This Worksheet will be collected at the end of your recitation section on **Thursday, Sep 15th**.

3.1/2. Defining the Derivative and the Derivative as a Function

1. Determine which of the following functions are differentiable at $x = 0$. Make sure to justify your work.
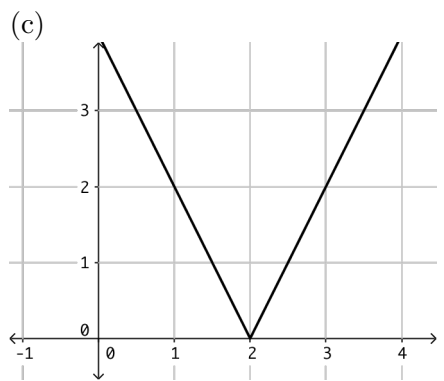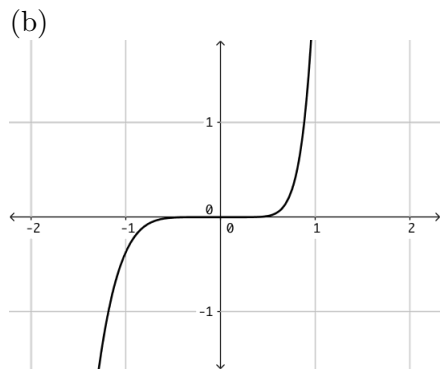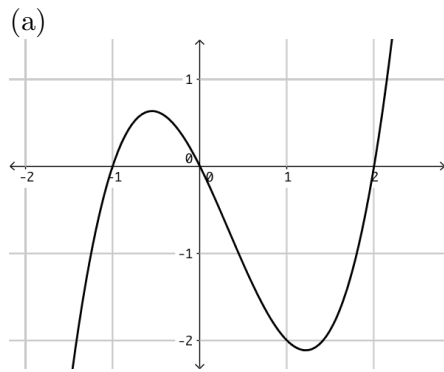
a) $f(x) = \begin{cases} -x, & \text{if } x \leq 0 \\ x^2 & \text{if } x > 0. \end{cases}$

b) $g(x) = \begin{cases} 2\sqrt{x+1} & \text{if } x \geq 0 \\ x^2 + x & \text{if } x < 0. \end{cases}$

c) $h(x) = \dfrac{|x|}{\sqrt{x+1}}$

d) $k(x) = \begin{cases} x\sin(1/x) & \text{if } x \neq 0 \\ 0 & \text{if } x = 0. \end{cases}$

2. For each of the functions graphed below, sketch the graph of their derivative

(a)

(b)

(c)

3. The following exercise will derive a formula for the derivative of x^n for an integer n. Suppose f is a differentiable function and that $g(x) = xf(x)$.

    a) Use the definition of the derivative to show that $g'(x) = xf'(x) + f(x)$. (*Hint: Since f is differentiable, then it is continuous*).

   b) Use the definition of the derivative to find the derivative of $f(x) = x$.

    c) Use the previous two parts to find the derivative of $g(x) = x^2$. (*Hint: let $f(x) = x$*).

d) Now find the derivatives of x^3, x^4, and x^5 using the previous parts of this problem.

e) Explain how you could continue the preceding process to find the derivative of x^{100}. (You don't need to actually carry out this process. That would be very time consuming).

f) Suppose n is a positive integer. Hypothesize a formula for the derivative of x^n.

4. Let f' be graphed below, and suppose that $f(0) = 0$.
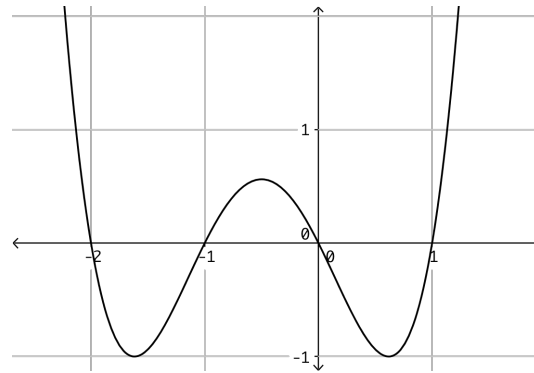
a) Determine where f is increasing and decreasing.

b) Sketch the graph of f.

c) Sketch the graph of f''.

Questionnaire:

Below are a few questions which are completely optional, and are meant to benefit you. Please only fill out what you feel comfortable with.

1. Is there anyone in class that you'd like to be grouped with next week?

2. Did you feel you worked well with your group this week?

3. Any other comments?

Grading Rubric:

Attendance: /20

Participation: /20

Completeness: /60