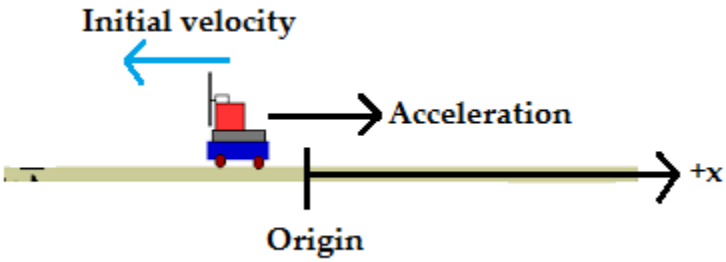
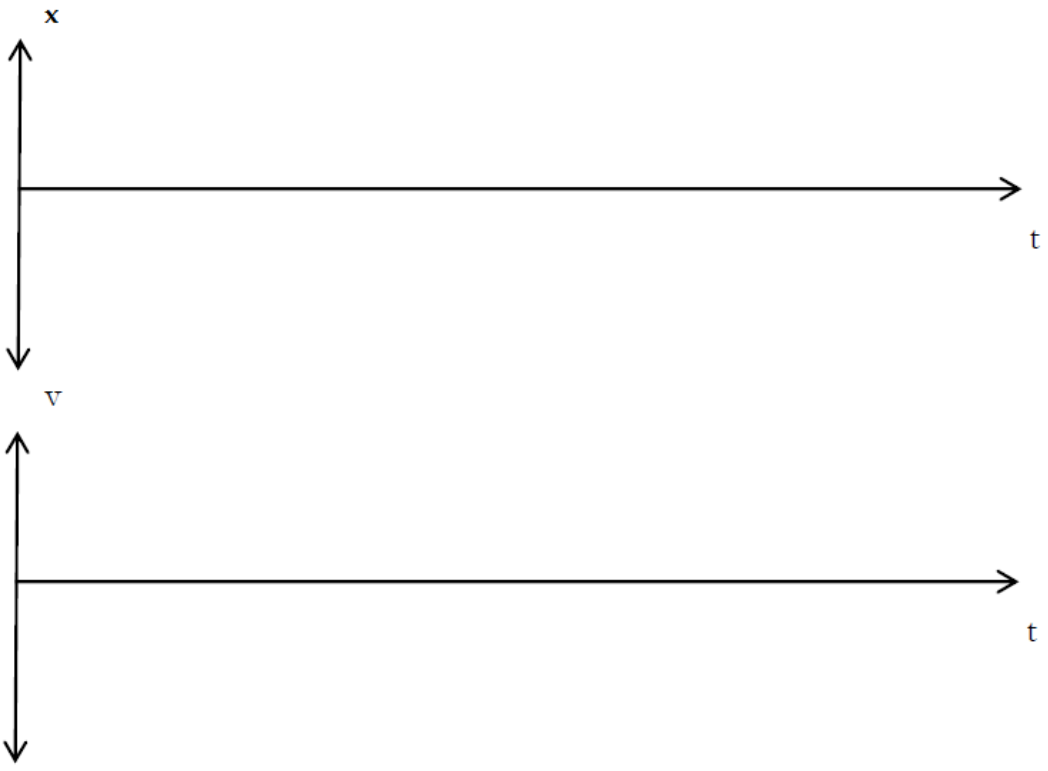
Note: this sample test is longer that the actual test will be.

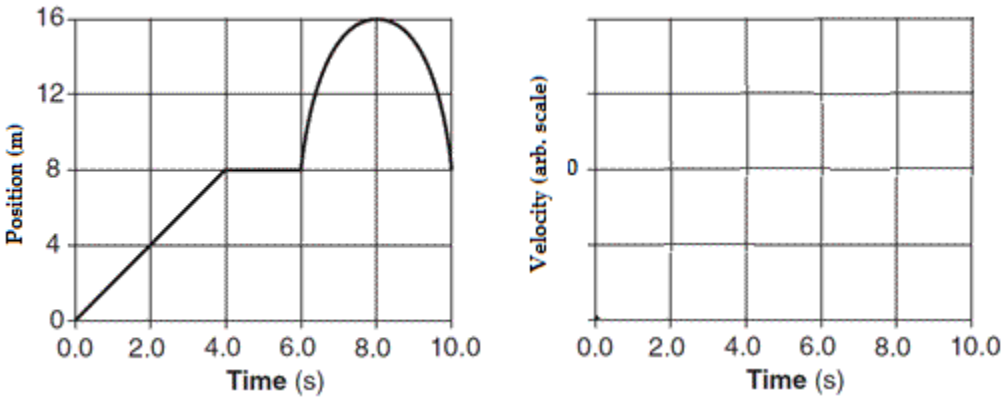
PHYS 250, Sample Test 1

For all problems, show your work! Credit will not be given for the answer only. For maximum partial credit, explain your work in words as well as equations, and be sure to use diagrams! Good luck!



1. The figure above depicts a cart with a fan attached to it moving on a flat track with negligible friction. The fan pushes the cart, causing an acceleration to the right. At time t=0, the cart is moving to the left, and is located to the left of the origin. Draw position vs. time and velocity vs. time graphs that depict the motion of the cart after time t=0. Be sure to use the same time scale on both graphs. REALLY THINK THESE THROUGH! Check to make sure each part of your graph makes sense! (10 points)





2. The graph to the left above shows the position vs. time graph describing the motion of an object. The arc-shaped portion is parabolic.
    a. In the graph to the right, sketch the corresponding velocity vs. time graph. The vertical scale is arbitrary, so you don't need to worry about the values, just the shape. Do note, however, that the line indicating 0 velocity is labeled. (3 points)
    b. What is the instantaneous velocity of the object at time t=2.0 seconds? Show and explain your work. (2 points)

    c. What is the average velocity of the object between times 6.0 s and 8.0 s? Show and explain your work. (2 points)

3. A rocket leaves the launch pad and travels straight up with constant acceleration of 1 m/s^2 to a height of 450 m. The engine then shuts off, and the rocket enters free fall (the effects of air resistance are negligible). What is the maximum height the rocket reaches? (10 points)

   Show all of your work. Use proper problem solving steps, including drawing a diagram and listing your variables. Partial credit will be given for showing this work, and you will lose credit if it is not shown.

4. At time t=0, a car is located 15 m to the west of a stop sign. Take east to be the +x direction. The car is initially moving with a speed of +10 m/s. The car's acceleration from t=0 until it stops is given by the equation

$$a(t) = -5m/s^2 + (1\ m/s^3)t$$

Does the car stop before it reaches the stop sign?

Show all of your work. Use proper problem solving steps, including drawing a diagram and listing your variables. Partial credit will be given for showing this work, and you will lose credit if it is not shown.

1. An archer shoots an arrow with an initial velocity of 150 m/s at an angle of 60 degrees above the horizontal. Neglect air resistance in this problem. Show all your work and explain your reasoning on paper.
    a. How high above the point of release does the arrow get?
    b. At the point where the arrow is highest, how far has the arrow travelled horizontally from the point of release?

2. At the moment shown the car is going around a circular track with radius of curvature 100 m. The car stays on the road. The instantaneous acceleration is given by $\vec{a} = \left(\frac{9m}{s^2}\right)\hat{\imath} - \left(\frac{4m}{s^2}\right)\hat{\jmath}$. Show all your work and explain your reasoning on paper.
    a. What is the speed of the car? (Assume the car stays on the track).
    b. Is the car speeding up or slowing down? How do you know?
    c. What is the magnitude and direction of the car's (overall) acceleration? Express the direction as an angle counterclockwise from the x-axis.