Differentiate each of the following functions.

1. $f(x) = x^5 \cos x$
2. $f(x) = x^3 \ln x$
3. $f(x) = \sqrt[3]{x^5} \sin x$
4. $f(x) = (3x^{10} - 5x^6) \ln x$
5. $f(x) = x \ln x - x$
6. $f(x) = \dfrac{\ln x}{x^3}$
7. $f(x) = \ln(8x^{10})$
8. $f(x) = \sin x \cdot \cos x$
9. $f(x) = \ln x \cdot \sin x$
10. $f(x) = \sin 2x$
11. $f(x) = x^{10} \ln(x^{10})$
12. $f(x) = \cos x\,(x^2 - 4x + 1) - (x^3 - 2)$
13. $f(x) = \dfrac{\cos x}{x^2}$
14. $f(x) = \dfrac{x^3 - 2x + 1}{x^2}$
15. $f(x) = \dfrac{\ln x}{x}$
16. $f(x) = \dfrac{\ln(x^3)}{\sqrt{x^3}}$

Answers

1.) $f'(x) = -x^5 \sin x + 5x^4 \cos x$ 2.) $f'(x) = x^2 + 3x^2 \ln x$

3.) $f'(x) = (\cos x)\sqrt[3]{x^5} + \frac{5}{3}\sqrt[3]{x^2}(\sin x)$ 4.) $f'(x) = (30x^9 - 30x^5)(\ln x) + 3x^9 - 5x^5$

5.) $f'(x) = \ln x$ 6.) $f'(x) = \frac{-3\ln x + 1}{x^4}$ 7.) $f'(x) = \frac{10}{x}$ 8.) $f'(x) = \cos^2 x - \sin^2 x$

9.) $f'(x) = \ln x \cos x + \frac{1}{x}\sin x$ 10.) $f'(x) = 2\left(\cos^2 x - \sin^2 x\right) = 2\cos 2x$

11.) $f'(x) = 10x^9 + 100x^9 \ln x$ 12.) $f'(x) = -\sin x \cdot (x^2 - 4x + 1) + (\cos x)(2x - 4) - 3x^2$

13.) $f'(x) = -\frac{1}{x^2}\sin x - \frac{2}{x^3}\cos x$ 14.) $f'(x) = 1 + \frac{2}{x^2} - \frac{2}{x^3}$ 15.) $f'(x) = \frac{1 - \ln x}{x^2}$

16.) $f'(x) = \frac{-\frac{9}{2}\ln x + 3}{x^{5/2}}$