Name _____

Worksheet 1 — Math 307

Worksheet objectives: (1) Get to know class members so that you have someone to turn to when you get stuck on homework. (2) Prepare for a discussion in class about some of the issues that come up when solving differential equations: constants of integration, solution domains, and uniqueness of solutions.

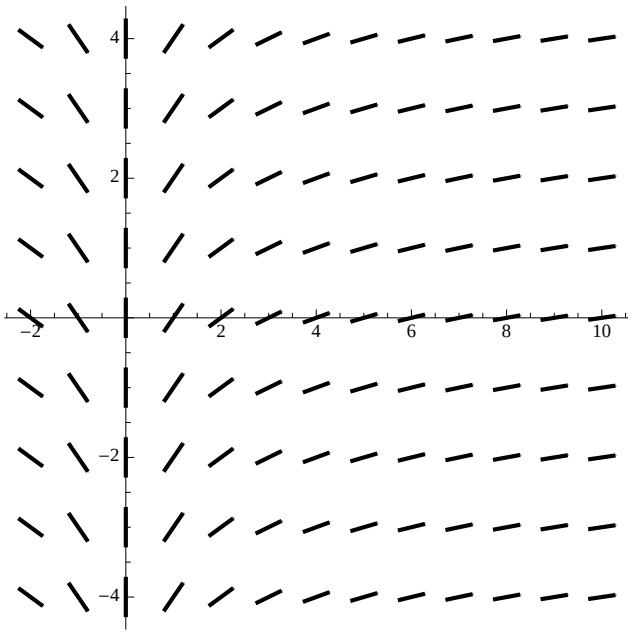
For this worksheet, we will study the differential equation $y' = \dfrac{1}{x}$.

1. Work on this worksheet in a group of 4–7 people. You must meet outside of class for 20–50 minutes. If you are lucky, you will find someone in your group who you can work on homework problems with.

   List of people in your group: _____

   I spent at least 20 minutes with this group outside of class (sign here): _____

2. Here is a slope field for the differential equation above.



   (a) Draw 5 or 6 solutions to the differential equation. Make sure some of them are to the left of the y-axis and some of them are to the right of the y-axis. Use the `dfield` program, if you want.

   (b) Explain why none of your solutions cross the y-axis.

3. The general solution to this differential equation is $y = \ln|x| + c$, where c is an arbitrary constant.

   (a) Find a solution that satisfies the initial condition $x = 1, y = 3$. (i.e. find the constant)

   (b) Find a solution that satisfies the initial condition $x = -2, y = 0$.

   (c) Explain why you need to absolute value in the general solution to find the answer to part (b).

4. Take the derivative of the function you found in problem 3(a) and make sure it is really $1/x$.

   Hint: To take the derivative of a function that has an absolute value, you need to write it as a piecewise function:

$$\ln|x| + c = \begin{cases} \ln x + c & \text{if } x > 0 \\ \ln(-x) + c & \text{if } x < 0 \end{cases}$$

   Then you take the derivative of each piece.