MATH120: Derivatives Rules

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Learning Objectives

- Apply the product rule to differentiate products of functions
- Apply the quotient rule to differentiate rational functions
- Apply the chain rule to differentiate composite functions
- Combine differentiation rules for complex expressions

Simplify each expression completely. Show all steps and circle your final answer.

Differentiating polynomials

1. A company's total revenue is R(x) = 1x^3 + -3x^2 + 13x + 15. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -3x^2 + 13x + 15,\ x = 1$$

Answer: _____

2. A company's total revenue is R(x) = 1x^3 + 0x^2 + 6x + 37. Find the marginal revenue R'(3).

$$f(x) = 1x^3 + 0x^2 + 6x + 37,\ x = 3$$

Answer: _____

3. A company's total revenue is R(x) = 2x^3 + -1x^2 + 16x + 40. Find the marginal revenue R'(1).

$$f(x) = 2x^3 + -1x^2 + 16x + 40,\ x = 1$$

Answer: _____

4. A company's total revenue is R(x) = 1x^3 + 0x^2 + 14x + 30. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + 0x^2 + 14x + 30,\ x = 2$$

Answer: _____

5. A company's total revenue is R(x) = 1x^3 + -2x^2 + 11x + 2. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -2x^2 + 11x + 2,\ x = 1$$

Answer: _____

6. A company's total revenue is R(x) = 1x^3 + -3x^2 + 12x + 29. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + -3x^2 + 12x + 29,\ x = 2$$

Answer: _____

7. A company's total revenue is R(x) = 1x^3 + -1x^2 + 18x + 15. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + -1x^2 + 18x + 15,\ x = 2$$

Answer: _____

8. A company's total revenue is R(x) = 1x^3 + -1x^2 + 19x + 28. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -1x^2 + 19x + 28,\ x = 1$$

