Product Rule Practice Problems

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Differentiate each of the following functions with respect to x using the product rule:

1. $f(x) = x \cdot \sin(x)$
2. $f(x) = x^4 \cdot \cos(x)$
3. $f(x) = \frac{1}{3}x \cdot \tan(x)$
4. $f(x) = 5x \cdot e^x$
5. $f(x) = 2x^3 \cdot e^x$
6. $f(x) = (x^2 + 5)(x^4 + 6)$
7. $f(x) = (2x^3 + 5)(x^5 - 7)$
8. $f(x) = (-6x^4 + 5x)(x^3 - 7x)$
9. $f(x) = \sec(x) \cdot \tan(x)$
10. $f(x) = \sin(x) \cdot \csc(x)$
11. $f(x) = 5x^2 \cdot \csc(x)$
12. $f(x) = (x^5 - 7x) \cdot e^x$
13. $f(x) = 5x^3 \cdot \ln(x)$
14. $f(x) = \sin(x) \cdot \ln(x)$
15. $f(x) = 7x^{3/5} \cdot \ln(x)$

Solutions

1. $f(x) = x \cdot \sin(x)$
   $f'(x) = \sin(x) + x \cdot \cos(x)$

2. $f(x) = x^4 \cdot \cos(x)$
   $f'(x) = 4x^3 \cdot \cos(x) - x^4 \cdot \sin(x)$

3. $f(x) = \frac{1}{3}x \cdot \tan(x)$
   $f'(x) = \frac{1}{3} \cdot (\tan(x) + x \cdot \sec^2(x))$

4. $f(x) = 5x \cdot e^x$
   $f'(x) = 5e^x + 5x \cdot e^x$

5. $f(x) = 2x^3 \cdot e^x$
   $f'(x) = 6x^2 \cdot e^x + 2x^3 \cdot e^x$

6. $f(x) = (x^2 + 5)(x^4 + 6)$
   $f'(x) = (2x)(x^4 + 6) + (x^2 + 5)(4x^3)$

7. $f(x) = (2x^3 + 5)(x^5 - 7)$
   $f'(x) = (6x^2)(x^5 - 7) + (2x^3 + 5)(5x^4)$

8. $f(x) = (-6x^4 + 5x)(x^3 - 7x)$
   $f'(x) = (-24x^3 + 5)(x^3 - 7x) + (-6x^4 + 5x)(3x^2 - 7)$

9. $f(x) = \sec(x) \cdot \tan(x)$
   $f'(x) = \sec(x) \cdot \tan^2(x) + \sec^3(x)$

10. $f(x) = \sin(x) \cdot \csc(x)$
    $f'(x) = 0$

11. $f(x) = 5x^2 \cdot \csc(x)$
    $f'(x) = 10x \cdot \csc(x) - 5x^2 \cdot \csc(x) \cdot \cot(x)$

12. $f(x) = (x^5 - 7x) \cdot e^x$
    $f'(x) = (5x^4 - 7) \cdot e^x + (x^5 - 7x) \cdot e^x$

13. $f(x) = 5x^3 \cdot \ln(x)$
    $f'(x) = 15x^2 \cdot \ln(x) + 5x^3 \cdot \frac{1}{x}$

14. $f(x) = \sin(x) \cdot \ln(x)$
    $f'(x) = \cos(x) \cdot \ln(x) + \sin(x) \cdot \frac{1}{x}$

15. $f(x) = 7x^{3/5} \cdot \ln(x)$
    $f'(x) = \frac{21}{5}x^{-2/5} \cdot \ln(x) + 7x^{3/5} \cdot \frac{1}{x}$