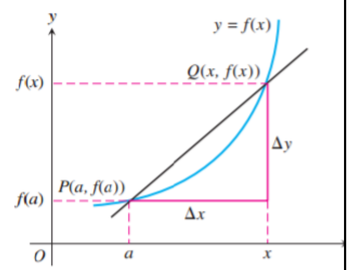
Derivative of a Function	Alternative Definition:	
Let $y = f(x)$ denote a function f. The derivative of f at x, denoted by $f'(x)$, read "f prime of x," is defined by $f'(x) =$ provided that this limit exists. The derivative of a function f gives the slope of f for any value of x is the domain of f'.	The derivative of the function f at the point $x = a$ is the limit $f'(a) =$	

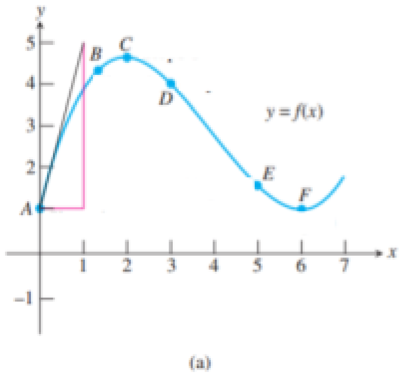
1. Find the slope of the function $f(x) = \sqrt{x}$.

2. Use the definition $f'(a) = \lim_{x \to a} \frac{f(x) - f(a)}{x - a}$ to find the derivative of $f(x) = 2x + 3$ at $a = -1$.

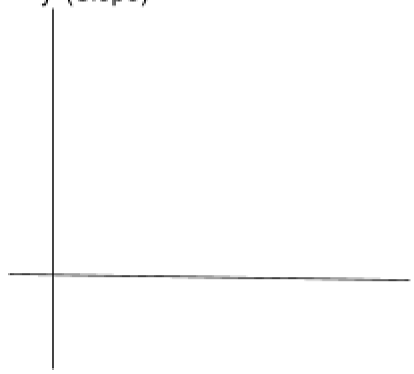
Different ways to write the derivative:

1. 2. 3. 4.

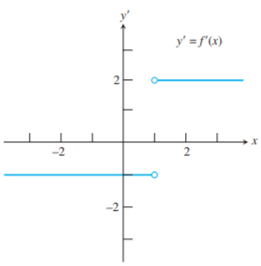
Comparing graphs of derivative to function:

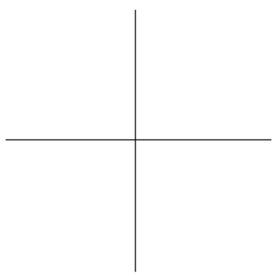


(a)

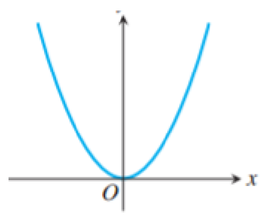


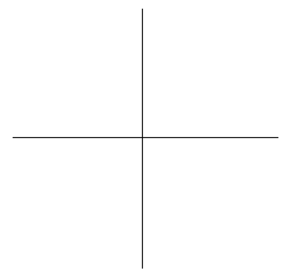
2. Sketch the graph of a function f that has the following properties:
   I. $f(0) = 0$
   II. The graph of f' is shown below
   III. f is continuous for all x





3. Sketch a graph of the derivative from the function below.





One-Sided Derivatives

A function $y = f(x)$ is **differentiable on a closed interval** $[a, b]$ if it has a derivative at every interior point of the interval, and if the limits

$$\lim_{h \to 0^+} \frac{f(a+h) - f(a)}{h} \quad \text{[the \textbf{right-hand derivative at } a\text{]}}$$

$$\lim_{h \to 0^-} \frac{f(b+h) - f(b)}{h} \quad \text{[the \textbf{left-hand derivative at } b\text{]}}$$

exist at the endpoints. In the right-hand derivative, h is positive and $a + h$ approaches a from

4. Show that the following function has left-hand and right-hand derivatives at $x = 0$, but no derivative at $x = 0$

$$y = \begin{cases} x^2, & x \le 0 \\ 2x, & x > 0 \end{cases}$$