Answer: _____

Power rule

9. Use the power rule to find the derivative of f(x) = 1x^3. Then evaluate f'(3).

$$f(x) = 1x^3, \quad x = 3$$

Answer: _____

10. Find the instantaneous rate of change of C(x) = 5x^4 at x = 1. (Use the power rule.)

$$f(x) = 5x^4, \quad x = 1$$

Answer: _____

11. Use the power rule to find the derivative of f(x) = 3x^2. Then evaluate f'(2).

$$f(x) = 3x^2, \quad x = 2$$

Answer: _____

12. Find the instantaneous rate of change of C(x) = 6x^3 at x = 2. (Use the power rule.)

$$f(x) = 6x^3, \quad x = 2$$

Answer: _____

13. Use the power rule to find the derivative of f(x) = 2x^4. Then evaluate f'(3).

$$f(x) = 2x^4, \quad x = 3$$

Answer: _____

14. Find the instantaneous rate of change of C(x) = 4x^2 at x = 4. (Use the power rule.)

$$f(x) = 4x^2, \quad x = 4$$

Answer: _____

15. Use the power rule to find the derivative of f(x) = 1x^2. Then evaluate f'(1).

$$f(x) = 1x^2, \quad x = 1$$

Answer: _____

16. Find the instantaneous rate of change of C(x) = 8x^4 at x = 1. (Use the power rule.)

$$f(x) = 8x^4, \quad x = 1$$

Answer: _____

17. Use the power rule to find the derivative of f(x) = 2x^2. Then evaluate f'(3).

$$f(x) = 2x^2, \quad x = 3$$

Answer: _____

18. Find the instantaneous rate of change of C(x) = 4x^3 at x = 2. (Use the power rule.)

$$f(x) = 4x^3, \quad x = 2$$

Answer: _____

19. Use the power rule to find the derivative of f(x) = 4x^3. Then evaluate f'(2).

$$f(x) = 4x^3, \quad x = 2$$

Answer: _____

20. Find the instantaneous rate of change of C(x) = 5x^2 at x = 4. (Use the power rule.)

$$f(x) = 5x^2, \quad x = 4$$

Answer: _____

21. Use the power rule to find the derivative of f(x) = 1x^2. Then evaluate f'(2).

$$f(x) = 1x^2, \quad x = 2$$

Answer: _____

22. Find the instantaneous rate of change of C(x) = 7x^3 at x = 1. (Use the power rule.)

$$f(x) = 7x^3, \quad x = 1$$

Answer: _____

23. Use the power rule to find the derivative of f(x) = 3x^4. Then evaluate f'(3).

$$f(x) = 3x^4, \quad x = 3$$

Answer: _____

Product rule

24. Use the product rule to differentiate f(x) = (3x + 4)(4x + 3). Find f'(0).

$$f(x) = (3x + 4)(4x + 3),\ x = 0$$

Answer: _____

25. Use the product rule to differentiate f(x) = (1x + 3)(4x + 1). Find f'(2).

$$f(x) = (1x + 3)(4x + 1),\ x = 2$$

Answer: _____

26. Use the product rule to differentiate f(x) = (2x + 4)(4x + 6). Find f'(2).

$$f(x) = (2x + 4)(4x + 6),\ x = 2$$

Answer: _____

27. Use the product rule to differentiate f(x) = (1x + 3)(1x + 2). Find f'(2).

$$f(x) = (1x + 3)(1x + 2),\ x = 2$$

Answer: _____

28. Use the product rule to differentiate f(x) = (4x + 2)(2x + 3). Find f'(2).

$$f(x) = (4x + 2)(2x + 3),\ x = 2$$

Answer: _____

29. Use the product rule to differentiate f(x) = (4x + 3)(3x + 5). Find f'(1).

$$f(x) = (4x + 3)(3x + 5),\ x = 1$$

Answer: _____

30. Use the product rule to differentiate f(x) = (1x + 1)(2x + 1). Find f'(2).

$$f(x) = (1x + 1)(2x + 1),\ x = 2$$

Answer: _____

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ANSWER KEY & SOLUTIONS

Topics: Differentiating polynomials, Product rule, Power rule. All answers verified by independent computation.

Solutions

Differentiating polynomials

1. A company's total revenue is R(x) = 1x^3 + -3x^2 + 13x + 15. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -3x^2 + 13x + 15,\ x = 1$$

→ *R'(x) = 3x^2 + -6x + 13.*
→ *R'(1) = 3(1)^2 + -6(1) + 13 = 10.*
→ *Marginal revenue at x = 1 units is $10.*

Answer: $f'(x) = 3x^2 + -6x + 13, \quad f'(1) = 10$

2. A company's total revenue is R(x) = 1x^3 + 0x^2 + 6x + 37. Find the marginal revenue R'(3).

$$f(x) = 1x^3 + 0x^2 + 6x + 37,\ x = 3$$

→ *R'(x) = 3x^2 + 0x + 6.*
→ *R'(3) = 3(3)^2 + 0(3) + 6 = 33.*
→ *Marginal revenue at x = 3 units is $33.*

Answer: $f'(x) = 3x^2 + 0x + 6, \quad f'(3) = 33$

3. A company's total revenue is R(x) = 2x^3 + -1x^2 + 16x + 40. Find the marginal revenue R'(1).

$$f(x) = 2x^3 + -1x^2 + 16x + 40,\ x = 1$$

→ *R'(x) = 6x^2 + -2x + 16.*
→ *R'(1) = 6(1)^2 + -2(1) + 16 = 20.*
→ *Marginal revenue at x = 1 units is $20.*

Answer: $f'(x) = 6x^2 + -2x + 16, \quad f'(1) = 20$

4. A company's total revenue is R(x) = 1x^3 + 0x^2 + 14x + 30. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + 0x^2 + 14x + 30,\ x = 2$$

→ *R'(x) = 3x^2 + 0x + 14.*
→ *R'(2) = 3(2)^2 + 0(2) + 14 = 26.*
→ *Marginal revenue at x = 2 units is $26.*

Answer: $f'(x) = 3x^2 + 0x + 14, \quad f'(2) = 26$

5. A company's total revenue is R(x) = 1x^3 + -2x^2 + 11x + 2. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -2x^2 + 11x + 2,\ x = 1$$

→ *R'(x) = 3x^2 + -4x + 11.*
→ *R'(1) = 3(1)^2 + -4(1) + 11 = 10.*
→ *Marginal revenue at x = 1 units is $10.*

Answer: $f'(x) = 3x^2 + -4x + 11, \quad f'(1) = 10$

6. A company's total revenue is R(x) = 1x^3 + -3x^2 + 12x + 29. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + -3x^2 + 12x + 29,\ x = 2$$

→ *R'(x) = 3x^2 + -6x + 12.*
→ *R'(2) = 3(2)^2 + -6(2) + 12 = 12.*
→ *Marginal revenue at x = 2 units is $12.*

Answer: $f'(x) = 3x^2 + -6x + 12, \quad f'(2) = 12$

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7. A company's total revenue is R(x) = 1x^3 + -1x^2 + 18x + 15. Find the marginal revenue R'(2).

$$f(x) = 1x^3 + -1x^2 + 18x + 15,\ x = 2$$

→ *R'(x) = 3x^2 + -2x + 18.*
→ *R'(2) = 3(2)^2 + -2(2) + 18 = 26.*
→ *Marginal revenue at x = 2 units is $26.*

