MASTER TABLE: RULES OF DIFFERENTIATION

NOTE: This table spans multiple videos.

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

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	
$g'(x) = \frac{d}{dx}7 = \lim_{h\to 0}\frac{7-7}{h} = \lim_{h\to 0} 0 = 0$	$\frac{d}{dx}c = \_\_\_$	$g'(x) = \frac{d}{dx}7 =$
$f'(x) = \frac{d}{dx}x = \lim_{h\to 0}\frac{x+h-x}{h} = \lim_{h\to 0}\frac{h}{h} = \lim_{h\to 0} 1 = 1$	$\frac{d}{dx}x = \_\_\_$	$f'(x) = \frac{d}{dx}x =$

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

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

TOPIC: BASIC RULES OF DIFFERENTIATION

PRACTICE Find the indicated derivative.

($\boldsymbol{A}$) $f(x) = 3x - 4$

$f'(x) =$

($\boldsymbol{B}$) $\dfrac{d}{dt}(-5t)$

($\boldsymbol{C}$) $\dfrac{d}{dt}(-5x)$

($\boldsymbol{D}$) $\dfrac{d}{dx}\pi$

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	$\frac{d}{dx}x^{n} = \_\_\_ \cdot x^{n\_\_\_}$	$\frac{d}{dx}x^6 =$

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 $f(x) = 2x^3 - 3x + 5$.

$(\boldsymbol{A})$ Find $f'(x)$.

$(\boldsymbol{B})$ Find the equation of the tangent line at $x = 1$.

$(\boldsymbol{C})$ 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?

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