Power Rule & Constant Rule: Finding Derivatives

Calculus Worksheet · Grade 11–12

Name: ________________________________ Date: __________________

Learning Objectives

- Apply the Power Rule to find derivatives of polynomial and rational functions
- Apply the Constant Rule to identify the derivative of any constant as zero
- Convert radical and fractional expressions before differentiating using the Power Rule

Problems

1. Use the Constant Rule to find the derivative of the function below.

$$f(x) = 47$$

2. Use the Power Rule to find the derivative of the function below with respect to x.

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

3. Use the Power Rule to find the derivative of the function below with respect to x.

$$f(x) = 6x^4$$

4. Find the derivative of the linear function below with respect to x using the Power Rule.

$$f(x) = 9x$$

5. Use the Power Rule and Constant Rule to find the derivative of the polynomial function below with respect to x.

$$f(x) = 4x^3 - 7x^2 + 5x - 12$$

6. Expand the binomial first, then find the derivative of the function below with respect to x.

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$$f(x) = (2x + 3)^2$$

7. Convert the radical expression to exponential form, then use the Power Rule to find the derivative with respect to x.

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

8. Convert the fraction to a negative exponent, then use the Power Rule to differentiate with respect to x. Also apply the Constant Rule where needed.

$$f(x) = \frac{5}{x^3} + e^{\pi}$$

9. Convert the cube root to exponential form and then find the derivative of the function below with respect to t.

$$g(t) = 4t^5 - \frac{3}{t^2} + \sqrt[3]{t^4}$$

10. Rewrite all terms using exponents, then find the derivative of the function below with respect to x. Simplify and express all answers with positive exponents.

$$h(x) = 3x^6 - \frac{8}{x^4} + 5\sqrt[4]{x^3} - \pi^2 + \frac{1}{2x^5}$$

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Power Rule & Constant Rule: Finding Derivatives — Answer Key

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Answer Key

1. Answer: f'(x) = 0

- 47 is a constant value — it does not change with respect to x.
- By the Constant Rule, the derivative of any constant is 0.
- Therefore, f'(x) = 0.

2. Answer: f'(x) = 5x■

- Apply the Power Rule: if f(x) = x^n, then f'(x) = n · x^(n–1).
- Here n = 5, so bring down the exponent: f'(x) = 5 · x^(5–1).
- Simplify: f'(x) = 5x■.

3. Answer: f'(x) = $24x^3$

- Apply the Power Rule: bring down the exponent as a multiplier.
- f'(x) = 4 · 6x^(4–1) = 24x^3.
- Therefore, f'(x) = $24x^3$.

4. Answer: f'(x) = 9

- Rewrite as f(x) = 9x^1. The exponent is n = 1.
- Apply the Power Rule: f'(x) = 1 · 9x^(1–1) = 9x^0.
- Since x^0 = 1, f'(x) = 9.

5. Answer: f'(x) = $12x^2 – 14x + 5$

- Differentiate each term separately.
- Derivative of $4x^3$: 3 · 4x^(3–1) = $12x^2$.
- Derivative of $–7x^2$: 2 · (–7)x^(2–1) = –14x.
- Derivative of 5x: 1 · 5x^(1–1) = 5.
- Derivative of –12 (constant): 0.
- Combine: f'(x) = $12x^2 – 14x + 5$.

6. Answer: f'(x) = 8x + 12

- Expand: $(2x + 3)^2$ = (2x + 3)(2x + 3) = $4x^2 + 12x + 9$.
- Differentiate each term: derivative of $4x^2$ = 8x, derivative of 12x = 12, derivative of 9 = 0.
- Combine: f'(x) = 8x + 12.

7. Answer: f'(x) = 1 / (2√x)

- Rewrite the radical as an exponent: f(x) = x^(1/2).
- Apply the Power Rule: f'(x) = (1/2) · x^(1/2 – 1) = (1/2)x^(–1/2).
- Rewrite with a positive exponent: f'(x) = 1 / (2x^(1/2)) = 1 / (2√x).

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8. Answer: f'(x) = –15 / x[redacted]

- Rewrite the fraction: $5/x^3$ = 5x^(–3). Note that e^π is a constant.
- Differentiate 5x^(–3): (–3) · 5x^(–3–1) = –15x^(–4).
- Differentiate e^π using the Constant Rule: derivative = 0.
- Rewrite with a positive exponent: f'(x) = –15 / x[redacted].

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9. Answer: g'(t) = 20t[redacted] + $6/t^3$ + (4/3)t^(1/3)

- Rewrite each term in exponential form: 4t^5, –3t^(–2), and t^(4/3).
- Differentiate 4t^5: 5 · 4t^(5–1) = 20t^4.
- Differentiate –3t^(–2): (–2)(–3)t^(–2–1) = 6t^(–3) = $6/t^3$.
- Differentiate t^(4/3): (4/3)t^(4/3 – 1) = (4/3)t^(1/3).
- Combine: g'(t) = 20t[redacted] + $6/t^3$ + (4/3)t^(1/3).

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10. Answer: h'(x) = 18x[redacted] + 32/x[redacted] + (15/4)x^(–1/4) – 5/(2x[redacted])

- Rewrite each term: 3x^6, –8x^(–4), 5x^(3/4), $-\pi^2$ (constant), (1/2)x^(–5).
- Differentiate 3x^6: 6 · 3x^5 = 18x^5.
- Differentiate –8x^(–4): (–4)(–8)x^(–5) = 32x^(–5) = 32/x^5.
- Differentiate 5x^(3/4): (3/4) · 5x^(3/4 – 1) = (15/4)x^(–1/4).
- Differentiate $-\pi^2$ using the Constant Rule: derivative = 0.
- Differentiate (1/2)x^(–5): (–5)(1/2)x^(–6) = –(5/2)x^(–6) = –5/(2x^6).
- Combine: h'(x) = 18x[redacted] + 32/x[redacted] + (15/4)x^(–1/4) – 5/(2x[redacted]).

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