# Calculus Practice: Chain Rule 7b

**Differentiate each function with respect to *x*.**

1) $y = \sec^{-1} 4x^2$

2) $y = \tan^{-1} -2x^4$

3) $f(x) = \csc^{-1} 5x^4$

4) $f(x) = \tan^{-1} 4x^2$

5) $f(x) = \sin^{-1} 5x^4$

6) $y = \cot^{-1} 5x^3$

7) $y = \cos^{-1} -4x^4$

8) $y = \cot^{-1} x^3$

9) $y = \tan^{-1}\left(5x^4 + 4\right)^4$

10) $y = \cos^{-1}\sqrt[5]{x^3 + 3}$

11) $y = \cot^{-1}\sqrt{x^2 - 2}$

12) $y = \csc^{-1}\left(3x^5 + 2\right)^5$

# Calculus Practice: Chain Rule 7b

**Differentiate each function with respect to *x*.**

1) $y = \sec^{-1} 4x^2$

$$\frac{dy}{dx} = \frac{1}{\left|4x^2\right|\sqrt{(4x^2)^2 - 1}} \cdot 8x$$
$$= \frac{2}{x\sqrt{16x^4 - 1}}$$

2) $y = \tan^{-1} -2x^4$

$$\frac{dy}{dx} = \frac{1}{(-2x^4)^2 + 1} \cdot -8x^3$$
$$= -\frac{8x^3}{4x^8 + 1}$$

3) $f(x) = \csc^{-1} 5x^4$

$$f'(x) = -\frac{1}{\left|5x^4\right|\sqrt{(5x^4)^2 - 1}} \cdot 20x^3$$
$$= -\frac{4}{x\sqrt{25x^8 - 1}}$$

4) $f(x) = \tan^{-1} 4x^2$

$$f'(x) = \frac{1}{(4x^2)^2 + 1} \cdot 8x$$
$$= \frac{8x}{16x^4 + 1}$$

5) $f(x) = \sin^{-1} 5x^4$

$$f'(x) = \frac{1}{\sqrt{1 - (5x^4)^2}} \cdot 20x^3$$
$$= \frac{20x^3}{\sqrt{1 - 25x^8}}$$

6) $y = \cot^{-1} 5x^3$

$$\frac{dy}{dx} = -\frac{1}{(5x^3)^2 + 1} \cdot 15x^2$$
$$= -\frac{15x^2}{25x^6 + 1}$$

7) $y = \cos^{-1} -4x^4$

$$\frac{dy}{dx} = -\frac{1}{\sqrt{1 - (-4x^4)^2}} \cdot -16x^3$$
$$= \frac{16x^3}{\sqrt{1 - 16x^8}}$$

8) $y = \cot^{-1} x^3$

$$\frac{dy}{dx} = -\frac{1}{(x^3)^2 + 1} \cdot 3x^2$$
$$= -\frac{3x^2}{x^6 + 1}$$

9) $y = \tan^{-1}\left(5x^4 + 4\right)^4$

$$\frac{dy}{dx} = \frac{1}{\left(\left(5x^4 + 4\right)^4\right)^2 + 1} \cdot 4\left(5x^4 + 4\right)^3 \cdot 20x^3$$
$$= \frac{80x^3\left(5x^4 + 4\right)^3}{\left(5x^4 + 4\right)^8 + 1}$$

10) $y = \cos^{-1}\sqrt[5]{x^3 + 3}$

$$\frac{dy}{dx} = -\frac{1}{\sqrt{1 - \left(\left(x^3 + 3\right)^{\frac{1}{5}}\right)^2}} \cdot \frac{1}{5}\left(x^3 + 3\right)^{-\frac{4}{5}} \cdot 3x^2$$
$$= -\frac{3x^2}{5\sqrt{1 - \sqrt[5]{\left(x^3 + 3\right)^2}} \cdot \sqrt[5]{\left(x^3 + 3\right)^4}}$$

11) $y = \cot^{-1}\sqrt{x^2 - 2}$

$$\frac{dy}{dx} = -\frac{1}{\left(\left(x^2 - 2\right)^{\frac{1}{2}}\right)^2 + 1} \cdot \frac{1}{2}\left(x^2 - 2\right)^{-\frac{1}{2}} \cdot 2x$$
$$= -\frac{x}{\sqrt{x^2 - 2}\left(x^2 - 1\right)}$$

12) $y = \csc^{-1}\left(3x^5 + 2\right)^5$

$$\frac{dy}{dx} = -\frac{1}{\left|\left(3x^5 + 2\right)^5\right| \sqrt{\left(\left(3x^5 + 2\right)^5\right)^2 - 1}} \cdot 5\left(3x^5 + 2\right)^4 \cdot 15x^4$$
$$= -\frac{75x^4\left(3x^5 + 2\right)^4}{\left|\left(3x^5 + 2\right)^5\right| \sqrt{\left(3x^5 + 2\right)^{10} - 1}}$$