Welcome to the first lab of the semester! For the labs in this course, you will work in a group of 3 students (or possibly 4, if the number isn't divisible by 3). For this lab only, the class will be broken up into groups based on alphabetical order.

In general, labs will be made up of some practice problems and some problems to be turned in. It's usually a good idea to understand the practice problems before working on the turn-in problems. You should not expect to finish all the problems during the lab period. Depending on how much you get done, your group might need to meet outside of class to continue work on the lab.

Your group will turn in a single lab report for the group, consisting of your solutions to the turn-in problems. (But if you really object to that, you can write up a lab report on your own.) The members of the group will probably want to divide up the task of writing up solutions to various problems. Treat the write-ups as writing assignments in which you should present your solution to the problem, if you found one. Even if you did not find a solution, you can still discuss how you approached the problem and any ideas or partial solutions that you came up with.

Lab reports will be collected in class next Monday, September 6.

Problems for practice:

1. Draw the graph of the function $f(x) = |x^2 - 3|$ by first drawing a graph of $g(x) = x^2 - 3$ and then thinking about what the absolute value operation will do to this graph.

2. A function $f(x)$ is said to be **even** if $f(-x) = f(x)$ for all x in its domain. It is said to be **odd** if $f(-x) = -f(x)$ for all x in its domain. Check whether the function $g(x) = 2^x + 2^{-x}$ is even or odd (or neither). Do the same for the function $h(x) = 2^x - 2^{-x}$.

3. You remember equations of lines, right? Find an equation for the line that passes through the points $(-3, 5)$ and $(2, 7)$. What is the *slope* of this line?

4. What is the distance between the point $(-3, 5)$ and the $(2, 7)$? (If you can't remember the distance formula, find the distance by plotting the points, drawing a right-triangle whose hypotenuse is the line segment between the two points, and applying the Pythagorean Theorem.)

Problems to turn in:

1. General Problem Solving. Some people think of mathematics as simply following rules in a mechanical way to get a correct answer. But doing real mathematics means creative problem solving. It means that you have to think up different approaches, and be willing to discard an approach and try something else when what you are doing doesn't seem to be going anywhere. It means thinking logically, but also looking for flashes of intuition. It means that sometimes you won't ever get to a solution, but when you do it can be very satisfying. Here are three problems for you to try.

a) One of three boxes contains apples, another box contains oranges, and another box contains a mixture of apples and oranges. The boxes are labeled APPLES, ORANGES and APPLES AND ORANGES, but every label is incorrect. Can you select one fruit from only one box and determine the correct labels?

b) If a clock takes 5 seconds to strike 5:00 (with 5 equally spaced chimes), how long does it take to strike 10:00 (with 10 equally spaced chimes)?

c) Sven placed exactly in the middle among all runners in a race. Dan was slower than Sven, in 10th place, and Lars was in 16th place. How many runners were in the race?

2. Are the three points $(6, 4)$, $(-1, 2)$, and $(12, 7)$ collinear? (That is, do they lie on the same line?) Try to find at least two completely different ways to answer this question, and explain both approaches.

3. Suppose that $f(x)$ is any function that is defined for all values of x. Define two functions $E(x)$ and $\mathcal{O}(x)$ as follows:

$$E(x) = \frac{f(x) + f(-x)}{2} \qquad \text{and} \qquad \mathcal{O}(x) = \frac{f(x) - f(-x)}{2}$$

a) Show that $E(x)$ is an **even** function.

b) Show that $\mathcal{O}(x)$ is an **odd** function.

c) Show that $f(x) = E(x) + \mathcal{O}(x)$ for all x (hence showing that any function that is defined for all x can be written as a sum of an even function and an odd function).

d) Consider the particular function $f(x) = x^5 - 3x^4 + x^3 + 5x^2$. Find simplified formulas for $E(x)$ and $\mathcal{O}(x)$ for this example. What does your answer suggest about the origin of the terms "even function" and "odd function"?

4. Not-so-easy Graphing. This problem is Exercise 57 from Section 1.1 in the textbook. In fact, you can look up the answer in the back of the textbook. Your assignment for this lab exercise is to explain in some detail how to get the answer. The problem is to graph the equation $|x| - |y| = 1$. (That is, draw the set of points in the plane $\{(x, y) \mid |x| - |y| = 1\}$.)

a) The absolute value function, $|a|$ is defined by the fact that $|a| = a$ when $a \geq 0$ and $|a| = -a$ when $a < 0$. When you consider two absolute values at the same time, $|x|$ and $|y|$, there is a total of **four** possibilities. What are they? What region of the plane corresponds to each possibility? You will want to include some pictures in your explanations!

b) For each of the four cases, draw the part of the graph in the corresponding region of the plane. For example, when $x \geq 0$ and $y < 0$, we have $|x| = x$ and $|y| = -y$. What does the equation $|x| - |y| = 1$ become in this case? What is the graph of that equation? What happens when you take just the part of the graph in the corresponding region of the plane?

c) Put the four parts of the graph together to get the complete graph.