Worksheet #4 - Using the Definition of Derivative

In this worksheet, you will practice calculating derivatives directly from the limit definition.

In all of the following problems, you will need to calculate the derivative of a function using the definition:

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

1. Let \( f(x) = x^2 - 3x \). Calculate \( f'(3) \).
2 Find the slope of a tangent line to the graph of \( f(x) = \frac{1}{x} \) at the point \( (2, \frac{1}{2}) \).

3 Let \( f(x) = \sqrt{x} \). Calculate \( f'(x) \).
Find all the points on the graph of \( f(x) = x^3 - x \) where the tangent line is horizontal.
Find all the points on the graph of $f(x) = ax^2 + 2x$ where the slope of the tangent line is exactly 3. (Note: Your final answer will depend on the unknown constant $a$.)