Math 1300: Calculus I **Fall 2020**

Lecture: Section 3.1: Derivatives of polynomials and exponential functions

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Today's Goal: Avoid using the limit definition of derivative in some cases

Logistics: We should be starting this on a Monday and finishing on a Tuesday.
On the Monday we have a **check-in**!

Warm-Up 1.1 *If $f'(x) > 0$ and $f''(x) < 0$, then f is:*

(A) *increasing and concave up.*

(B) *increasing and concave down.*

(C) *decreasing and concave up.*

(D) *decreasing and concave down.*

(E) *None of the above.*

1.1 Derivative Rules

Rule	**Formula**	**Example**
Constant Rule		
x		
Power Rule		
Constant Multiple Rule		
Sum Rule		
Difference Rule		
NO PRODUCT OR QUOTIENT RULES		

1.1.1 Proof of Power Rule

1.1.2 Proof of Sum Rule

1.2 Examples

Find the derivatives of the following functions using the rules:

(1) $f(x) = 3x^4 - 6x^{1/3} + 2x - 1$

(2) $f(x) = \sqrt{x} + 34x - \frac{1}{x}$

(3) $f(x) = \frac{x^3 - 4x^2 + \sqrt{x}}{x}$

(4) $f(x) = \frac{2x^3 - \sqrt[3]{x^2}}{2}$

(5) $f(x) = \sqrt{2x} + \sqrt{5}x$

(6) $f(x) = 3x^2 - \pi^2$

1.3 Exponential Functions

You may recall e being vaguely defined in Precalculus: $e \approx 2.718....$ The definition of e involves **limits**, so we are ready for it now!

Definition 1.2

$$e \textit{ is the number such that } \lim_{h \to 0} \frac{e^h - 1}{h} = 1$$

Definition 1.3 (Definition of Derivative of $y = e^x$)

$$\frac{d}{dx} e^x = e^x$$

Definition 1.4 (Definition of Derivative of $y = a^x$ for any $a > 0$)

$$\frac{d}{dx} a^x = \ln(a) a^x$$

Example 1.5 *Compute the derivative of the function* $f(x) = 2e^x - 3x^2 + 54e$

Example 1.6 *At what point on the curve* $y = 1 + 2(5^x) - 3x$ *is the tangent line parallel to the line* $3x - y = 5$*?*