Name_____

Calculus Practice: Chain Rule 4b

Differentiate each function with respect to x.

1) $f(x) = \cot 3x^2$

2) $y = \cot x^4$

3) $y = \csc\left(\tan 3x^4\right)$

4) $f(x) = \sec\left(\sec 3x^3\right)$

5) $f(x) = \cot 5x^4 \cdot (2x^5 + 5)$

6) $f(x) = (5x^5 + 2)\csc 2x^4$

7) $f(x) = \dfrac{-x^3 + 2}{\csc 3x^4}$

8) $y = \dfrac{5x^5 + 1}{\sec 4x^3}$

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Calculus Practice: Chain Rule 4b

Differentiate each function with respect to *x*.

1) $f(x) = \cot 3x^2$

$$f'(x) = -\csc^2 3x^2 \cdot 6x$$
$$= -6x\csc^2 3x^2$$

2) $y = \cot x^4$

$$\frac{dy}{dx} = -\csc^2 x^4 \cdot 4x^3$$
$$= -4x^3\csc^2 x^4$$

3) $y = \csc\left(\tan 3x^4\right)$

$$\frac{dy}{dx} = -\csc\left(\tan 3x^4\right)\cot\left(\tan 3x^4\right) \cdot \sec^2 3x^4 \cdot 12x^3$$
$$= -12x^3\csc\left(\tan 3x^4\right)\cot\left(\tan 3x^4\right)\sec^2 3x^4$$

4) $f(x) = \sec\left(\sec 3x^3\right)$

$$f'(x) = \sec\left(\sec 3x^3\right)\tan\left(\sec 3x^3\right) \cdot \sec 3x^3\tan 3x^3 \cdot 9x^2$$
$$= 9x^2\sec\left(\sec 3x^3\right)\tan\left(\sec 3x^3\right)\sec 3x^3\tan 3x^3$$

5) $f(x) = \cot 5x^4 \cdot (2x^5 + 5)$

$\qquad f'(x) = \cot 5x^4 \cdot 10x^4 + (2x^5 + 5) \cdot -\csc^2 5x^4 \cdot 20x^3$
$\qquad\qquad = 10x^3(x\cot 5x^4 - 4x^5\csc^2 5x^4 - 10\csc^2 5x^4)$

6) $f(x) = (5x^5 + 2)\csc 2x^4$

$\qquad f'(x) = (5x^5 + 2) \cdot -\csc 2x^4\cot 2x^4 \cdot 8x^3 + \csc 2x^4 \cdot 25x^4$
$\qquad\qquad = x^3\csc 2x^4 \cdot (-40x^5\cot 2x^4 - 16\cot 2x^4 + 25x)$

7) $f(x) = \dfrac{-x^3 + 2}{\csc 3x^4}$

$\qquad f'(x) = \dfrac{\csc 3x^4 \cdot -3x^2 - (-x^3 + 2) \cdot -\csc 3x^4\cot 3x^4 \cdot 12x^3}{\csc^2 3x^4}$

$\qquad\qquad = \dfrac{3x^2(-1 - 4x^4\cot 3x^4 + 8x\cot 3x^4)}{\csc 3x^4}$

8) $y = \dfrac{5x^5 + 1}{\sec 4x^3}$

$\qquad \dfrac{dy}{dx} = \dfrac{\sec 4x^3 \cdot 25x^4 - (5x^5 + 1) \cdot \sec 4x^3\tan 4x^3 \cdot 12x^2}{\sec^2 4x^3}$

$\qquad\qquad = \dfrac{x^2(25x^2 - 60x^5\tan 4x^3 - 12\tan 4x^3)}{\sec 4x^3}$