

Inverse Trigonometric Chain Rule

Differentiate in radians. Use the arccot principal range $(0, \pi)$. Give exact factored answers.

1.

$$y = \frac{-1}{2} \cdot \arccos \left(-x^3 + \frac{1}{2} \right)$$

2.

$$y = 2 \cdot \left(-\operatorname{arccsc}(x) - 2 \right)^5$$

3.

$$y = -2 \cdot \operatorname{arcsec}(2x + 1)$$

4.

$$y = \frac{1}{2} \cdot \left(-\arctan(x) + 2 \right)^6$$

5.

$$y = 2 \cdot \operatorname{arccot} \left(-3x^3 + 1 \right)$$

6.

$$y = 3 \cdot \left(-\frac{1}{2} \cdot \arcsin(x) + 2 \right)^3$$

7.

$$y = 3 \cdot \arccos(x)^2$$

8.

$$y = \frac{1}{2} \cdot \operatorname{arccsc} \left(-\frac{1}{2} \cdot x^3 + 2 \right)$$

9.

$$y = -1 \cdot \left(\frac{3}{2} \cdot \operatorname{arcsec}(x) - 2 \right)^6$$

10.

$$y = 3 \cdot \arctan \left(\frac{3}{2} \cdot x - 2 \right)$$

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Answer Key

Differentiate in radians. Use the arccot principal range (0, pi). Give exact factored answers.

$$1. \quad y = \frac{-1}{2} \cdot \arccos \left(-x^3 + \frac{1}{2} \right)$$

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

Function: $|u| \leq 1$; derivative formula: $|u| < 1$; $u = -x^3 + 1/2$.

$$2. \quad y = 2 \cdot \left(-\operatorname{arccsc}(x) - 2 \right)^5$$

$$dy/dx = 10 \cdot \left(-\operatorname{arccsc}(x) - 2 \right)^4 \cdot \frac{1}{|x| \sqrt{x^2 - 1}}$$

Function: $|u| \geq 1$; derivative formula: $|u| > 1$; $u = x$.

$$3. \quad y = -2 \cdot \operatorname{arcsec}(2x + 1)$$

$$dy/dx = -4 \cdot \frac{1}{|2x + 1| \sqrt{(2x + 1)^2 - 1}}$$

Function: $|u| \geq 1$; derivative formula: $|u| > 1$; $u = 2x + 1$.

$$4. \quad y = \frac{1}{2} \cdot \left(-\arctan(x) + 2 \right)^6$$

$$dy/dx = -3 \cdot \left(-\arctan(x) + 2 \right)^5 \cdot \frac{1}{1 + x^2}$$

Formula valid for all real inputs.

$$5. \quad y = 2 \cdot \operatorname{arccot} \left(-3x^3 + 1 \right)$$

$$dy/dx = 18 \cdot x^2 \cdot \frac{1}{1 + \left(-3x^3 + 1 \right)^2}$$

Formula valid for all real inputs.

$$6. \quad y = 3 \cdot \left(-\frac{1}{2} \cdot \arcsin(x) + 2 \right)^3$$

$$dy/dx = \frac{-9}{2} \cdot \left(-\frac{1}{2} \cdot \arcsin(x) + 2 \right)^2 \cdot \frac{1}{\sqrt{1 - x^2}}$$

Function: $|u| \leq 1$; derivative formula: $|u| < 1$; $u = x$.

$$7. \quad y = 3 \cdot \arccos(x)^2$$

$$dy/dx = -6 \cdot \arccos(x) \cdot \frac{1}{\sqrt{1 - x^2}}$$

Function: $|u| \leq 1$; derivative formula: $|u| < 1$; $u = x$.

$$8. \quad y = \frac{1}{2} \cdot \operatorname{arccsc} \left(-\frac{1}{2} \cdot x^3 + 2 \right)$$

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

Function: $|u| \geq 1$; derivative formula: $|u| > 1$; $u = -1/2 \cdot x^3 + 2$.

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Answer Key

Differentiate in radians. Use the arccot principal range (0, pi). Give exact factored answers.

9. $y = -1 \cdot \left(\frac{3}{2} \cdot \operatorname{arcsec}(x) - 2 \right)^6$

$$dy/dx = -9 \cdot \left(\frac{3}{2} \cdot \operatorname{arcsec}(x) - 2 \right)^5 \cdot \frac{1}{|x| \sqrt{x^2 - 1}}$$

Function: $|u| \geq 1$; derivative formula: $|u| > 1$; $u = x$.

10. $y = 3 \cdot \arctan\left(\frac{3}{2} \cdot x - 2\right)$

$$dy/dx = \frac{9}{2} \cdot \frac{1}{1 + \left(\frac{3}{2} \cdot x - 2\right)^2}$$

Formula valid for all real inputs.