Answer: $f'(x) = 3x^2 + -2x + 18, \quad f'(2) = 26$

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8. A company's total revenue is R(x) = 1x^3 + -1x^2 + 19x + 28. Find the marginal revenue R'(1).

$$f(x) = 1x^3 + -1x^2 + 19x + 28,\ x = 1$$

→ *R'(x) = 3x^2 + -2x + 19.*
→ *R'(1) = 3(1)^2 + -2(1) + 19 = 20.*
→ *Marginal revenue at x = 1 units is $20.*

Answer: $f'(x) = 3x^2 + -2x + 19, \quad f'(1) = 20$

Power rule

9. Use the power rule to find the derivative of f(x) = 1x^3. Then evaluate f'(3).

$$f(x) = 1x^3, \quad x = 3$$

→ *Power rule: d/dx[1x^3] = 3x^2.*
→ *f'(3) = 3(3)^2 = 27.*

Answer: $f'(x) = 3x^2, \quad f'(3) = 27$

10. Find the instantaneous rate of change of C(x) = 5x^4 at x = 1. (Use the power rule.)

$$f(x) = 5x^4, \quad x = 1$$

→ *C'(x) = 20x^3.*
→ *C'(1) = 20(1)^3 = 20.*

Answer: $f'(x) = 20x^3, \quad f'(1) = 20$

11. Use the power rule to find the derivative of f(x) = 3x^2. Then evaluate f'(2).

$$f(x) = 3x^2, \quad x = 2$$

→ *Power rule: d/dx[3x^2] = 6x^1.*
→ *f'(2) = 6(2)^1 = 12.*

Answer: $f'(x) = 6x^1, \quad f'(2) = 12$

12. Find the instantaneous rate of change of C(x) = 6x^3 at x = 2. (Use the power rule.)

$$f(x) = 6x^3, \quad x = 2$$

→ *C'(x) = 18x^2.*
→ *C'(2) = 18(2)^2 = 72.*

Answer: $f'(x) = 18x^2, \quad f'(2) = 72$

13. Use the power rule to find the derivative of f(x) = 2x^4. Then evaluate f'(3).

$$f(x) = 2x^4, \quad x = 3$$

→ *Power rule: d/dx[2x^4] = 8x^3.*
→ *f'(3) = 8(3)^3 = 216.*

Answer: $f'(x) = 8x^3, \quad f'(3) = 216$

14. Find the instantaneous rate of change of C(x) = 4x^2 at x = 4. (Use the power rule.)

$$f(x) = 4x^2, \quad x = 4$$

→ *C'(x) = 8x^1.*
→ *C'(4) = 8(4)^1 = 32.*

Answer: $f'(x) = 8x^1, \quad f'(4) = 32$

15. Use the power rule to find the derivative of f(x) = 1x^2. Then evaluate f'(1).

$$f(x) = 1x^2, \quad x = 1$$

→ *Power rule: d/dx[1x^2] = 2x^1.*
→ *f'(1) = 2(1)^1 = 2.*

Answer: $f'(x) = 2x^1, \quad f'(1) = 2$

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16. Find the instantaneous rate of change of C(x) = 8x^4 at x = 1. (Use the power rule.)

$$f(x) = 8x^4, \quad x = 1$$

→ *C'(x) = 32x^3.*
→ *C'(1) = 32(1)^3 = 32.*

Answer: $f'(x) = 32x^3, \quad f'(1) = 32$

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17. Use the power rule to find the derivative of f(x) = 2x^2. Then evaluate f'(3).

$$f(x) = 2x^2, \quad x = 3$$

→ *Power rule: d/dx[2x^2] = 4x^1.*
→ *f'(3) = 4(3)^1 = 12.*

Answer: $f'(x) = 4x^1, \quad f'(3) = 12$

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18. Find the instantaneous rate of change of C(x) = 4x^3 at x = 2. (Use the power rule.)

$$f(x) = 4x^3, \quad x = 2$$

→ *C'(x) = 12x^2.*
→ *C'(2) = 12(2)^2 = 48.*

Answer: $f'(x) = 12x^2, \quad f'(2) = 48$

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19. Use the power rule to find the derivative of f(x) = 4x^3. Then evaluate f'(2).

$$f(x) = 4x^3, \quad x = 2$$

→ *Power rule: d/dx[4x^3] = 12x^2.*
→ *f'(2) = 12(2)^2 = 48.*

Answer: $f'(x) = 12x^2, \quad f'(2) = 48$

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20. Find the instantaneous rate of change of C(x) = 5x^2 at x = 4. (Use the power rule.)

