HW2

Reading assignment: Einstein chapters 7-9.
Reading assignment: Feynman sections 3.1 and 3.2.
For the problems below, please show all work! You only need to do 4 problems for full credit (although you are welcome to try all 5). You must try problem number 5, this type of calculation will become very important when discussing special relativity on Wednesday.

1. A ball is thrown vertically upward.(a) What are its velocity and acceleration when it reaches its maximum height? (b) What is the acceleration of the ball just before it hits the ground? (c) With words or a diagram describe the motion of the ball. (d) Suppose a man on a train traveling at a speed w passes by the person throwing this ball (who is standing on the train-station platform), with words or a diagram describe the motion as seen by the man. (e) Explain the statement that "although the path of the ball looks different from each reference frame, the physics on both the train and the ground are the same."

2. Draw a position versus time graph for a car in motion given the information that $x_i = -3m$, $v_i = 0$, $a = 2m/s$.

3. A truck accelerates from rest at $2m/s^2$ until it reaches a speed of $20m/s$. How long and how far has the truck traveled? To stop the truck in $10s$ what constant acceleration needs to be applied?

4. Recall a Galilean coordinate transformation relates a reference from K' moving with a constant velocity v (along the x direction) relative to another reference frame K. Suppose we have a third reference frame K'' moving with a velocity w (along the x direction) relative to the frame K'. Find the condition such that all velocity measurements in K and K'' agree. (This problem is easier than it sounds. Hint: Use formulas given in class to write K' coordinates in terms of K coordinates, and K'' coordinates in terms of K' coordinates. Solve these algebraic equations to find K'' coordinate in K, from which the condition is obvious).

5. (Please try this one) An airplane travels in the horizontal (x-axis) direction from the origin O of a reference frame K to point B, and the length between these points is $L = B - O$. Suppose the plane travels with a speed c, (a) how long will it take the plane to make a round trip from O to B and back? (b) How long will it take the plane to make the round trip if a wind of velocity v is blowing in the positive x direction such that the plane's speed is now $c + v$ and $c - v$ for the trip to and from point B? (c) What happens with $v = c$? (Hint: this problem uses nothing but distance = (rate)*time and some careful thought. Drawing pictures would be very helpful too.)