

MASTER TABLE: RULES OF DIFFERENTIATION

NOTE: This table spans multiple videos.

RULES OF DIFFERENTIATION		
Name	Rule	Example
Constant	$\frac{d}{dx}c = \underline{\hspace{1cm}}$	$\frac{d}{dx}7 =$
Sum & Difference	$\frac{d}{dx}[f(x) \underline{\hspace{0.5cm}} g(x)] = \frac{d}{dx}f(x) \underline{\hspace{0.5cm}} \frac{d}{dx}g(x)$	$\frac{d}{dx}(x + 7) =$
Constant Multiple	$\frac{d}{dx}[c \cdot f(x)] = \underline{\hspace{0.5cm}} \cdot \frac{d}{dx}f(x)$	$\frac{d}{dx}(8x) =$
Power	$\frac{d}{dx}x^n = \underline{\hspace{0.5cm}} \cdot x^{n\underline{\hspace{0.5cm}}}$	$\frac{d}{dx}x^6 =$
Product	$\frac{d}{dx}[f(x) \cdot g(x)] = \underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}} + \underline{\hspace{1cm}} \cdot \underline{\hspace{1cm}}$	$h(x) = (x - 5)(2x + 9)$ $h'(x) = (\underline{\hspace{1cm}}) \cdot \underline{\hspace{1cm}} + (\underline{\hspace{1cm}}) \cdot \underline{\hspace{1cm}}$
Quotient	$\frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \underline{\hspace{2cm}}$	$h(x) = \frac{x}{3x - 4}$ $h'(x) = \underline{\hspace{2cm}}$
Chain	$\frac{d}{dx}[f(g(x))] = \underline{\hspace{1cm}}(\underline{\hspace{1cm}}) \cdot \underline{\hspace{1cm}}$	$\frac{d}{dx}(4x + 5)^3 = \underline{\hspace{1cm}}(\underline{\hspace{1cm}}) \cdot \underline{\hspace{1cm}}$

TOPIC: BASIC RULES OF DIFFERENTIATION

Derivatives of Linear Functions

◆ Instead of using limits, use these rules to quickly find derivatives.

EXAMPLE

Find the derivative of $g(x) = 7$ and $f(x) = x$.

Recall	Derivatives Using Limits	New	Derivatives Using Basic Rules
	$g'(x) = \frac{d}{dx} 7 = \lim_{h \rightarrow 0} \frac{\cancel{7} + h - \cancel{7}}{h}$ $= \lim_{h \rightarrow 0} 0 = 0$ $f'(x) = \frac{d}{dx} x = \lim_{h \rightarrow 0} \frac{\cancel{x} + h - \cancel{x}}{h}$ $= \lim_{h \rightarrow 0} \frac{h}{h}$ $= \lim_{h \rightarrow 0} 1 = 1$		$\frac{d}{dx} c = \underline{\hspace{1cm}}$ $g'(x) = \frac{d}{dx} 7 =$ $\frac{d}{dx} x = \underline{\hspace{1cm}}$ $f'(x) = \frac{d}{dx} x =$

RULES OF DIFFERENTIATION		
Name	Rule	Example
Sum & Difference	$\frac{d}{dx} [f(x) \pm g(x)] = \frac{d}{dx} f(x) \pm \frac{d}{dx} g(x)$	$\frac{d}{dx} (x + 7) =$
Constant Multiple	$\frac{d}{dx} [c \cdot f(x)] = c \cdot \frac{d}{dx} f(x)$	$\frac{d}{dx} (8x) =$

◆ Use *multiple* rules together to find derivatives of more complicated functions.

TOPIC: BASIC RULES OF DIFFERENTIATION

PRACTICE

Find the indicated derivative.

(A)

$$f(x) = 3x - 4$$

$$f'(x) =$$

(B)

$$\frac{d}{dt}(-5t)$$

(C)

$$\frac{d}{dt}(-5x)$$

(D)

$$\frac{d}{dx}\pi$$

TOPIC: BASIC RULES OF DIFFERENTIATION

The Power Rule

◆ To find the derivative of ANY power fcn $f(x) = x^n$, multiply by original exponent, then decrease exponent by ____.

RULES OF DIFFERENTIATION		
Name	Rule	Example
Power	$\frac{d}{dx} x^n = \text{---} \cdot x^{n\text{---}}$	$\frac{d}{dx} x^6 =$

EXAMPLE

Find the derivative of each function.

(A) $f(x) = x^4 + x^3$

(B) $g(x) = 3x^2$

TOPIC: BASIC RULES OF DIFFERENTIATION

The Power Rule: Negative & Rational Exponents

◆ Recall: The power rule works for *ANY* power function, including those with **negative** or **rational** exponents.

► Hint: You may need to _____ a fcn as a power fcn *before* taking the derivative.

Recall

$$\frac{d}{dx} x^n = n \cdot x^{n-1}$$

EXAMPLE

Find the derivative of each function using the power rule.

(A)

$$f(x) = x^{-3}$$

(B)

$$f(x) = x^{3/2}$$

(C)

$$f(x) = \frac{1}{x}$$

(D)

$$f(x) = \sqrt[3]{x}$$

TOPIC: BASIC RULES OF DIFFERENTIATION

EXAMPLE

Find the derivative of the given function.

$$y = 2x^3 - x^2 + 4x + 7$$

PRACTICE

Find the indicated derivative.

(A)

$$f(x) = 6x^4 - 4^3$$

$$f'(x) =$$

(B)

$$\frac{d}{dt}(5 - 7t^{-3})$$

(C)

$$y = \frac{5}{2}x^5 + 2x^3 + 6x - \frac{\sqrt{3}}{4}$$

$$y' =$$

(D)

$$h(t) = \frac{1}{2}t^3 + \frac{4}{t^2} + 3\sqrt{t}$$

$$h'(t) =$$

TOPIC: BASIC RULES OF DIFFERENTIATION

EXAMPLE

Answer the questions below given the function $f(x) = 2x^3 - 3x + 5$.

- (A) Find $f'(x)$.
- (B) Find the equation of the tangent line at $x = 1$.
- (C) Find the values of x for which the tangent line is horizontal.

EXAMPLE

The number of cells in a cell culture is given by the function $P(t)$, where P is the number of cells and t is measured in hours. Find $P(24)$ and $P'(24)$. What does this tell you about the cell culture?

$$P(t) = 1500 + 2t^2$$

TOPIC: BASIC RULES OF DIFFERENTIATION

EXAMPLE

A business's total sales (in thousands of dollars) t months from now are given by the function below. Find $S(6)$ and $S'(6)$. What do these values tell you about the business?

$$S(t) = 2.4t^3 + 0.4t^2 + 5t - 1$$