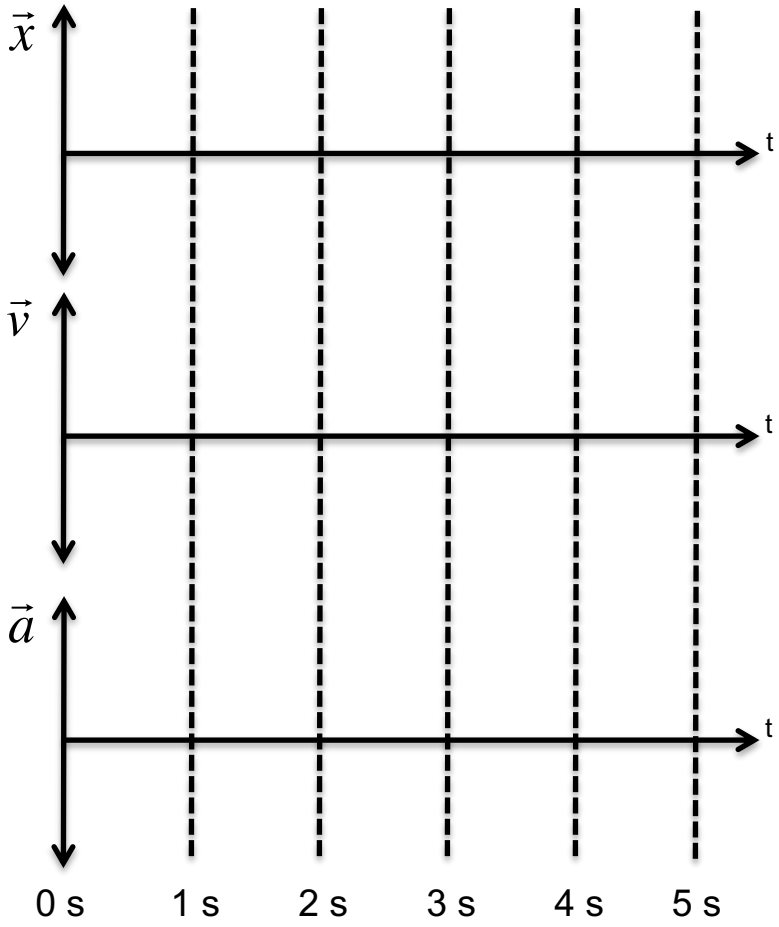
MT#1 121, W2019, Schwartz
You will be graded on your *communication* of physics understanding.

#1 I step into an elevator at rest on the ground floor. It accelerates upward at 4 m/s^2 for 1 s, continues at constant speed for 2 s, and then comes to rest over a 2 s period. Please graph the elevator's motion over this 5 s period. Please label the correct values throughout. Record relevant discussion and calculations below. Very few students showed their calculations or even thought processes for finding displacement. You don't have to show every calculation that you do in your head (or calculator), but identify and defend your method. Strangely, I give you acceleration data and folks had more difficlty with the a ⇔ t graph than the v ⇔ t graph. Many people found the displacement at 1 s to be 4 m. Why is this incorrect? Do you end at an elevation of 14 m?



#2 In the problem above, my mass is 100 kg, and the rest of the elevator's mass is 900 kg. I am standing on a scale. What does the scale read at 3.5 s? I gave you the masses of two different bodies. How many bodies are we working with in this problem? We need to make a *strong* initial statement… you could say, "dynamics because forces cause acceleration." However, if you instead, do a drawing, and identify *which* forces cause acceleration *in which direction*, to *which* mass… then you've almost solved the problem already with your initial statement. Try it… see how it feels!

#3 In the problem above, what is the average power put out by the elevator's motor over the first two seconds of operation? Again, as in #2… if we *really* spend some time on the statement, we can almost solve the problem with our first statement. Folks really like the $W = F * \Delta x$… However, there are lots and lots and LOTS of difficulty with this method. Which force are we looking at? Which *body* are we looking at? The forces change… how do we get an average? Over what displacement does the force act. You can try to us this way of calculating work… no one did it correctly. However, we can also look at the change in energy or energies. Which body are we addressing? How does the energy change, is there more than one kind of energy? … In fact, we're looking for the power output of the motor… do you think you should draw the motor into your picture? Regardless, for full credit… and really just to get a "D", I need to see an energy conversion if you're using an energy lens. In this case, it may be important to include the work of the motor in the energy conversion. Do you calculate 34 kW? How many horsepower is that? Does it seem like a lot? Consider, it's around the mass of a car, and being drawn straight upward.

#4 A 1 kg block sits on a concrete surface. You fire a 5g bullet at a speed of 1000 m/s, which embeds itself into the block. The block slides 2 meters across the concrete surface before coming to rest. Please find the coefficient of friction between the block and the concrete surface. Most people recognized this as requiring more than one lens because in an inelastic collision, we can't be sure kinetic energy is conserved… in fact, we *can* be sure that kinetic energy *isn't* conserved. Again, this problem requires that you spend some time setting up the concepts. If I see you are grasping for formulas, you will not receive credit for subsequent answers. There are two or three different ways in working a solutions, but all the methods require proper treatment of the initial collision. Some of you got a ridiculous coefficient and stated it… good for you.

It may be instrumental (and worth some credit) to carefully map out the energy changes and indicate where some energy is lost from the system as thermal energy.

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