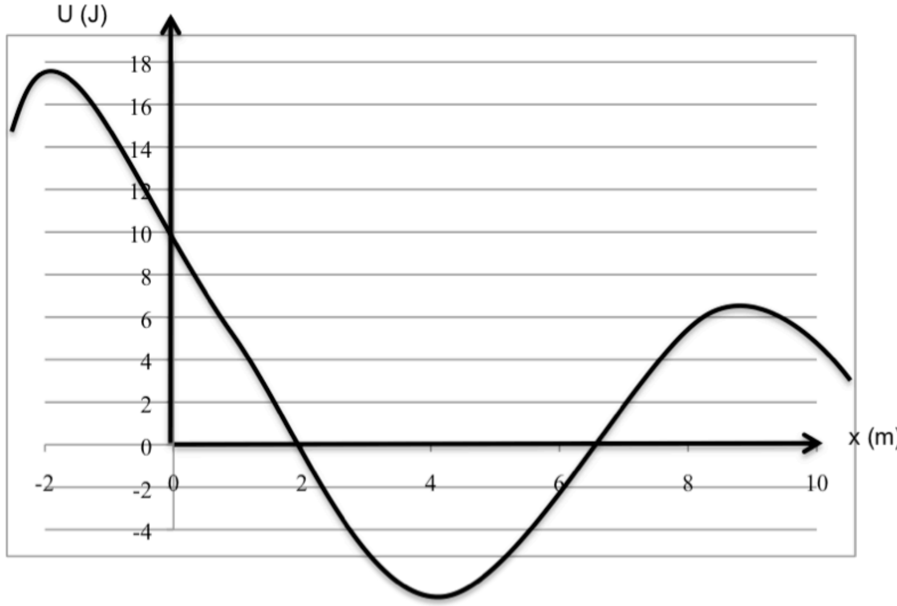
3. You see below a potential energy diagram for a **3 kg mass**, as a function of displacement. (positive *x* is to the right). The mass **<u>is at *x* = 6 m moving at 2 m/s</u>** to the right. *There may be more than one correct answer. In this case, list all correct answers.*

a) Is the mass accelerating at this point (x = 6)? If so, estimate the acceleration. ~ -1.3 m/s^2

b) Are there any turning points, or does the mass go on forever? If there are turning points, please state their location(s), x~7.4m, 1.4m

c) Is the mass in equilibrium at any point(s) in time? If so where?

Why is there only one equilibrium point in this problem?



One interesting thing that a few people did for a) that was wrong, but very smart in my opinion, is they used an energy lens, conserving total energy to show that the velocity changed from place to place near 6 m. This is correct, so there must be acceleration! That logic is lovely. However, many made the mistake of dividing by meters (the distance between the two points) rather than the time. You could compute the time by using kinematics, but there's a much easier way to find the force from a change in potential energy. Remember? You might want to watch that part of the video again.