

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

$$f(x) = (2 - 3x)\sqrt{3x}$$

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

$$f(x) = (-x)\sqrt{-3 - 2x}$$

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

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

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

$$f(x) = (3 - x)\sqrt{3x}$$

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

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

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

$$f(x) = (3x)\sqrt{-3 - x}$$

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

$$f(x) = (3 + 2x)\sqrt{2 + 2x}$$

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

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

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

$$f(x) = (1 + 3x)\sqrt{-3 + x}$$

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

$$f(x) = (-2 - x)\sqrt{1 - 2x}$$

$$\begin{aligned} \frac{x^2 - 1}{x^2 + 2} &= (x) f' \quad 10. \\ \frac{x^2 + 1}{x^2 - 4} &= (x) f' \quad 8. \\ \frac{x - 3}{x^2 - 9} &= (x) f' \quad 6. \\ \frac{x^3}{x^2 - 9} &= (x) f' \quad 4. \\ \frac{x^2 - 3}{x^2 + 6} &= (x) f' \quad 2. \end{aligned}$$

$$\begin{aligned} \frac{x + 3}{x^2 - 1} &= (x) f' \quad 6. \\ \frac{x^2 + 2}{x^2 + 12} &= (x) f' \quad 7. \\ \frac{x^2 + 1}{x^2 - 12} &= (x) f' \quad 5. \\ \frac{x + 1}{x^2 + 6} &= (x) f' \quad 3. \\ \frac{x^3}{x^2 - 27} &= (x) f' \quad 1. \end{aligned}$$

Answers:

Solutions:

$$1. f'(x) = \frac{d}{dx}(2-3x)\sqrt{3x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (2-3x)\frac{d}{dx}\sqrt{3x} + \sqrt{3x}\frac{d}{dx}(2-3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (2-3x)\frac{1}{2\sqrt{3x}}\frac{d}{dx}(3x) + \sqrt{3x}\frac{d}{dx}(2-3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (2-3x)\frac{1}{2\sqrt{3x}}(3) + \sqrt{3x}(-3) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (2-3x)\frac{1}{2\sqrt{3x}}(3) + \frac{2\sqrt{3x}}{2\sqrt{3x}}\sqrt{3x}(-3) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(2-3x)(3) + 2(3x)(-3)}{2\sqrt{2-3x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{6-27x}{2\sqrt{3x}}$$

$$2. f'(x) = \frac{d}{dx}(-x)\sqrt{-3-2x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (-x)\frac{d}{dx}\sqrt{-3-2x} + \sqrt{-3-2x}\frac{d}{dx}(-x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (-x)\frac{1}{2\sqrt{-3-2x}}\frac{d}{dx}(-3-2x) + \sqrt{-3-2x}\frac{d}{dx}(-x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (-x)\frac{1}{2\sqrt{-3-2x}}(-2) + \sqrt{-3-2x}(-1) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (-x)\frac{1}{2\sqrt{-3-2x}}(-2) + \frac{2\sqrt{-3-2x}}{2\sqrt{-3-2x}}\sqrt{-3-2x}(-1) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(-x)(-2) + 2(-3-2x)(-1)}{2\sqrt{-x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{6+6x}{2\sqrt{-3-2x}}$$

$$3. f'(x) = \frac{d}{dx}(-2+2x)\sqrt{1+x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (-2+2x)\frac{d}{dx}\sqrt{1+x} + \sqrt{1+x}\frac{d}{dx}(-2+2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (-2+2x)\frac{1}{2\sqrt{1+x}}\frac{d}{dx}(1+x) + \sqrt{1+x}\frac{d}{dx}(-2+2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (-2+2x)\frac{1}{2\sqrt{1+x}}(1) + \sqrt{1+x}(2) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (-2+2x)\frac{1}{2\sqrt{1+x}}(1) + \frac{2\sqrt{1+x}}{2\sqrt{1+x}}\sqrt{1+x}(2) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(-2+2x)(1) + 2(1+x)(2)}{2\sqrt{-2+2x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{2+6x}{2\sqrt{1+x}}$$

