

Math 2250-010 Lab 1
Week 1 2014

Your lab consists of two parts. Part I problems are from your homework that is due Friday January 10, by the start of class. Part II problems are "lab" problems that are due Wednesday January 15, by the start of class.

Part I: You may hand in these completed sheets for the given homework problems, if you wish.

1) (This is homework problem **w1.3.** You may also use the slope field below to do the textbook problem **1.3.6.**)

Consider the differential equation

$$y'(x) = x - y + 1.$$

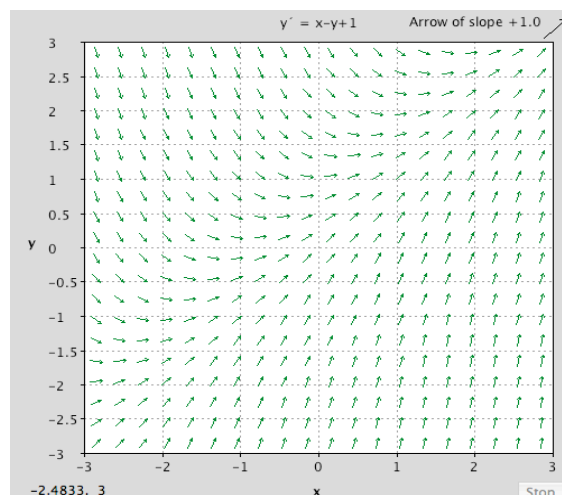
a) Show that the functions $y(x) = x + C e^{-x}$ solve this differential equation.

b) Find the value of C in the general solution above, so that $y(x)$ solves the initial value problem

$$\begin{aligned} y'(x) &= x - y + 1 \\ y(-1) &= 2. \end{aligned}$$

Identify the graph of this solution on your slope field from text problem **1.3.6.** You may do that by sketching the graph onto the dfield plot below, making sure to identify the initial point. Also add the diagonal asymptote for this graph, and write its equation. Notice that the diagonal asymptote is itself the graph of one of the solution functions. The slope field picture has been created using the JAVA applet "dfield", at the URL

<http://math.rice.edu/~dfield/dfpp.html>



2) (This is homework problem **1.1.29**) A function $y = g(x)$ has the property that every straight line normal to the graph $y = g(x)$ passes through the point $(0, 1)$. (Recall that normal lines to graphs are perpendicular to them, i.e. perpendicular to the tangent lines through the common points on the graph.) Write a differential equation

$$\frac{dy}{dx} = f(x, y)$$

having the function $g(x)$ as one of its solutions. Can you guess what the graphs of such functions $g(x)$ might look like?

3) (This is homework problem **1.2.26** as modified for our class.) A projectile is fired straight upward with an initial velocity of $50 \frac{m}{s}$ from the top of a building 20 m high. Assume that the only force acting on it is from gravity, and that $g = 9.8 \frac{m}{s^2}$.

3a) Find its maximum height above the ground.

3b) When does it pass the top of the building on its way back down?

3c) How long is the projectile in the air, assuming it lands on the ground at the base of the building?

Name _____ uid _____

Part II: These two lab problems are to be handed in before the start of class on Wednesday January 15. Explain all work carefully and neatly.

L1) Car accident reconstruction. A driver skids 210 ft. after applying his brakes. He claims to the investigating officers that he was going 25 miles per hour before trying to stop. A police test of his vehicle shows that if the brakes are applied to force a skid at an initial speed of $25 \frac{mi}{h}$ then the auto skids only 45 ft. Assuming that the car is decelerating at a constant rate while skidding, about how fast was the driver really going?

L2) (Reconstructing the position function from a graph of the velocity function): A car is traveling along a marked road which we may consider equivalent to an x -axis. Set $x(0) = x_0 = 0$. Recorded below is a graph of the car velocity $v(t)$ in miles per minute.

- Find a formula for $x(t)$, for the interval $0 \leq t \leq 3$ minutes, and graph $x = x(t)$.
- Use the formula for $x(t)$ to determine how far the car traveled in those three minutes.
- The distance the car traveled is also computable in terms of an area associated to the velocity graph. The reason has to do with the Fundamental Theorem of Calculus. Explain the connection, and verify that this area agrees with your answer from (b).

