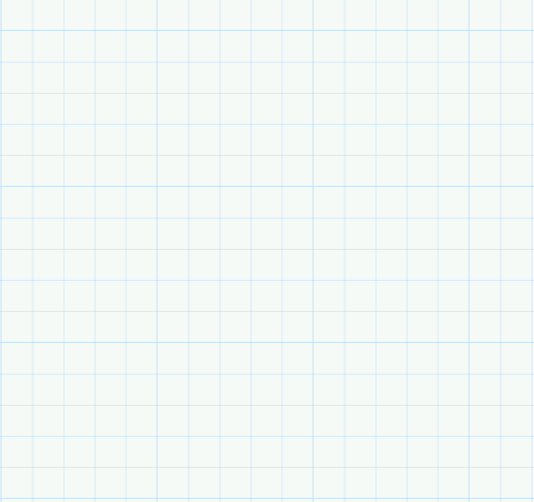
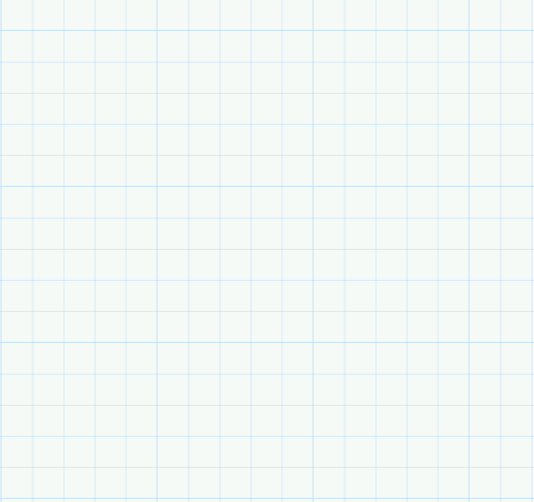
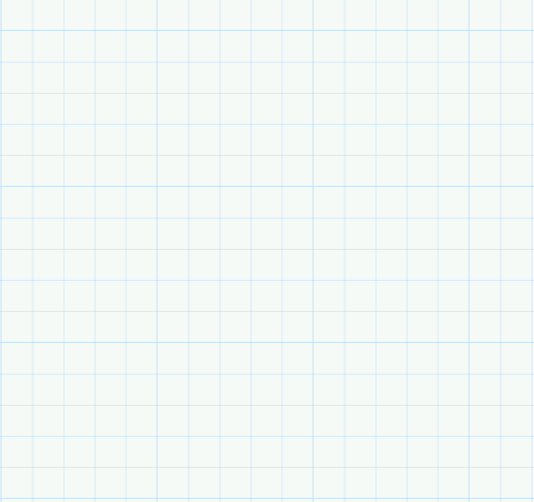
**Homework Assignment 1 Due 1/24**

**Translational Kinematics (general)**

**Problem 1.** A model rocket accelerates upward at a constant rate for 10s. Thereupon, its engines shut off, and it coasts in free fall with a constant downward acceleration until it hits the ground at t = 30s. Draw rough y vs. t, vy vs. t, and ay vs. t graphs of this situation. You don’t need any numbers on the graph (except for t = 10s, 30s) – just the correct shapes.

**Problem 2**. Say (or well, indicate) whether you’re speeding up or slowing down in the following scenarios.

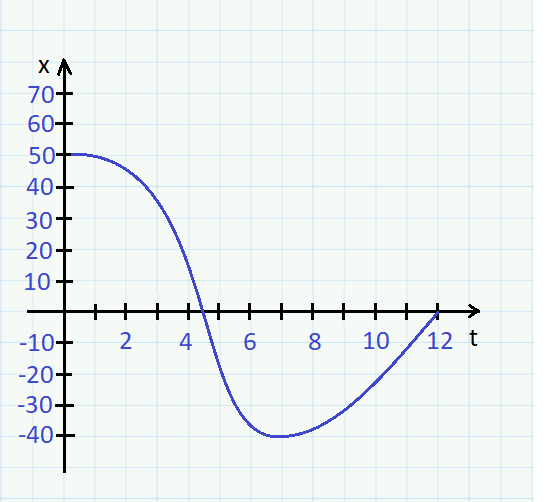
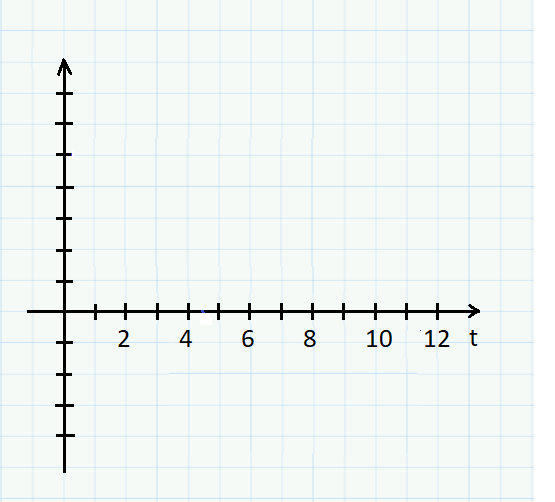
(a) Your’re driving to the right with positive acceleration.