$$4. f'(x) = \frac{d}{dx}(3-x)\sqrt{3x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (3-x)\frac{d}{dx}\sqrt{3x} + \sqrt{3x}\frac{d}{dx}(3-x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (3-x)\frac{1}{2\sqrt{3x}}\frac{d}{dx}(3x) + \sqrt{3x}\frac{d}{dx}(3-x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (3-x)\frac{1}{2\sqrt{3x}}(3) + \sqrt{3x}(-1) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (3-x)\frac{1}{2\sqrt{3x}}(3) + \frac{2\sqrt{3x}}{2\sqrt{3x}}\sqrt{3x}(-1) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(3-x)(3) + 2(3x)(-1)}{2\sqrt{3-x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{9-9x}{2\sqrt{3x}}$$

$$5. f'(x) = \frac{d}{dx}(-3-2x)\sqrt{-1+2x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (-3-2x)\frac{d}{dx}\sqrt{-1+2x} + \sqrt{-1+2x}\frac{d}{dx}(-3-2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (-3-2x)\frac{1}{2\sqrt{-1+2x}}\frac{d}{dx}(-1+2x) + \sqrt{-1+2x}\frac{d}{dx}(-3-2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (-3-2x)\frac{1}{2\sqrt{-1+2x}}(2) + \sqrt{-1+2x}(-2) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (-3-2x)\frac{1}{2\sqrt{-1+2x}}(2) + \frac{2\sqrt{-1+2x}}{2\sqrt{-1+2x}}\sqrt{-1+2x}(-2) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(-3-2x)(2) + 2(-1+2x)(-2)}{2\sqrt{-3-2x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{-2-12x}{2\sqrt{-1+2x}}$$

$$6. f'(x) = \frac{d}{dx}(3x)\sqrt{-3-x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (3x)\frac{d}{dx}\sqrt{-3-x} + \sqrt{-3-x}\frac{d}{dx}(3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}\sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}}\frac{d}{dx}f(x)$$

$$= (3x)\frac{1}{2\sqrt{-3-x}}\frac{d}{dx}(-3-x) + \sqrt{-3-x}\frac{d}{dx}(3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1}$$

$$= (3x)\frac{1}{2\sqrt{-3-x}}(-1) + \sqrt{-3-x}(3) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (3x)\frac{1}{2\sqrt{-3-x}}(-1) + \frac{2\sqrt{-3-x}}{2\sqrt{-3-x}}\sqrt{-3-x}(3) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(3x)(-1) + 2(-3-x)(3)}{2\sqrt{3x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{-18-9x}{2\sqrt{-3-x}}$$

$$7. f'(x) = \frac{d}{dx}(3+2x)\sqrt{2+2x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx}f(x)g(x) = f(x)\frac{d}{dx}g(x) + g(x)\frac{d}{dx}f(x)$$

$$= (3 + 2x) \frac{d}{dx} \sqrt{2 + 2x} + \sqrt{2 + 2x} \frac{d}{dx} (3 + 2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} \sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}} \frac{d}{dx} f(x)$$

$$= (3 + 2x) \frac{1}{2\sqrt{2 + 2x}} \frac{d}{dx} (2 + 2x) + \sqrt{2 + 2x} \frac{d}{dx} (3 + 2x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} (x^n) = nx^{n-1}$$

$$= (3 + 2x) \frac{1}{2\sqrt{2 + 2x}} (2) + \sqrt{2 + 2x} (2) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (3 + 2x) \frac{1}{2\sqrt{2 + 2x}} (2) + \frac{2\sqrt{2 + 2x}}{2\sqrt{2 + 2x}} \sqrt{2 + 2x} (2) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(3 + 2x)(2) + 2(2 + 2x)(2)}{2\sqrt{3 + 2x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{14 + 12x}{2\sqrt{2 + 2x}}$$

$$8. f'(x) = \frac{d}{dx} (3 - x)\sqrt{1 + 2x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx} f(x)g(x) = f(x) \frac{d}{dx} g(x) + g(x) \frac{d}{dx} f(x)$$

