- Margaret and I will be available to help you with the problems. You should also ask your group members questions, and share your ideas with each other.

- Focus on understanding the solution each problem, and on being able to explain them to each other.

Recall the limit definition of the derivative.

\[ f'(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \]

The value \( f'(x) \) is the slope of the tangent line at the point \((x, f(x))\).

1. Suppose that \( f(x) = 5 - 6x + 4x^2 \).
   
   (a) Compute \( f'(1) \) using the limit definition. (Set \( x = 1 \) in the definition)
   
   (b) Write the equation of the tangent line to the curve \( y = f(x) \) at the point where \( x = 1 \).

2. For each of the following, find \( f'(x) \) using the limit definition of the derivative (**).
   
   (a) \( f(x) = x^3 \)
   
   (b) \( f(x) = \sqrt{x} \)
   
   (c) \( f(x) = \frac{1}{x} \)
   
   (d) \( f(x) = \frac{x+1}{x-1} \)
   
   (e) \( f(x) = \frac{1}{\sqrt{x}} \)

3. When simplifying a sum or difference of two complicated expressions, it often saves a lot of work to look for common factors before proceeding. This problem gives some practice identifying common factors.
   
   (a) Consider the expression
      
      \[ 9x^2y + 2xy^3. \]
      
      Simplify this expression by factoring out \( xy \).
   
   (b) Consider the expression
      
      \[ 2(x+1)^2y^3 - 8(x+1)y^5. \]
      
      What is the biggest common factor that can be factored out? Factor this out and simplify the expression.
   
   (c) Simplify the expression
      
      \[ 3(x+1)^2(1-2x)^4 + (x+1)^3(1-2x)^3(-2). \]
      
      This problem arises in a derivative computation that we will do in a couple weeks.
4. Shown below is the graph of a function $f(x)$.

(a) For which values of $x$ is $f'(x)$ equal to 0? Where is it positive? Where is it negative?

(b) Sketch a little piece of the tangent line to this curves at $x = 0, 2, 4, 6, 8, \text{ and } 10$. Using these sketches, approximate the value of $f'(x)$ at each of these points (no need to be too exact, just get a rough estimate.)

(c) Plot these 6 values of $f'(x)$ on the axes below. Use them to make a rough sketch of the graph $y = f'(x)$ of the derivative function.