(b) You’re driving to the left with positive acceleration.

(c) You’re driving to the left with negative acceleration.

(d) You’re driving to the right with negative acceleration.

**Problem 3.** Rochelle the roach is munching on the chocolate chip you dropped on the kitchen floor 5 days ago. When you turn the lights on, Rochelle scrambles back and forth in a manner described by the following x vs. t graph (t is measured in s, and x in cm) .

(a) When is she moving to the left? When is she moving to the right?

(b) When is she speeding up? When is she slowing down?

(c) What is her displacement between t = 2s and t = 6s? What is her average velocity during this same time interval?

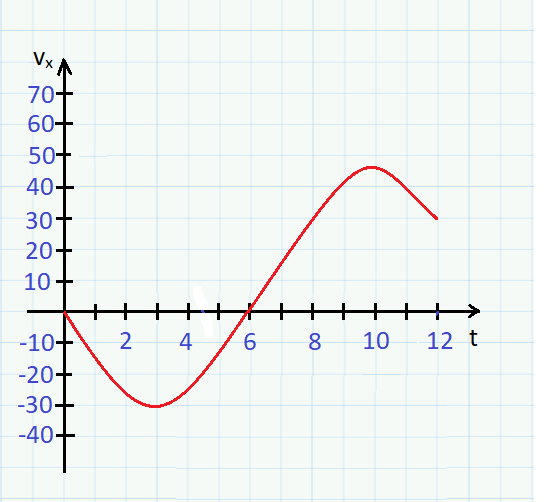
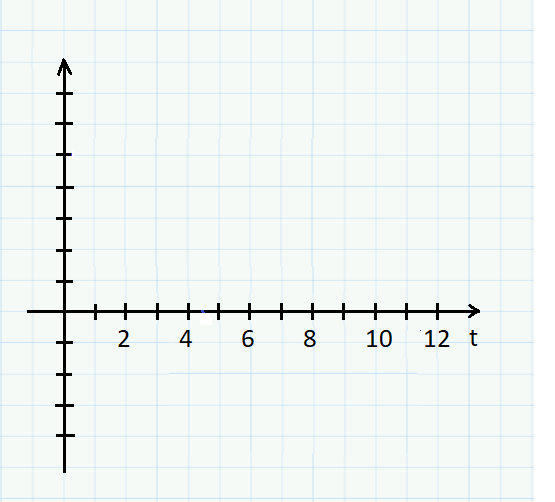
(d) What is her displacement between t = 6s and t = 10s? What is her average velocity during this time interval?

(e) Estimate her velocity at t = 4s. And show the lines you’re using for this estimate.

(f) Estimate her velocity at t = 12s. And show the line you’re using for this estimate.

(g) Draw a rough vx (in cm/s) vs. t curve in the graph above.

**Problem 4.** While your friend, Fred, is driving along the road, you pay attention to the speedometer (newer car models have negative speedometers), and make the following plot from memory (vx is measured in mph, and t is in s).

(a) When is he moving to the left? When is he moving to the right?

(b) When is he speeding up? When is he slowing down?

(c) What is his average acceleration (in m/s2) between t = 0s and t = 3s? (note 1m/s = 2.25mph)

(d) What is his average acceleration (in m/s2) between t = 0s and t = 9s?

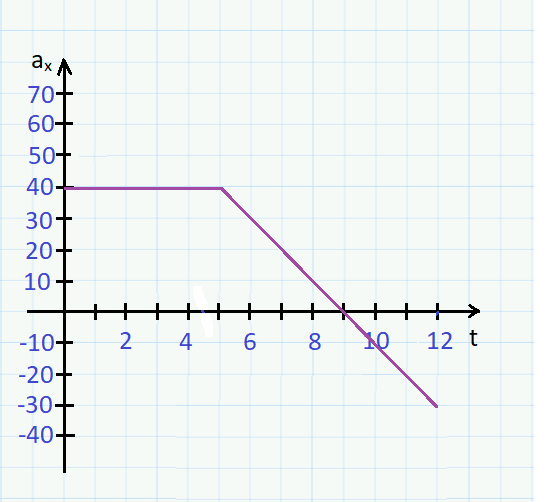
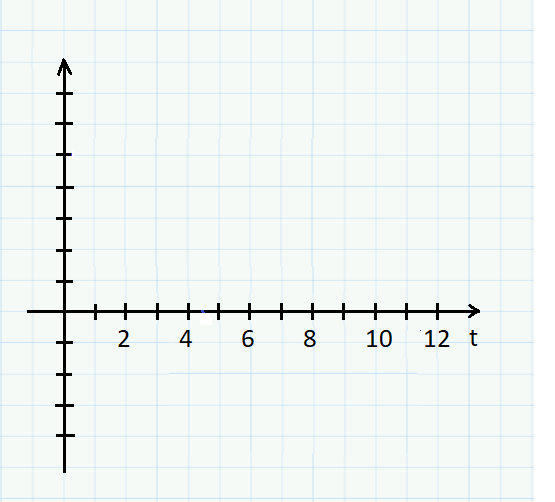
(e) Estimate his acceleration (in m/s2) at t = 2s. Show the line you’re using for this purpose.

