TOPIC: THE CHAIN RULE

Intro to the Chain Rule

◆ To differentiate a composite function $f(g(x))$, start from the **outside** and work your way **inside**.

RULES OF DIFFERENTIATION		
Name	**Rule**	**Example**
Chain	$\frac{d}{dx}[f(g(x))] =$ _____(_____) · _____	$\frac{d}{dx}(4x+5)^3 =$ ___(_____) · ___

► Alternate notation: If $y = f(u)$ and $u = g(x)$, $\frac{dy}{dx} = \frac{dy}{du} \cdot \frac{du}{dx}$.

EXAMPLE Find $f'(x)$ using the chain rule.

$f(x) = 2(3x^2 - x)^4$

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PRACTICE Find the derivative of the function.

($\boldsymbol{A}$)

$f(x) = \sqrt{5x^2 - 3x}$

($\boldsymbol{B}$)

$y = (8x^3 - 2x)^{3/2}$

($\boldsymbol{C}$)

$f(t) = (3t^2 + 7t - 2)^{10}$

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EXAMPLE Find $\frac{dy}{dx}$ for the function.

$(\boldsymbol{A})$

$$y = (2x - 1)^4 \cdot (3 + x)^2$$

$(\boldsymbol{B})$

$$y = \frac{(2x - 1)^4}{(3 + x)^2}$$

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EXAMPLE Find the derivative of each function.

(***A***)

$f(x) = \sin^5 x$

(***B***)

$f(x) = \sin(x^5)$

PRACTICE Find the derivative of the function.

(***A***)

$f(x) = \sin(3x^2)$

(***B***)

$y = 3\cos^4\theta$

(***C***)

$f(t) = \sec(4t + 5)$

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The Chain Rule for 3+ Functions

◆ Recall: Use the chain rule from the **outside** to **inside**. You may need to use this rule *multiple* times.

► When given trig functions with powers (e.g. $\sin^n x$), rewrite power on the _____: $(\sin x)$—

EXAMPLE Find $f'(x)$ using the chain rule.

$f(x) = \sin^4(3x^2)$

Recall

$$\frac{d}{dx}[f(g(x))] = f'(g(x)) \cdot g'(x)$$

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PRACTICE Find the derivative of the function.

$(\boldsymbol{A})$

$$f(x) = \sin^5(2x^3 + 1)$$

$(\boldsymbol{B})$

$$y = \cos^3(\sec\theta)$$

EXAMPLE Find the derivative.

$$f(x) = \tan(3 - \sin 2x)$$