MATH 1910: Exam 1 Name: UUID:

No calculators or phones or smartwatches are permitted. If you need extra paper or a pencil I will have some at the front. There is a take home bonus worth an extra 8 points that I will email to everyone after the exam. This is an 80 point exam. Good luck!

1. Calculate the following limits. Show your work. (5 pts each)

   (a) $\lim_{x\to 0} \frac{\sin(4x)}{x}$ (You may assume that $\lim_{x\to 0} \frac{\sin(x)}{x} = 1$.)

   (b) $\lim_{x\to 2} \frac{x^2+x}{x-1}$

   (c) $\lim_{x\to 3} \frac{x^2-9}{x-3}$

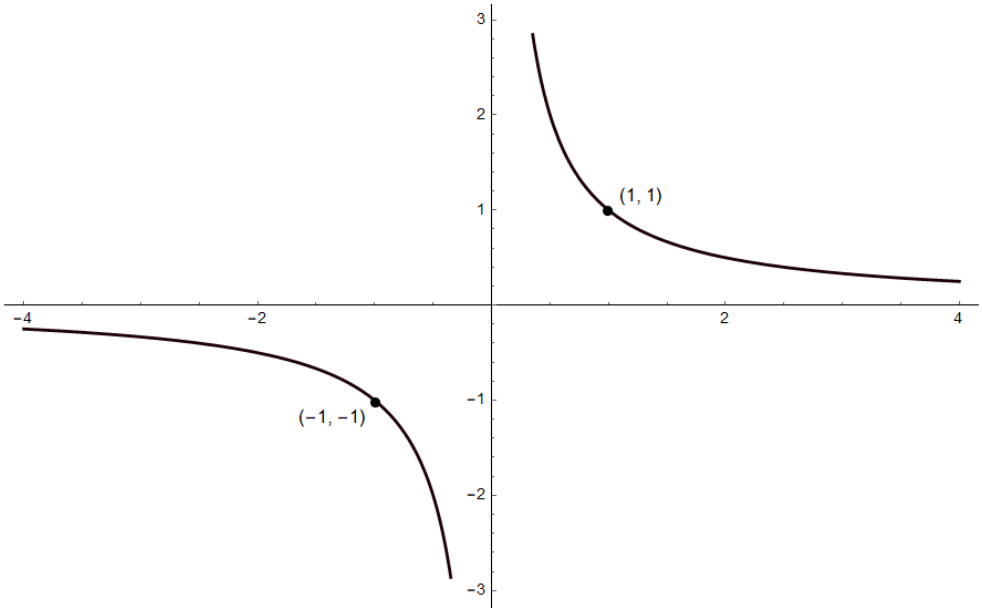
2. Calculate the following derivatives using the limit definition of derivative. Show your work. (5 pts each)