(f) Estimate his acceleration (in m/s2) at t = 6s, and show the line you’re using.

(g) Estimate his acceleration (in m/s2) at t = 12s and show the line.

(h) Draw a rough ax (in m/s2) vs. t curve in the graph above.

**Problem 5.** An aerial drone has a built in accelerometer, which measures its acceleration of course. It starts off from rest and accelerates as follows (in m/s2).

(a) When is it moving up? When is it moving down (tricky….)?

(b) When is it speeding up? When is it slowing down?

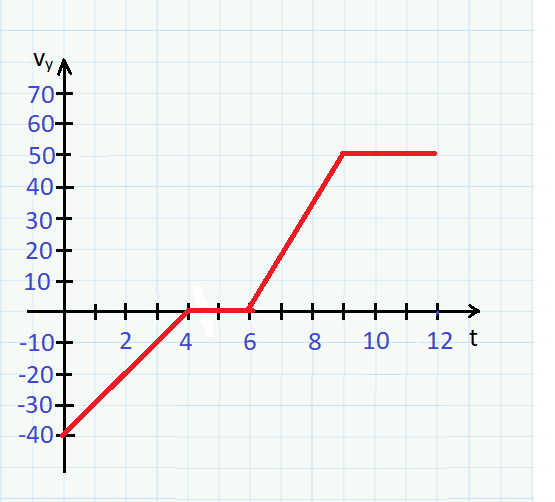
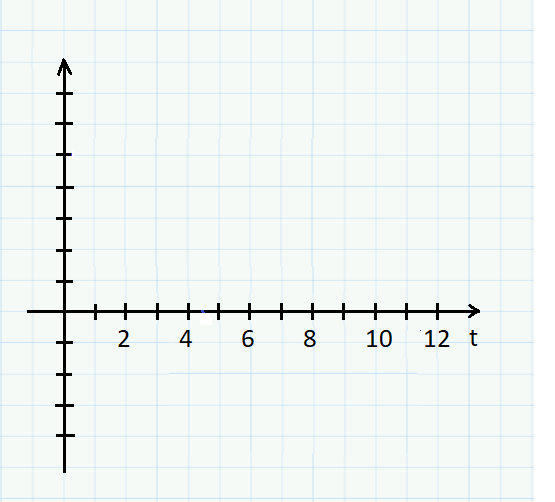
(c) What is its velocity at t = 5s?

(d) What is its velocity at t = 9s?

(e) What is its velocity at t = 12s?

(f) Draw a rough vx (in m/s) vs. t graph above.

**Problem 6**. Now the drone is released at height y = 100m, and proceeds to execute the following vy vs. t graph.

(a) What is its height at t = 4s?

(b) What is its height at t = 6s?

(c) What is its height at t = 9s?

(d) What is its height at t = 12s?

(e) Draw a rough y (in m) vs. t graph above, por favor.

**Translational Kinematics (constant acceleration)**

**Problem 7.** You’re driving your car at 30m/s you see a red light and apply the brakes, giving yourself an acceleration of -8m/s2.

(a) Taking your present position to be 0m, write down an expression for x(t) and vx(t).

(b) What is your position at t = 2s? What is your velocity at t = 2s?

(c) When do you stop?

(d) How far have you traveled by then?

**Problem 8.** Consider a similar scenario. You’re doing 30m/s when you see the red light. You apply the brakes, slowing down at the rate of 5m/s2 for 4s. But then the light turns green and so you step on the accelerator, speeding back up to 30m/s in 6s.

(a) Write down an expression for x(t) and v(t) during the first 4s.

(b) Write down an expression for x(t) and v(t) for the last 6s.

(c) How far have you traveled in those 10s?

**Problem 9.** You’re minding your business, doing 25m/s when suddenly a suicidal dear jumps out in front of you, 50m away. You slam on the breaks.

(a) How long will it take to come to rest in those 50m?

(b) What acceleration would you have?

**Problem 10.** You’re trying out for the football team. The 40m dash time trials are up. You run it in 4.7s, with a constant acceleration. What was your finishing speed?

**Problem 11.** You’re a midevil knight in a jousting tournament. You’re at position x = 0m, and your opponent is at x = 50m. The referee strikes the gong and you (on your horse) begin to gallop at a constant acceleration of 4m/s2, but your helmet comes loose. Your opponent accelerates towards you at 2m/s2, but since he’s a knight in training, was allowed a head start and so has an initial speed of 5m/s.

(a) How long do you have to fix your helmet?

(b) And at what coordinate will you two meet?

(c) And what are yall’s speeds?