Проверить, является ли функция $f$ выпуклой (вогнутой) на заданном множестве $X$, или указать области, в которыхо $f$ является выпуклой или вогнутой:

1. $f(x) = x_1^6 + x_2^2 + x_3^2 + x_4^2 + 10x_1 + 5x_2 + 3x_4 + 20;\ X = \mathbf{R}^4$;
2. $f(x) = e^{2x_1 + x_2};\ X = \mathbf{R}^2$;
3. $f(x) = -x_1^3 - x_2^3 - x_3^3 + 10x_1 - x_2 + 15x_3 + 6;\quad X = \{x \in \mathbf{R}^3 : x \geq 0\}$;
4. $f(x) = x_1^2 + x_2^2 + \frac{1}{2}x_3^2 + x_4^2 + x_1x_2 - x_3 + 10;\quad X = \mathbf{R}^4$;
5. $f(x) = -x_1^2 - x_2^2 - 2x_3^2 + x_1x_2 + x_1x_3 + x_2x_3 + 5x_2 + 25;\ X = \mathbf{R}^3$;
6. $f(x) = -x_2^5 + \frac{1}{2}x_3^2 + 7x_1 - x_3 + 6;\quad X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
7. $f(x) = 3x_1^2 + x_2^2 + 2x_3^2 + x_1x_2 + 3x_1x_3 + x_2x_3 + 3x_2 - 6;\ X = \mathbf{R}^3$;
8. $f(x) = 5x_1^2 + \frac{1}{2}x_2^2 + 4x_3^2 + x_1x_2 + 2x_1x_3 + 2x_2x_3 + x_3 + 1;\ X = \mathbf{R}^3$;
9. $f(x) = -2x_1^2 - \frac{1}{2}x_2^2 - 5x_3^2 + \frac{1}{2}x_1x_2 + 2x_1x_3 + x_2x_3 + 3x_1 - 2x_2 + 6;\ X = \mathbf{R}^3$;
10. $f(x) = x_1^3 + 2x_3^3 + 10x_1 + x_2 - 5x_3 + 6;\quad X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
11. $f(x) = 5x_1^4 + x_2^6 + x_3^2 - 13x_1 + 7x_3 - 8;\ X = \mathbf{R}^3$;
12. $f(x) = -3x_1^2 + x_2^2 + 2x_3^2 + 3x_1x_2 + x_1x_3 + 2x_2x_3 + 17;\ X = \mathbf{R}^3$;
13. $f(x) = 4x_1^3 - x_2^4 - \frac{1}{2}x_3^4 + 3x_1 + 8x_2 + 11;\quad X = \{x \in \mathbf{R}^3 : x \leq 0\}$;
14. $f(x) = 10 - (x_2 - x_1)^2;\quad X = \{x \in \mathbf{R}^2 :\ -1 \leq x_i \leq 1,\quad i = 1,2\}$;
15. $f(x) = 8x_1^3 - 12x_3^2 - 3x_1x_2 + 6x_2 + 17;\quad X = \{x \in \mathbf{R}^3 :\ x \geq 0\}$;
16. $f(x) = -2x_1^2 - 2x_2^2 - 4x_3^2 + 2x_1x_2 + 2x_1x_3 + 2x_2x_3 + 10;\ X = \mathbf{R}^3$;
17. $f(x) = -\frac{1}{2}x_1^7 + \frac{1}{2}x_3^4 + 2x_2x_3 + 11x_1 + 6;\quad X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
18. $f(x) = \frac{5}{2}x_1^2 + x_2^2 + 4x_3^2 + \frac{3}{2}x_1x_2 + 2x_1x_3 + \frac{1}{2}x_2x_3 + 8x_3 + 13;\ X = \mathbf{R}^3$;
19. $f(x) = -3x_1^2 + \frac{1}{2}x_2^3 + 2x_1x_2 + 5x_1x_3 + 7x_1 + 16;\ X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
20. $f(x) = -2x_1^2 - x_2^2 + \frac{3}{2}x_3^2 + x_1x_2 + \frac{1}{2}x_1x_3 + 2x_2x_3 + 10;\ X = \mathbf{R}^3$;
21. $f(x) = 2x_1^2 + \frac{3}{2}x_3^2 + \frac{5}{2}x_1x_3 + 12x_2 + 18;\ X = \mathbf{R}^3$;
22. $f(x) = 6x_1^2 + x_2^3 + 6x_3^2 + 12x_1 - 8x_3 + 7;\ X = \{x \in \mathbf{R}^3 :\ x \geq 0\}$;
23. $f(x) = -x_1^2 - \frac{3}{2}x_2^2 - 2x_3^2 + x_1x_2 + x_1x_3 - 2x_2x_3 + 8x_2;\ X = \mathbf{R}^3$;
24. $f(x) = \frac{7}{2}x_1^2 - \frac{4}{3}x_2^3 - \frac{1}{2}x_3^3 + 13x_1 - 9;\ X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
25. $f(x) = \frac{7}{2}x_1^2 - \frac{4}{3}x_2^3 - \frac{1}{2}x_3^3 + 13x_1 - 9;\ X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;
26. $f(x) = -\frac{5}{6}x_1^3 - \frac{1}{4}x_2^5 - \frac{3}{2}x_3^3 + 22x_2 + 17;\ X = \{x \in \mathbf{R}^3 :\ x \leq 0\}$;

27. $f(x) = -\frac{5}{6}x_1^3 - 2x_2^2 + \frac{3}{2}x_3^2 + 2x_1x_2 + 3x_1x_3 + x_2x_3;\ \ X = \{x \in \mathbf{R}^3 :\ \ x \le 0\};$

