Derivatives of Exponential Functions

Calculus Worksheet · Grade 11-12

Name: _____ Date: _____ Score: / 10

Learning Objectives

- Apply the derivative rule for e^u to differentiate natural exponential functions
- Apply the derivative rule for a^u to differentiate general exponential functions
- Use the chain rule with exponential functions involving polynomial exponents

Find the derivative of each function using the rules for differentiating exponential functions, and simplify your answer.

1. Find the derivative of the function.

$y = e^{7x}$

Answer: _____

2. Find the derivative of the function.

$y = 5^{7x}$

Answer: _____

3. Find the derivative of the function.

$y = 5e^{2x^3 + 3x}$

Answer: _____

4. Find the derivative of the function.

$y = e^{4x^2}$

Answer: _____

5. Find the derivative of the function.

$y = 3^{x^2 + 1}$

Answer: _____

6. Find the derivative of the function.

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

Answer: _____

7. Find the derivative of the function.

$y = 2^{5x - 1}$

Answer: _____

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8. Find the derivative of the function.

$y = 4e^{x^3 - 2x}$

Answer: _____

9. Find the derivative of the function.

$y = 10^{3x^2}$

Answer: _____

10. Find the derivative of the function.

$f(x) = e^{(3x)^5}$

Answer: _____

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ANSWER KEY & SOLUTIONS

Remind students that the derivative of e^u is e^u times du/dx, and the derivative of a^u is a^u times ln(a) times du/dx.

Solutions

1. Find the derivative of the function.

$y = e^{7x}$

→ *Identify u equals 7x, so du/dx equals 7.*
→ *Apply the rule: derivative of e to the u equals e to the u times du/dx.*
→ *Multiply to get 7 times e to the 7x.*

Answer: $y' = 7e^{7x}$

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2. Find the derivative of the function.

$y = 5^{7x}$

→ *Identify the base a equals 5 and exponent u equals 7x.*
→ *Apply the rule: derivative of a to the u equals a to the u times ln(a) times du/dx.*
→ *Since du/dx equals 7, multiply to get 7 times 5 to the 7x times ln 5.*

Answer: $y' = 7 \cdot 5^{7x} \ln 5$

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3. Find the derivative of the function.

$y = 5e^{2x^3 + 3x}$

→ *Keep the constant 5 outside and focus on differentiating e to the 2x cubed plus 3x.*
→ *Apply the rule: derivative equals e to the u times du/dx where u equals 2x cubed plus 3x.*
→ *Compute du/dx equals 6x squared plus 3.*
→ *Multiply by the constant 5 using the distributive property to get 30x squared plus 15 times e to the 2x cubed plus 3x.*

Answer: $y' = (30x^2 + 15)e^{2x^3 + 3x}$

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4. Find the derivative of the function.

$y = e^{4x^2}$

→ *Let u equal 4x squared so du/dx equals 8x.*
→ *Apply the e to the u rule: e to the u times du/dx.*
→ *Write the final answer as 8x times e to the 4x squared.*

Answer: $y' = 8x\, e^{4x^2}$

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5. Find the derivative of the function.

$y = 3^{x^2 + 1}$

→ *Identify base a equals 3 and exponent u equals x squared plus 1.*
→ *Apply the rule: a to the u times ln(a) times du/dx.*
→ *Since du/dx equals 2x, the derivative is 2x times 3 to the x squared plus 1 times ln 3.*

Answer: $y' = 2x \cdot 3^{x^2 + 1} \ln 3$

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6. Find the derivative of the function.

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

→ *Let u equal the square root of x, which is x to the one-half power.*
→ *Compute du/dx equals one over two times the square root of x.*
→ *Apply the e to the u rule and multiply to get e to the square root of x divided by 2 times the square root of x.*

Answer: $f'(x) = \frac{e^{\sqrt{x}}}{2\sqrt{x}}$

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7. Find the derivative of the function.

$y = 2^{5x-1}$

→ *Identify base a equals 2 and exponent u equals 5x minus 1.*
→ *Apply the rule: a to the u times ln(a) times du/dx.*
→ *Since du/dx equals 5, the answer is 5 times 2 to the 5x minus 1 times ln 2.*

Answer: $y' = 5 \cdot 2^{5x-1} \ln 2$

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8. Find the derivative of the function.

$y = 4e^{x^3 - 2x}$

→ *Keep the constant 4 outside and focus on e to the x cubed minus 2x.*
→ *Let u equal x cubed minus 2x so du/dx equals 3x squared minus 2.*
→ *Apply the e to the u rule and multiply by the constant 4 to get 4 times the quantity 3x squared minus 2 times e to the x cubed minus 2x.*

Answer: $y' = 4(3x^2 - 2)e^{x^3 - 2x}$

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9. Find the derivative of the function.

$y = 10^{3x^2}$

→ *Identify base a equals 10 and exponent u equals 3x squared.*
→ *Apply the rule: a to the u times ln(a) times du/dx.*
→ *Compute du/dx equals 6x and multiply to get 6x times 10 to the 3x squared times ln 10.*

Answer: $y' = 6x \cdot 10^{3x^2} \ln 10$

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10. Find the derivative of the function.

$f(x) = e^{(3x)^5}$

→ *Simplify the exponent: 3x raised to the 5th equals 243 times x to the 5th.*
→ *Let u equal 243 x to the 5th so du/dx equals 1215 x to the 4th.*
→ *Apply the e to the u rule to get 1215 x to the 4th times e to the 243 x to the 5th.*

Answer: $f'(x) = 1215x^4 e^{243x^5}$