- 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.**

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

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

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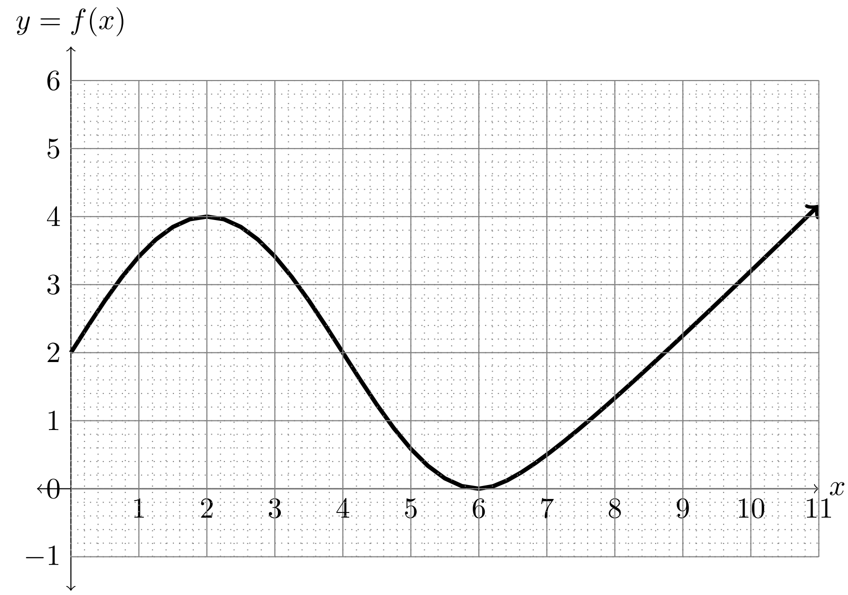
1. Suppose that $f(x) = 5 - 6x + 4x^2$.
   (a) Compute $f'(1)$ using the limit definition. (Set $x = 1$ in the definition)
   (b) Write the **equation of the tangent line** to the curve $y = f(x)$ at the point where $x = 1$.

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) $f(x) = \dfrac{1}{x}$
   (d) $f(x) = \dfrac{x+1}{x-1}$
   (e) $f(x) = \dfrac{1}{\sqrt{x}}$

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
   $$3(x+1)^2(1-2x)^4 + (x+1)^3 4(1-2x)^3(-2).$$
   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 $x = 0, 2, 4, 6, 8$, 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.