1 3.1: The Derivative

Now that we can find the slope of the line tangent to a curve at any point (provided the limit of the slope exists), we can talk about a new function based on this calculation.

**Definition:** The derivative function of a function $f$ (or the derivative of $f$) is a function defined by

$$f'(x) =$$

When is $f$ not differentiable? (i.e., when does $f'(x)$ not exist or when is $x$ not in the domain of $f''$?
Examples:

Let \( f(x) = \frac{8}{x + 2} \). Find \( f'(x) \) and use it to determine the slope of the line tangent to \( f \) at the point where \( x = 0 \), \( x = 2 \) and \( x = -1 \).

A clock has a radius of 10 cm. Let \( f(t) \) be the horizontal position of the tip of the second hand (where \( f(t) = 0 \) refers to the diameter through the 12 and 6). Sketch a rough graph of \( f(t) \), then sketch the graph of \( f'(t) \).
On Your Own: Determine whether \( f(x) = |x^2 - 9| \) is differentiable at \( x = 3 \).

No; left hand limit = \(-6\); right hand limit = 6.