   (a) $\frac{d}{dx}\left(\sqrt{x+1}\right)$

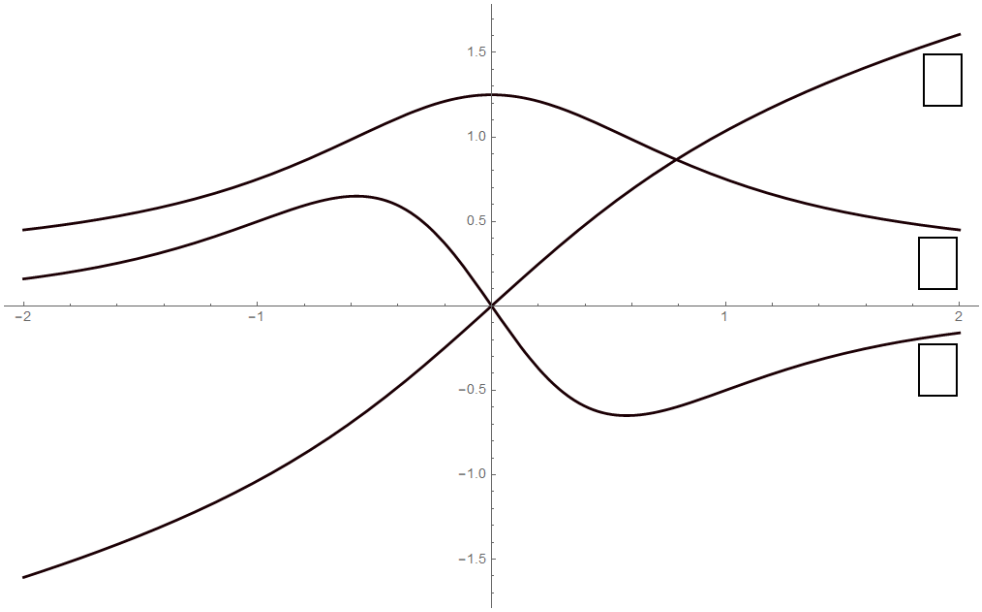
   (b) $\frac{d}{dx}\left(2x+1\right)$

   (c) $\frac{d}{dx}\left((x+1)^2\right)$

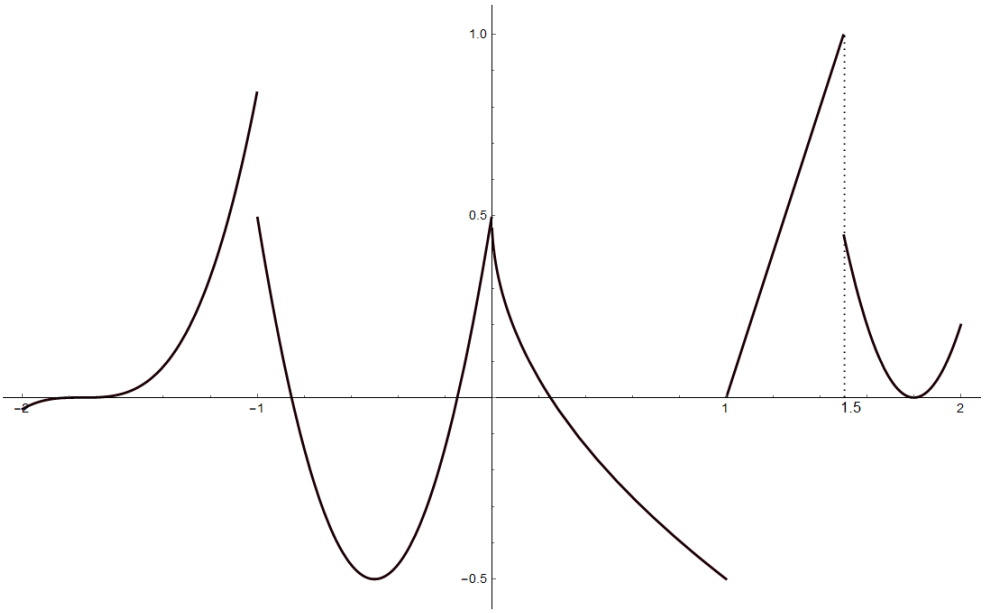
3. Find an equation for the tangent line to the function $f(x) = \frac{1}{x}$ at the points $(1, 1)$ and $(-1, -1)$. Sketch the tangent line on the image below. Show your work. (20 pts)



4. On the image below, the graph of a function, f, as well as its first and second derivative, are illustrated. Label f, f', f'' in the boxes provided. (15 pts)



5. Observe the graph of a function below.



(a) At what points is the function discontinuous? (5 pts)

(b) At what points is the function non-differentiable? (5 pts)

6. Determine whether each statement is true or false. (1 pt each)

   (a) If a function is continuous at a point a, then it is differentiable at a.

   (b) If f is a function, then $f(x+y) = f(x) + f(y)$.

   (c) Rational functions are continuous at every point in their domain.

   (d) Let f be a function which is continuous on the interval $[a, b]$. If $f(a) < 0 < f(b)$, then f has a root in (a, b).

   (e) If a function, $|f|$, is continuous at a then, f is also continuous at a.

This part is optional. Circle one:

Did you learn anything from this exam? If so, what?