1. Use the Quotient Rule to differentiate. Simplify the answer.

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

2. Use the Quotient Rule to differentiate. Simplify the answer.

$$f(x) = \frac{-1 - 2x + 3x^2 + x^3}{-3 - 3x^2}$$

3. Use the Quotient Rule to differentiate. Simplify the answer.

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

4. Use the Quotient Rule to differentiate. Simplify the answer.

$$f(x) = \frac{1}{-2 + 2x^2}$$

5. Use the Quotient Rule to differentiate. Simplify the answer.

$$f(x) = \frac{-1 - 2x + 2x^2 + 3x^3}{2x + x^2 - 2x^3}$$

6. Use the Quotient Rule to differentiate. Simplify the answer.

$$f(x) = \frac{-3 + x - 3x^2 + 3x^3}{-1 - 2x - 3x^2}$$

7. Use the Quotient Rule to differentiate. Simplify the answer.

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

8. Use the Quotient Rule to differentiate. Simplify the answer.

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

9. Use the Quotient Rule to differentiate. Simplify the answer.

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

10. Use the Quotient Rule to differentiate. Simplify the answer.

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

Answers:

1. $f'(x) = \dfrac{-3 - 2x + 11x^2 + 2x^4}{(-3 - 2x^2)^2}$

2. $f'(x) = \dfrac{6 - 24x - 15x^2 - 3x^4}{(-3 - 3x^2)^2}$

3. $f'(x) = \dfrac{2 + 4x + 15x^2 + 12x^3}{(x + x^2 + 2x^3)^2}$

4. $f'(x) = \dfrac{-4x}{(-2 + 2x^2)^2}$

5. $f'(x) = \dfrac{2 + 2x + 4x^3 + 7x^4}{(2x + x^2 - 2x^3)^2}$

6. $f'(x) = \dfrac{-7 - 12x - 12x^3 - 9x^4}{(-1 - 2x - 3x^2)^2}$

7. $f'(x) = \dfrac{4 - 6x - 14x^2 - 2x^4}{(-2 - x^2)^2}$

8. $f'(x) = \dfrac{-2 - 4x + 16x^2 - 6x^4}{(-2 + x + 3x^2 - 3x^3)^2}$

9. $f'(x) = \dfrac{9 - 6x - 24x^2 - 6x^3 - 3x^4}{(3 - 3x + 3x^2 + 3x^3)^2}$

10. $f'(x) = \dfrac{-2 + 4x + 3x^2 + 6x^3 - 3x^4}{(x - x^2)^2}$

Solutions:

1. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-2+x-x^2-x^3}{-3-2x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-3-2x^2)\frac{\mathrm{d}}{\mathrm{d}x}(-2+x-x^2-x^3) - (-2+x-x^2-x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-3-2x^2)}{(-3-2x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-3-2x^2)(1-2x-3x^2) - (-2+x-x^2-x^3)(-4x)}{(-3-2x^2)^2}$ ▶ Expand and simplify:

$= \dfrac{-3-2x+11x^2+2x^4}{(-3-2x^2)^2}$

2. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-1-2x+3x^2+x^3}{-3-3x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-3-3x^2)\frac{\mathrm{d}}{\mathrm{d}x}(-1-2x+3x^2+x^3) - (-1-2x+3x^2+x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-3-3x^2)}{(-3-3x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-3-3x^2)(-2+6x+3x^2) - (-1-2x+3x^2+x^3)(-6x)}{(-3-3x^2)^2}$ ▶ Expand and simplify:

$= \dfrac{6-24x-15x^2-3x^4}{(-3-3x^2)^2}$

3. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-2-3x}{x+x^2+2x^3}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(x+x^2+2x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-2-3x) - (-2-3x)\frac{\mathrm{d}}{\mathrm{d}x}(x+x^2+2x^3)}{(x+x^2+2x^3)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(x+x^2+2x^3)(-3) - (-2-3x)(1+2x+6x^2)}{(x+x^2+2x^3)^2}$ ▶ Expand and simplify:

$= \dfrac{2+4x+15x^2+12x^3}{(x+x^2+2x^3)^2}$

4. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{1}{-2+2x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2+2x^2)\frac{\mathrm{d}}{\mathrm{d}x}(1) - (1)\frac{\mathrm{d}}{\mathrm{d}x}(-2+2x^2)}{(-2+2x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-2+2x^2)(0) - (1)(4x)}{(-2+2x^2)^2}$ ▶ Expand and simplify:

