

Find  $D_f$ ,  $f'(x)$  and  $f''(x)$ :

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

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

3.  $f(x) = (x + 5)x^{2/3}$

4.  $f(x) = \frac{\sqrt{x^2 - 2}}{x}$

5.  $f(x) = \sqrt{x^2 - 5x + 6}$

6.  $f(x) = \frac{x}{\sqrt[3]{x^2 - 4}}$

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

8.  $f(x) = x + e^x$

9.  $f(x) = (1 + x^2)e^x$

10.  $f(x) = e^{-x^2}$

11.  $f(x) = e^{1/x}$

12.  $f(x) = e^{1/x} - x$

13.  $f(x) = (x + 2)e^{1/x}$

14.  $f(x) = e^{\sin x}$

15.  $f(x) = \ln(x^2 - 1)$

16.  $f(x) = x^2 \ln x$

17.  $f(x) = x \ln^2 x$

18.  $f(x) = \frac{\ln x}{\sqrt{x}}$

19.  $f(x) = x + \ln|x| - 1$

20.  $f(x) = \ln(\sin x)$

21.  $f(x) = x + \sin x$

22.  $f(x) = \sin x + \cos x$

23.  $f(x) = x + \arcsin x$

24.  $f(x) = x + \arccos x$

25.  $f(x) = x + \arctan x$

26.  $f(x) = \arctan \frac{1}{x}$

27.  $f(x) = x^x$

28.  $f(x) = \arctan(\sin x)$

**Answers:**

1.  $D_f = \mathbb{R} \setminus \{-1\}$ ,  $f'(x) = \frac{x^2 + 2x - 1}{(x + 1)^2}$ ,  $f''(x) = \frac{4}{(x + 1)^3}$

2.  $D_f = [-3, +\infty)$ ,  $f'(x) = \frac{3(x + 2)}{2\sqrt{x + 3}}$ ,  $f''(x) = \frac{3(x + 4)}{4(x + 3)\sqrt{x + 3}}$

3.  $D_f = \mathbb{R}$ ,  $f'(x) = \frac{5(x + 2)}{3\sqrt[3]{x}}$ ,  $f''(x) = \frac{10(x - 1)}{9\sqrt[3]{x^4}}$

4.  $D_f = \mathbb{R} \setminus (-\sqrt{2}, \sqrt{2}) = (-\infty, -\sqrt{2}] \cup [\sqrt{2}, +\infty)$ ,

$$f'(x) = \frac{2}{x^2\sqrt{x^2 - 2}}, \quad f''(x) = -\frac{2(3x^2 - 4)}{x^3\sqrt{(x^2 - 2)^3}}$$

5.  $D_f = (-\infty, 2) \cup (3, +\infty)$ ,  $f'(x) = \frac{2x - 5}{2\sqrt{x^2 - 5x + 6}}$ ,  $f''(x) = \frac{-2x^2 + 10x - 13}{2\sqrt{(x^2 - 5x + 6)^3}}$

6.  $D_f = \mathbb{R}$ ,  $f'(x) = \frac{x^2 - 12}{3\sqrt[3]{(x^2 - 4)^4}}$ ,  $f''(x) = -\frac{2x(x^2 - 36)}{9\sqrt[3]{(x^2 - 4)^7}}$

$$7. D_f = (-\infty, -1] \cup [1, +\infty), f'(x) = \frac{-2x}{\sqrt{x^4 - 1}(\sqrt{x^2 - 1} + \sqrt{x^2 + 1})},$$

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

$$8. D_f = \mathbb{R}, f'(x) = 1 + e^x, f''(x) = e^x$$

$$9. D_f = \mathbb{R}, f'(x) = (x + 1)^2 e^x, f''(x) = (x + 1)(x + 3)e^x$$

$$10. D_f = \mathbb{R}, f'(x) = -2xe^{-x^2}, f''(x) = 2(2x^2 - 1)e^{-x^2}$$

$$11. D_f = \mathbb{R} \setminus \{0\}, f'(x) = -\frac{1}{x^2}e^{1/x}, f''(x) = \frac{2x - 1}{x^4}e^{1/x}$$

$$12. D_f = \mathbb{R} \setminus \{0\}, f'(x) = -\frac{e^{1/x}}{x^2} - 1, f''(x) = \frac{(2x + 1)e^{1/x}}{x^4}$$

$$13. D_f = \mathbb{R} \setminus \{0\}, f'(x) = \frac{x^2 - x - 2}{x^2}e^{1/x}, f''(x) = \frac{5x + 2}{x^4}e^{1/x}$$

$$14. D_f = \mathbb{R}, f'(x) = e^{\sin x} \cos x, f''(x) = e^{\sin x}(1 - \sin x - \sin^2 x)$$

$$15. D_f = (-\infty, -1) \cup (1, +\infty), f'(x) = \frac{2x}{x^2 - 1}, f''(x) = \frac{-2x^2 - 2}{(x^2 - 1)^2}$$

$$16. D_f = (0, +\infty), f'(x) = x(2 \ln x + 1), f''(x) = 2 \ln x + 3$$

$$17. D_f = (0, +\infty), f'(x) = \ln x(\ln x + 2), f''(x) = \frac{2}{x}(\ln x + 1)$$

$$18. D_f = (0, +\infty), f'(x) = \frac{2 - \ln x}{2x\sqrt{x}}, f''(x) = \frac{3 \ln x - 7}{2\sqrt{x^5}}$$

$$19. D_f = \mathbb{R} \setminus \{0\}, f'(x) = \frac{x + 1}{x}, f''(x) = -\frac{1}{x^2}$$

$$20. D_f = \{(2k\pi, (2k + 1)\pi), k \in \mathbb{Z}\}, f'(x) = \cot x, f''(x) = -\frac{1}{\sin^2 x}$$

$$21. D_f = \mathbb{R}, f'(x) = 1 + \cos x, f''(x) = -\sin x$$

$$22. D_f = \mathbb{R}, f'(x) = \cos x - \sin x, f''(x) = -\sin x - \cos x$$

23.  $D_f = [-\frac{\pi}{2}, \frac{\pi}{2}]$ ,  $f'(x) = 1 + \frac{1}{\sqrt{1-x^2}}$ ,  $f''(x) = \frac{x}{\sqrt{(1-x^2)^3}}$

24.  $D_f = [0, \pi]$ ,  $f'(x) = \frac{\sqrt{1-x^2}-1}{\sqrt{1-x^2}}$ ,  $f''(x) = -\frac{x}{\sqrt{(1-x^2)^3}}$

25.  $D_f = \mathbb{R}$ ,  $f'(x) = \frac{x^2+2}{x^2+1}$ ,  $f''(x) = -\frac{2x}{(1+x^2)^2}$

26.  $D_f = \mathbb{R} \setminus \{0\}$ ,  $f'(x) = -\frac{1}{x^2+1}$ ,  $f''(x) = \frac{2x}{(x^2+1)^2}$

27.  $D_f = (0, +\infty)$ ,  $f'(x) = x^x(\ln x + 1)$ ,  $f''(x) = x^x(\ln x + 1)^2 + x^{x-1}$

28.  $D_f = \mathbb{R}$ ,  $f'(x) = \frac{\cos x}{1 + \sin^2 x}$ ,  $f''(x) = -\frac{\sin x(3 \sin^2 x - 1)}{(1 + \sin^2 x)^2}$