$$f(x) = 5x^2, \quad x = 4$$

→ *C'(x) = 10x^1.*
→ *C'(4) = 10(4)^1 = 40.*

Answer: $f'(x) = 10x^1, \quad f'(4) = 40$

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21. Use the power rule to find the derivative of f(x) = 1x^2. Then evaluate f'(2).

$$f(x) = 1x^2, \quad x = 2$$

→ *Power rule: d/dx[1x^2] = 2x^1.*
→ *f'(2) = 2(2)^1 = 4.*

Answer: $f'(x) = 2x^1, \quad f'(2) = 4$

---

22. Find the instantaneous rate of change of C(x) = 7x^3 at x = 1. (Use the power rule.)

$$f(x) = 7x^3, \quad x = 1$$

→ *C'(x) = 21x^2.*
→ *C'(1) = 21(1)^2 = 21.*

Answer: $f'(x) = 21x^2, \quad f'(1) = 21$

---

23. Use the power rule to find the derivative of f(x) = 3x^4. Then evaluate f'(3).

$$f(x) = 3x^4, \quad x = 3$$

→ *Power rule: d/dx[3x^4] = 12x^3.*
→ *f'(3) = 12(3)^3 = 324.*

Answer: $f'(x) = 12x^3, \quad f'(3) = 324$

Product rule

24. Use the product rule to differentiate f(x) = (3x + 4)(4x + 3). Find f'(0).

$$f(x) = (3x + 4)(4x + 3),\ x = 0$$

→ u = 3x+4, v = 4x+3. u' = 3, v' = 4.
→ f'(x) = u'v + uv' = 3(4x+3) + 4(3x+4).
→ f'(0) = 3(3) + 4(4) = 25.

Answer: $f'(0) = 3 \cdot 3 + 4 \cdot 4 = 25$

25. Use the product rule to differentiate f(x) = (1x + 3)(4x + 1). Find f'(2).

$$f(x) = (1x + 3)(4x + 1),\ x = 2$$

→ u = 1x+3, v = 4x+1. u' = 1, v' = 4.
→ f'(x) = u'v + uv' = 1(4x+1) + 4(1x+3).
→ f'(2) = 1(9) + 4(5) = 29.

Answer: $f'(2) = 1 \cdot 9 + 4 \cdot 5 = 29$

26. Use the product rule to differentiate f(x) = (2x + 4)(4x + 6). Find f'(2).

$$f(x) = (2x + 4)(4x + 6),\ x = 2$$

→ u = 2x+4, v = 4x+6. u' = 2, v' = 4.
→ f'(x) = u'v + uv' = 2(4x+6) + 4(2x+4).
→ f'(2) = 2(14) + 4(8) = 60.

Answer: $f'(2) = 2 \cdot 14 + 4 \cdot 8 = 60$

27. Use the product rule to differentiate f(x) = (1x + 3)(1x + 2). Find f'(2).

$$f(x) = (1x + 3)(1x + 2),\ x = 2$$

→ u = 1x+3, v = 1x+2. u' = 1, v' = 1.
→ f'(x) = u'v + uv' = 1(1x+2) + 1(1x+3).
→ f'(2) = 1(4) + 1(5) = 9.

Answer: $f'(2) = 1 \cdot 4 + 1 \cdot 5 = 9$

28. Use the product rule to differentiate f(x) = (4x + 2)(2x + 3). Find f'(2).

$$f(x) = (4x + 2)(2x + 3),\ x = 2$$

→ u = 4x+2, v = 2x+3. u' = 4, v' = 2.
→ f'(x) = u'v + uv' = 4(2x+3) + 2(4x+2).
→ f'(2) = 4(7) + 2(10) = 48.

Answer: $f'(2) = 4 \cdot 7 + 2 \cdot 10 = 48$

29. Use the product rule to differentiate f(x) = (4x + 3)(3x + 5). Find f'(1).

$$f(x) = (4x + 3)(3x + 5),\ x = 1$$

→ u = 4x+3, v = 3x+5. u' = 4, v' = 3.
→ f'(x) = u'v + uv' = 4(3x+5) + 3(4x+3).
→ f'(1) = 4(8) + 3(7) = 53.

Answer: $f'(1) = 4 \cdot 8 + 3 \cdot 7 = 53$

30. Use the product rule to differentiate f(x) = (1x + 1)(2x + 1). Find f'(2).

$$f(x) = (1x + 1)(2x + 1),\ x = 2$$

→ *u = 1x+1, v = 2x+1. u' = 1, v' = 2.*
→ *f'(x) = u'v + uv' = 1(2x+1) + 2(1x+1).*
→ *f'(2) = 1(5) + 2(3) = 11.*

Answer: $f'(2) = 1 \cdot 5 + 2 \cdot 3 = 11$