28. $f(x) = 2x_1^2 + 4x_2^2 + x_3^2 - x_1x_2 + 9x_1x_3 + x_2x_3 - 9;\ X = \mathbf{R}^3;$

29. $f(x) = \frac{3}{2}x_1^2 + \frac{5}{2}x_2^2 - \frac{9}{2}x_3^2 - 3x_1x_3 + 7x_2x_3;\ X = \mathbf{R}^3;$

30. $f(x) = -\frac{7}{6}x_1^3 + \frac{5}{2}x_2^2 + \frac{5}{12}x_3^4 + \frac{1}{2}x_4 - 3x_2;\ \ X = \{x \in \mathbf{R}^4 :\ \ x \ge 0\};$

31. $f(x) = 4x_1^2 + x_2^2 - 2x_1x_2 + 6x_1 - x_2 - 2;\ X = \mathbf{R}^2;$

32. $f(x) = \sqrt{1 + x_1^2 + x_2^2};\ X = \mathbf{R}^2;$

33. $f(x) = x_1^2 + x_2^2 - \cos\frac{x_1 - x_2}{2};\ X = \mathbf{R}^2;$

34. $f(x) = \frac{x_1^2}{x_2};\quad X = \{x \in \mathbf{R}^2 :\ -1 \le x_2 \le 1,\ \ x_2 \le x_1^2 + 1\};$

35. $f(x) = \sin(x_1 + x_2);\quad X = \{x \in \mathbf{R}^2 :\ -2\pi \le x_i \le 2\pi,\ \ i = 1,2\};$

36. $f(x) = x_1^2 + 2x_2^2 - \sin(x_1 - x_2);\quad X = \{x \in \mathbf{R}^2 :\ \ x \ge 0\};$

37. $f(x) = x_1^2 + 2x_2^2 + \frac{1}{x_1 - x_2};\ \ X = \{x \in \mathbf{R}^2 :\ -\infty < x_1 \le 0,\ 1 \le x_2 < +\infty\};$

38. $f(x) = -2x_1^4 - 2x_2^2 - 5x_3^2 + 3x_2x_3 + 10x_2 + 22;\ \ X = \{x \in \mathbf{R}^3 :\ \ x \ge 0\};$

39. $f(x) = -3x_1^2 - 4x_2^4 - 5x_3^2 + 2x_1x_3 + 2x_2 - 7;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_1 \ge 0,\ \ x_3 \ge 0\};$

40. $f(x) = -2x_1^3 - 3x_2^2 - x_3^3 + 4x_1x_2 + 7x_3 + 18;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

41. $f(x) = -2x_1^2 - \frac{1}{2}x_2^3 - 3x_3^2 + 2x_1x_2 - 3;\quad X = \{x \in \mathbf{R}^3 :\ \ x_1 \ge 0,\ \ x_2 \ge 0\};$

42. $f(x) = \frac{1}{3}x_1^3 + \frac{3}{2}x_2^2 + \frac{5}{2}x_3^2 - 10x_3;\quad X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

43. $f(x) = -\frac{1}{2}x_1^3 - x_2^2 - \frac{3}{2}x_3^2 + 2x_2x_3 - 15;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

44. $f(x) = \frac{1}{3}x_1^4 + 3x_2^2 + 2x_3^3 + 2x_2x_3 + 7x_1;\ X = \{x \in \mathbf{R}^3 :\ x_2 \ge 0\};$

45. $f(x) = -x_1^3 - 2x_2^2 - 3x_3^2 + 2x_2x_3 + 5;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

46. $f(x) = -\frac{5}{6}x_1^3 - 4x_2^2 + \frac{1}{3}x_3^3 + 10;\ X = \{x \in \mathbf{R}^3 :\ x_2 \ge 0\};$

47. $f(x) = -\frac{1}{2}x_1^3 - x_2^2 - \frac{5}{2}x_3^5 + 2x_2x_3 - 4;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

48. $f(x) = -\frac{7}{2}x_1^2 - \frac{5}{6}x_2^3 + \frac{1}{5}x_3^5 - 5;\ X = \{x \in \mathbf{R}^3 :\ x_1 \ge 0\};$

49. $f(x) = -x_1^7 - \frac{1}{2}x_2^4 - 2x_3^2 - 5;\quad X = \{x \in \mathbf{R}^3 :\ \ x_1 \ge 0,\ \ x_3 \ge 0\};$

50. $f(x) = x_1^6 + 4x_2^2 + 2x_3^5 + 3x_4^2;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_2 \ge 0,\ \ x_3 \ge 0\};$

51. $f(x) = \frac{5}{3}x_1^3 + \frac{5}{2}x_2^2 + 2x_3^5 + 2x_2x_3;\ \ X = \{x \in \mathbf{R}^3 :\ x_1 \ge 0\};$

52. $f(x) = \frac{1}{3}x_1^3 + 2x_2^2 + \frac{3}{20}x_3^5 - x_4^2 + x_1x_4 - 4;\ \ X = \{x \in \mathbf{R}^3 :\ \ x_1 \ge 0,\ \ x_2 \ge 0\};$

53. $f(x) = \frac{9}{4}x_1^4 + \frac{1}{3}x_2^5 + x_3^2 - x_1x_2;\ \ X = \left\{x \in \mathbf{R}^3 :\ \ x_1 \geq 0,\ \ \ x_3 \geq 0\right\};$

54. $f(x) = 2x_1^5 + 4x_2^2 + \frac{3}{2}x_3^3 - x_1x_2;\ \ X = \left\{x \in \mathbf{R}^3 :\ \ x_1 \geq 0,\ \ \ x_2 \geq 0\right\}.$