$$= (3 - x) \frac{d}{dx} \sqrt{1 + 2x} + \sqrt{1 + 2x} \frac{d}{dx} (3 - x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} \sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}} \frac{d}{dx} f(x)$$

$$= (3 - x) \frac{1}{2\sqrt{1 + 2x}} \frac{d}{dx} (1 + 2x) + \sqrt{1 + 2x} \frac{d}{dx} (3 - x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} (x^n) = nx^{n-1}$$

$$= (3 - x) \frac{1}{2\sqrt{1 + 2x}} (2) + \sqrt{1 + 2x} (-1) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (3 - x) \frac{1}{2\sqrt{1 + 2x}} (2) + \frac{2\sqrt{1 + 2x}}{2\sqrt{1 + 2x}} \sqrt{1 + 2x} (-1) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(3 - x)(2) + 2(1 + 2x)(-1)}{2\sqrt{3 - x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{4 - 6x}{2\sqrt{1 + 2x}}$$

$$9. f'(x) = \frac{d}{dx} (1 + 3x)\sqrt{-3 + x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx} f(x)g(x) = f(x) \frac{d}{dx} g(x) + g(x) \frac{d}{dx} f(x)$$

$$= (1 + 3x) \frac{d}{dx} \sqrt{-3 + x} + \sqrt{-3 + x} \frac{d}{dx} (1 + 3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} \sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}} \frac{d}{dx} f(x)$$

$$= (1 + 3x) \frac{1}{2\sqrt{-3 + x}} \frac{d}{dx} (-3 + x) + \sqrt{-3 + x} \frac{d}{dx} (1 + 3x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} (x^n) = nx^{n-1}$$

$$= (1 + 3x) \frac{1}{2\sqrt{-3 + x}} (1) + \sqrt{-3 + x} (3) \quad \blacktriangleright \text{Find the common denominator:}$$

$$= (1 + 3x) \frac{1}{2\sqrt{-3 + x}} (1) + \frac{2\sqrt{-3 + x}}{2\sqrt{-3 + x}} \sqrt{-3 + x} (3) \quad \blacktriangleright \text{Factor the common denominator:}$$

$$= \frac{(1 + 3x)(1) + 2(-3 + x)(3)}{2\sqrt{1 + 3x}} \quad \blacktriangleright \text{Expand and simplify:}$$

$$= \frac{-17 + 9x}{2\sqrt{-3 + x}}$$

$$10. f'(x) = \frac{d}{dx} (-2 - x)\sqrt{1 - 2x} \quad \blacktriangleright \text{Apply: } \frac{d}{dx} f(x)g(x) = f(x) \frac{d}{dx} g(x) + g(x) \frac{d}{dx} f(x)$$

$$= (-2 - x) \frac{d}{dx} \sqrt{1 - 2x} + \sqrt{1 - 2x} \frac{d}{dx} (-2 - x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx} \sqrt{f(x)} = \frac{1}{2\sqrt{f(x)}} \frac{d}{dx} f(x)$$

$$\begin{aligned} &= (-2-x) \frac{1}{2\sqrt{1-2x}} \frac{d}{dx}(1-2x) + \sqrt{1-2x} \frac{d}{dx}(-2-x) \quad \blacktriangleright \text{Apply: } \frac{d}{dx}(x^n) = nx^{n-1} \\ &= (-2-x) \frac{1}{2\sqrt{1-2x}}(-2) + \sqrt{1-2x}(-1) \quad \blacktriangleright \text{Find the common denominator:} \\ &= (-2-x) \frac{1}{2\sqrt{1-2x}}(-2) + \frac{2\sqrt{1-2x}}{2\sqrt{1-2x}} \sqrt{1-2x}(-1) \quad \blacktriangleright \text{Factor the common denominator:} \\ &= \frac{(-2-x)(-2) + 2(1-2x)(-1)}{2\sqrt{1-2x}} \quad \blacktriangleright \text{Expand and simplify:} \\ &= \frac{2+6x}{2\sqrt{1-2x}} \end{aligned}$$