The Derivative

Goal:
• Can use proper derivative notation to describe the slope of a curve • Can determine if a function is differentiable based on its graph • Understands that derivative is just another word for slope.
Terminology:
• Differentiable

Review: Write the slope of the tangent line to the curve $f(x)$ at the point $\boxed{x = c.}$

$$\lim_{h \to 0} \frac{f(c+h) - f(c)}{h} \quad \text{or} \quad \lim_{x \to c} \frac{f(x) - f(c)}{x - c}$$

in general at x

$$\Rightarrow \lim_{h \to 0} \frac{f(x+h) - f(x)}{h} \quad \boxed{\text{The Derivative}}$$

Now that we are comfortable using this limit, we are going to define this slope at the general point x the **derivative**.

Notation: There are two ways we are going to talk about the derivative

1. Leibnitz's DX Notation

$$\text{Slope} = \frac{\Delta y}{\Delta x} \rightarrow \text{derivative} \quad \lim_{\Delta x \to 0} \frac{\Delta y}{\Delta x} = \frac{dy}{dx}$$

"Delta"

The function NOT a fraction

dy by dx

what changes

the derivative of y with respect to x

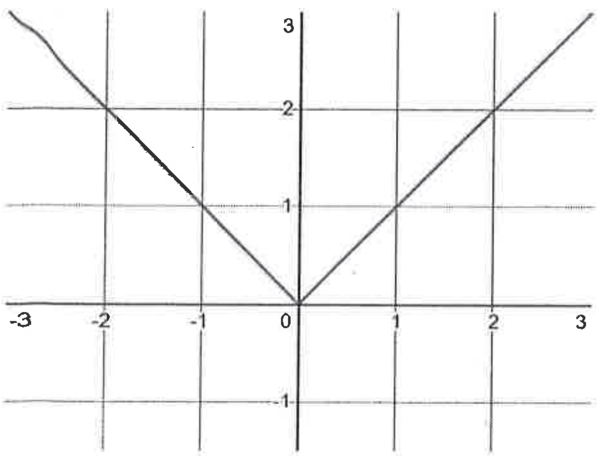
2. Newton's Prime Noation

if $y = f(x)$ then the derivative of y is y' or f'

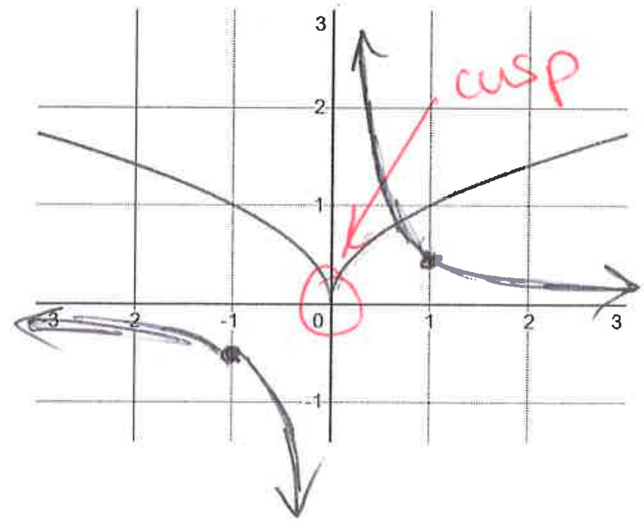
y prime f prime

Graph the derivatives of the following functions

1. $f(x) = |x|$



2. $g(x) = \sqrt{|x|}$



→ The derivative is not defined at $x=0$

→ Because there is an asymptote

use limit definition @ $x=0$

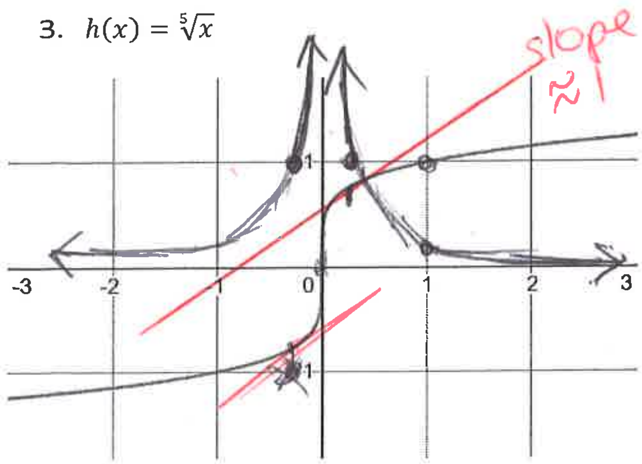
$$\lim_{h\to 0} \frac{f(0+h)-f(0)}{h}$$

$$\lim_{h\to 0} \frac{\sqrt{|h|}-0}{h} = \lim_{h\to 0} \frac{\sqrt{h}}{h} \ast$$

$$= \lim_{h\to 0} \frac{1}{\sqrt{|h|}}$$

DNE

3. $h(x) = \sqrt[5]{x}$

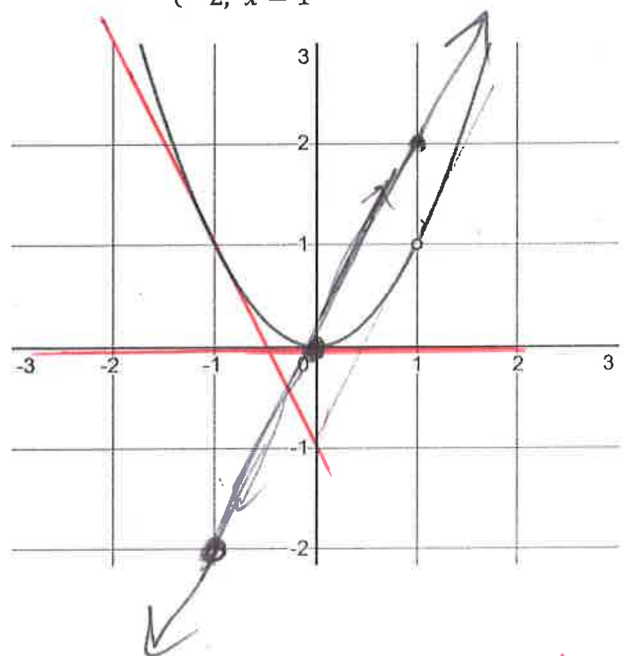


→ No derivative at $x=0$

→ we have a vertical tangent line at $x=0$

4.

$$k(x) = \begin{cases} x^2, & x \neq 1 \\ 2, & x = 1 \end{cases}$$



tell me what is the slope @ $x=c$, $c \neq 1$

$$\lim_{x \to c} \frac{x^2 - c^2}{x - c} = 2c$$

$$k'(x) = 2x$$

@ $x=1$

$$\lim_{h \to 0} \frac{f(1+h) - f(1)}{h}$$

b/c $f(1)=2$ There will be problems

All the graphs are differentiable (the derivative exists) at every point except one

Practice Problems: 2.1: # 2-4, 6, 9, 10, 12, 13

1, 11, 14-16