

# Derivatives Using the Power Rule

Calculus Worksheet · Grade 11–12 / College Intro Calculus

Name: \_\_\_\_\_

Date: \_\_\_\_\_

## Learning Objectives

- Apply the Power Rule to find derivatives of polynomial and rational functions
- Convert radical and rational expressions into exponential form before differentiating
- Simplify derivative results using algebraic manipulation and negative/fractional exponents

## Problems

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1. Find the derivative of the function using the Power Rule.

$$y = x^5$$

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2. Find the derivative of the function using the Power Rule.

$$y = 4x^3 - 7x^2 + 2x - 9$$

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3. Find the derivative of the function. Rewrite the fraction by separating constants before applying the Power Rule.

$$y = \frac{x^4}{4} + \frac{x^3}{3} - x$$

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4. Convert the square root to a fractional exponent, then find the derivative.

$$f(x) = \sqrt{x}$$

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5. Convert the cube root to a fractional exponent, then find the derivative.

$$g(x) = \sqrt[3]{x^2}$$

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**6.** Rewrite the expression by dividing each term in the numerator by  $x$ , then find the derivative using the Power Rule.

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


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**7.** Find the derivative of the function, which includes an exponential term. Recall that the derivative of  $e$  to the  $x$  equals  $e$  to the  $x$ .

$$h(x) = 6x^4 - 5e^x + 3$$


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**8.** Convert all radical and negative-power terms into fractional exponents, then find the derivative and simplify.

$$g(x) = \frac{5}{x^{3/5}} - 7e^x - 4\sqrt[3]{x}$$


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**9.** Rewrite the function by distributing  $x$  to the negative 1 to eliminate the denominator, then find the derivative.

$$f(x) = \frac{x^3 - 4x + 6}{x^2}$$


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**10.** Find the derivative of the function by first rewriting all terms using positive or negative integer and fractional exponents, then apply the Power Rule to each term and simplify fully.

$$y = \frac{x^3}{3} + \frac{x^2}{2} + x - \frac{3}{\sqrt{x}} + 2e^x$$


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# Derivatives Using the Power Rule — Answer Key

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## Answer Key

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### 1. Answer: $y' = 5x^4$

- Apply the Power Rule: if  $y = x^n$ , then  $y' = n \cdot x^{(n-1)}$
  - Bring down the exponent:  $y' = 5 \cdot x^{(5-1)}$
  - Simplify:  $y' = 5x^4$
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### 2. Answer: $y' = 12x^2 - 14x + 2$

- Differentiate each term separately using the Power Rule
  - $d/dx(4x^3) = 12x^2$
  - $d/dx(-7x^2) = -14x$
  - $d/dx(2x) = 2$
  - $d/dx(-9) = 0$  (constant rule)
  - Combine:  $y' = 12x^2 - 14x + 2$
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### 3. Answer: $y' = x^3 + x^2 - 1$

- Rewrite as  $y = (1/4)x^4 + (1/3)x^3 - x$
  - $d/dx[(1/4)x^4] = (1/4) \cdot 4x^3 = x^3$
  - $d/dx[(1/3)x^3] = (1/3) \cdot 3x^2 = x^2$
  - $d/dx[-x] = -1$
  - Combine:  $y' = x^3 + x^2 - 1$
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### 4. Answer: $f'(x) = 1/(2\sqrt{x})$ or $(1/2)x^{(-1/2)}$

- Rewrite:  $f(x) = x^{(1/2)}$
  - Apply the Power Rule:  $f'(x) = (1/2)x^{(1/2 - 1)}$
  - Simplify the exponent:  $1/2 - 1 = -1/2$
  - $f'(x) = (1/2)x^{(-1/2)} = 1/(2\sqrt{x})$
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### 5. Answer: $g'(x) = 2x^{(-1/3)}$ or $2/\sqrt[3]{x}$

- Rewrite:  $g(x) = 3x^{(2/3)}$
  - Apply the Power Rule:  $g'(x) = 3 \cdot (2/3)x^{(2/3 - 1)}$
  - Simplify the coefficient:  $3 \cdot (2/3) = 2$
  - Simplify the exponent:  $2/3 - 1 = 2/3 - 3/3 = -1/3$
  - $g'(x) = 2x^{(-1/3)} = 2/\sqrt[3]{x}$
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### 6. Answer: $f'(x) = 2x + 5 + 2x^{(-2)}$

- Divide each term by  $x$ :  $f(x) = x^2 + 5x - 2x^{(-1)}$
- Apply the Power Rule to each term
- $d/dx[x^2] = 2x$
- $d/dx[5x] = 5$
- $d/dx[-2x^{(-1)}] = -2 \cdot (-1)x^{(-2)} = 2x^{(-2)}$

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- Combine:  $f'(x) = 2x + 5 + 2x^{(-2)}$

**7. Answer:  $h'(x) = 24x^3 - 5e^x$**

- $d/dx[6x^4] = 24x^3$
- $d/dx[-5e^x] = -5e^x$  (since  $d/dx[e^x] = e^x$ )
- $d/dx[3] = 0$
- Combine:  $h'(x) = 24x^3 - 5e^x$

**8. Answer:  $g'(x) = -3x^{(-8/5)} - 7e^x - (4/3)x^{(-2/3)}$**

- Rewrite:  $g(x) = 5x^{(-3/5)} - 7e^x - 4x^{(1/3)}$
- $d/dx[5x^{(-3/5)}] = 5 \cdot (-3/5)x^{(-3/5 - 1)} = -3x^{(-8/5)}$
- $d/dx[-7e^x] = -7e^x$
- $d/dx[-4x^{(1/3)}] = -4 \cdot (1/3)x^{(1/3 - 1)} = -(4/3)x^{(-2/3)}$
- Combine:  $g'(x) = -3x^{(-8/5)} - 7e^x - (4/3)x^{(-2/3)}$

**9. Answer:  $f'(x) = 1 + 4x^{(-3)} - 12x^{(-4)}$**

- Divide each term by  $x^2$ :  $f(x) = x - 4x^{(-1)} + 6x^{(-2)}$
- $d/dx[x] = 1$
- $d/dx[-4x^{(-1)}] = -4 \cdot (-1)x^{(-2)} = 4x^{(-2)}$
- Wait — recheck:  $d/dx[-4x^{(-1)}] = 4x^{(-2)}$
- $d/dx[6x^{(-2)}] = 6 \cdot (-2)x^{(-3)} = -12x^{(-3)}$
- Combine:  $f'(x) = 1 + 4x^{(-2)} - 12x^{(-3)}$

**10. Answer:  $y' = x^2 + x + 1 + (3/2)x^{(-3/2)} + 2e^x$**

- Rewrite:  $y = (1/3)x^3 + (1/2)x^2 + x - 3x^{(-1/2)} + 2e^x$
- $d/dx[(1/3)x^3] = (1/3) \cdot 3x^2 = x^2$
- $d/dx[(1/2)x^2] = (1/2) \cdot 2x = x$
- $d/dx[x] = 1$
- $d/dx[-3x^{(-1/2)}] = -3 \cdot (-1/2)x^{(-3/2)} = (3/2)x^{(-3/2)}$
- $d/dx[2e^x] = 2e^x$
- Combine:  $y' = x^2 + x + 1 + (3/2)x^{(-3/2)} + 2e^x$

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