$= \dfrac{-4x}{(-2+2x^2)^2}$

5. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-1-2x+2x^2+3x^3}{2x+x^2-2x^3}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(2x+x^2-2x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-1-2x+2x^2+3x^3) - (-1-2x+2x^2+3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(2x+x^2-2x^3)}{(2x+x^2-2x^3)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(2x+x^2-2x^3)(-2+4x+9x^2) - (-1-2x+2x^2+3x^3)(2+2x-6x^2)}{(2x+x^2-2x^3)^2}$ ▶ Expand and simplify:

$$= \frac{2 + 2x + 4x^3 + 7x^4}{(2x + x^2 - 2x^3)^2}$$

6. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-3 + x - 3x^2 + 3x^3}{-1 - 2x - 3x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-1 - 2x - 3x^2)\frac{\mathrm{d}}{\mathrm{d}x}(-3 + x - 3x^2 + 3x^3) - (-3 + x - 3x^2 + 3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-1 - 2x - 3x^2)}{(-1 - 2x - 3x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-1 - 2x - 3x^2)(1 - 6x + 9x^2) - (-3 + x - 3x^2 + 3x^3)(-2 - 6x)}{(-1 - 2x - 3x^2)^2}$ ▶ Expand and simplify:

$= \dfrac{-7 - 12x - 12x^3 - 9x^4}{(-1 - 2x - 3x^2)^2}$

7. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{-3 - 2x + 2x^3}{-2 - x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2 - x^2)\frac{\mathrm{d}}{\mathrm{d}x}(-3 - 2x + 2x^3) - (-3 - 2x + 2x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-2 - x^2)}{(-2 - x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-2 - x^2)(-2 + 6x^2) - (-3 - 2x + 2x^3)(-2x)}{(-2 - x^2)^2}$ ▶ Expand and simplify:

$= \dfrac{4 - 6x - 14x^2 - 2x^4}{(-2 - x^2)^2}$

8. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{x + x^2 - 3x^3}{-2 + x + 3x^2 - 3x^3}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(-2 + x + 3x^2 - 3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(x + x^2 - 3x^3) - (x + x^2 - 3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(-2 + x + 3x^2 - 3x^3)}{(-2 + x + 3x^2 - 3x^3)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(-2 + x + 3x^2 - 3x^3)(1 + 2x - 9x^2) - (x + x^2 - 3x^3)(1 + 6x - 9x^2)}{(-2 + x + 3x^2 - 3x^3)^2}$ ▶ Expand and simplify:

$= \dfrac{-2 - 4x + 16x^2 - 6x^4}{(-2 + x + 3x^2 - 3x^3)^2}$

9. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{2 + x + x^2}{3 - 3x + 3x^2 + 3x^3}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(3 - 3x + 3x^2 + 3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(2 + x + x^2) - (2 + x + x^2)\frac{\mathrm{d}}{\mathrm{d}x}(3 - 3x + 3x^2 + 3x^3)}{(3 - 3x + 3x^2 + 3x^3)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$= \dfrac{(3 - 3x + 3x^2 + 3x^3)(1 + 2x) - (2 + x + x^2)(-3 + 6x + 9x^2)}{(3 - 3x + 3x^2 + 3x^3)^2}$ ▶ Expand and simplify:

$= \dfrac{9 - 6x - 24x^2 - 6x^3 - 3x^4}{(3 - 3x + 3x^2 + 3x^3)^2}$

10. $f'(x) = \dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{2 + x + 2x^2 + 3x^3}{x - x^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}\dfrac{f(x)}{g(x)} = \dfrac{g(x)\frac{\mathrm{d}}{\mathrm{d}x}f(x) - f(x)\frac{\mathrm{d}}{\mathrm{d}x}g(x)}{g^2(x)}$

$= \dfrac{(x - x^2)\frac{\mathrm{d}}{\mathrm{d}x}(2 + x + 2x^2 + 3x^3) - (2 + x + 2x^2 + 3x^3)\frac{\mathrm{d}}{\mathrm{d}x}(x - x^2)}{(x - x^2)^2}$ ▶ Apply: $\dfrac{\mathrm{d}}{\mathrm{d}x}(x^n) = nx^{n-1}$

$$= \frac{(x - x^2)(1 + 4x + 9x^2) - (2 + x + 2x^2 + 3x^3)(1 - 2x)}{(x - x^2)^2}$$

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

▶ Expand and simplify: