Math 2250 Lab 1 Name/Unid: _____
Due Date: 01/22/2015

1. (50 points) Consider the motion of a charged particle in an electric field. In the absence of magnetic field and gravity, the force exerted on the particle with charge q due to a constant electric field with strength E is given by

$$\vec{F} = q\vec{E}.$$

Suppose there are two plates of length ℓ that create a constant electric field pointing in the negative y direction, that is

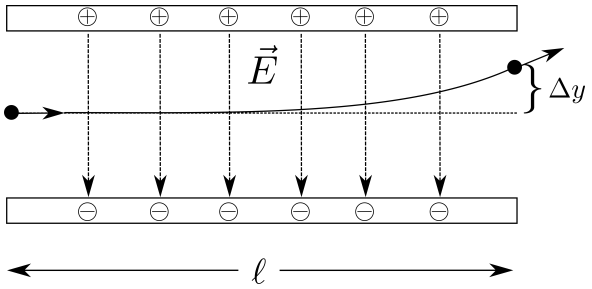
$$\vec{E} = -E_0\hat{y}.$$

Furthermore suppose that when the particle enters the plate region it is moving in the positive x direction at a constant velocity $v_{x,0}$.

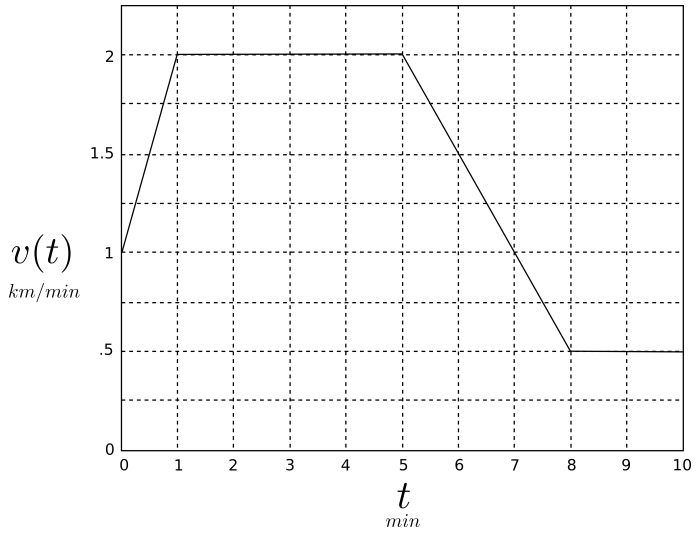
(a) Derive the equation of motion for the particle assuming that the plate region starts at $x = 0$.

(b) Suppose that when the particle leaves the region it has been vertically displaced by amount Δy. If the mass of the particle is known, then find the charge. Assume that the plates are far enough apart so that the particle actually leaves the region.

(c) How would the solution be different if we accounted for gravitational forces.



2. (50 points) Consider the time-dependent velocity of the car shown in the figure below.



(a) Calculate the acceleration $a(t)$ for $0 \leq t \leq 10$ except for at times $t = 1, 5, 8$. Why are these points problematic?

(b) Use the Fundamental Theorem of Calculus to find the equation for the position $x(t)$ for $0 \leq t \leq 10$ and graph $x = x(t)$. Use $x(0) = 0$ and continuity of $x(t)$ to find the constants of integration.

(c) Use your equation for $x(t)$ to determine how far the car has traveled at $t = 6$ minutes.