You will be graded on your *COMMUNICATION* of physics understanding

#1 You and your friends are excited to be the first people to be on the new super drop ride. With you and your friends in a car, the total mass is 1000 kg. Starting at rest, you drop down a very slippery track losing 15 m of elevation, slide along 40 m on level ground and then rise up 5 m to the top of a hill on level ground, coming to a stop by compressing a spring by 2 meters.

a) Without finding the answer, explain completely how you would go about finding the spring constant from the information given, right up to and *including* setting up the formulas.

b) Without finding the answer, explain completely how to find the maximum acceleration as we compress the spring, right up to and *including* setting up the formula. As with the problem we had on the practice midterm, we see that this is a forces lens (why?). The maximum acceleration must come when the maximum force is acting on it. Where in the spring compression is this the case?

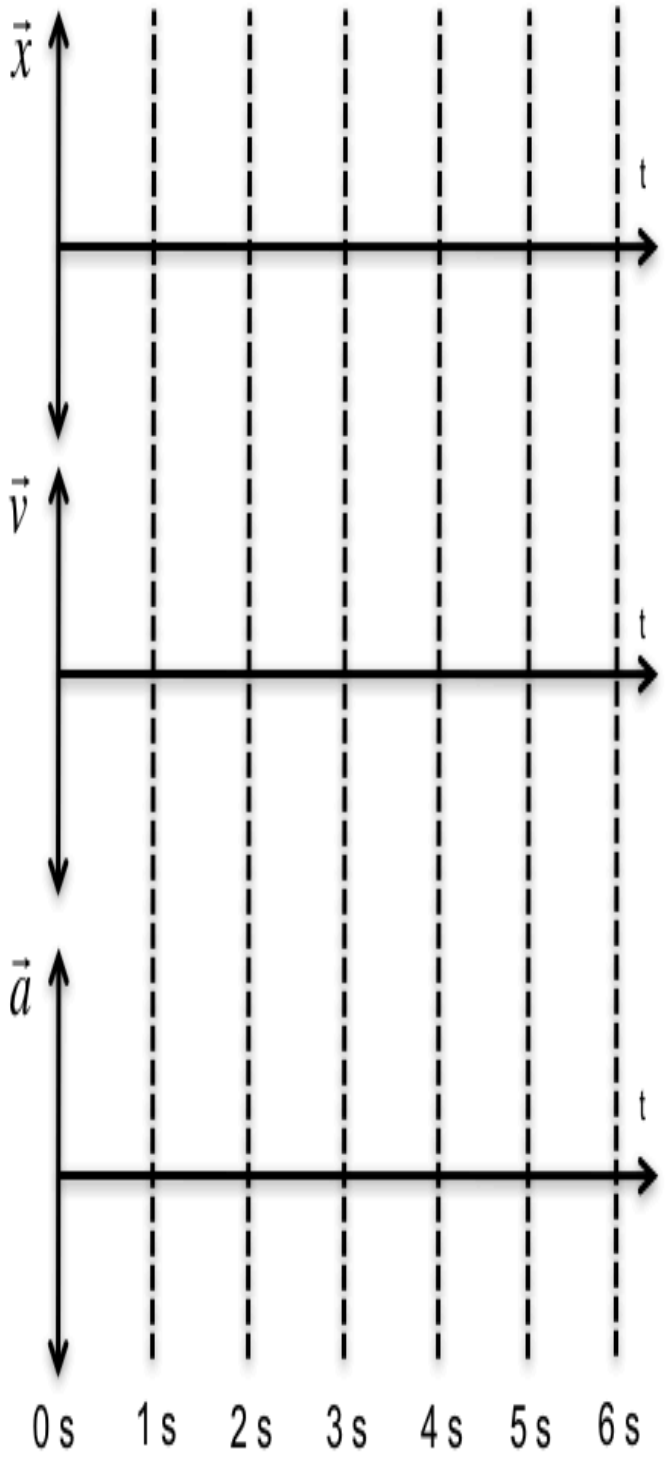
c) Let's say now that there is a coefficient of friction on the level part of the track of $\mu_d = 0.2$. Please describe how this would affect the way you solved (a) above for the spring constant. I again would use the energy lens. I can calculate how much kinetic energy is lost to friction through the work of the frictional force.

d) *Save for the end **only** if you have extra time*. Can you tell me if the consideration of friction would have a large or small effect on your answer for (a), *supporting your answer.* You should find that the final energy stored in the spring is greatly decreased if there is a 0.2 coefficient of friction.

#2 The mass of your friend is 50 kg and she is in a 450 kg elevator for a total mass of 500 kg. She is moving downward and her speed is decreasing as she stops on the ground floor. The table at right indicates the speed as a function of time.

Time (s)	Speed (m/s)
0	8
1	8
2	6
3	4
4	2
5	0
6	0

a) Please make the graphs describing her motion. Make sure they have the right shape, and if you have time, please fill in the correct numbers.
Because we have explicit information about the motion as a function of time, we would use the kinematics lens here. Please do a good job to get exact numbers for the problem set corrections.



#3 Imagine your friend is 50 kg and is standing on a scale in the previous page at t = ½ s, and t = 3 s.

a) At these two times, would you expect the scale to read >, <, or = the force of gravity on my friend? Why?

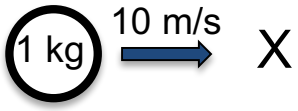
b) What does the scale under her read at t = ½ s?

c) What does the scale under her read at t = 3 s?

This is a dynamics problem because we are looking for a force (normal force provided by the scale) given other forces and the acceleration. The acceleration we have to calculate from the rate of change of velocity. I'll be looking for a good FBD with the direction of acceleration labeled. It may be a good idea to just look at the acceleration and state if the normal force is >, <, or = the force of gravity on our friend, explaining why.

#4 A 1.0 kg ball moving at 10 m/s *to the right,* has a totally *elastic* collision with *stationary* "Ball X" of unknown mass, and *turns around moving to the left* at 8 m/s. We want to find the mass of Ball X, and its final velocity.

a. Without doing any math, can you tell me if the mass of Ball "X" is more or less than 1 kg? That is: fill in the space with < , >, or = : m_X___1 kg
please give a reason



b. What must be the momentum of Ball X after the collision? Explain completely

c. What must be the kinetic energy of Ball X after the collision? Explain completely

d. ***Only*** *if you have time:* Find the mass of ball X and the final velocity of ball X.

If you are careful and use your energy and momentum lenses, you should be able to find that the mass is 9 kg, and the speed is 2 m/s. The simultaneous equations are easier to solve if you express kinetic energy as $p^2/2m$.

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