The 1st Derivative Test

… Set 2

SOLVE ON YOUR OWN PAPER. For each problem, find all intervals on which the function is increasing or decreasing. Also find any relative extrema.

1) $f(x) = -\frac{x^2}{2} - 3x - \frac{5}{2}$

2) $f(x) = -x^2 + 8x - 10$

3) $f(x) = -2x^2 + 16x - 33$

4) $f(x) = \frac{x^2}{2} + 2x$

5) $f(x) = x^3 - 3x^2 + 4$

6) $f(x) = x^3 - 3x + 4$

7) $f(x) = -x^3 + 3x^2 + 1$

8) $f(x) = -x^3 + 3x^2 - 5$

9) $f(x) = -x^3 + 3x^2 - 6$

10) $f(x) = x^3 - 3x^2$

11) $y = x^4 - 2x^2$

12) $y = -x^4 + 2x^2 + 4$

13) $y = -\frac{1}{x^2 - 4}$

14) $y = \frac{x^2}{2x - 4}$

15) $y = \frac{2}{x^2 - 16}$

16) $y = \frac{9x}{x^2 + 9}$

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Answers

Answers to Relative Extrema

1) No relative minima.
Relative maximum: $(-3, 2)$

2) No relative minima.
Relative maximum: $(4, 6)$

3) No relative minima.
Relative maximum: $(4, -1)$

4) Relative minimum: $(-2, -2)$
No relative maxima.

5) Relative minimum: $(2, 0)$
Relative maximum: $(0, 4)$

6) Relative minimum: $(1, 2)$
Relative maximum: $(-1, 6)$

7) Relative minimum: $(0, 1)$
Relative maximum: $(2, 5)$

8) Relative minimum: $(0, -5)$
Relative maximum: $(2, -1)$

9) Relative minimum: $(0, -6)$
Relative maximum: $(2, -2)$

10) Relative minimum: $(2, -4)$
Relative maximum: $(0, 0)$

11) Relative minima: $(-1, -1), (1, -1)$
Relative maximum: $(0, 0)$

12) Relative minimum: $(0, 4)$
Relative maxima: $(-1, 5), (1, 5)$

13) Relative minimum: $\left(0, \frac{1}{4}\right)$
No relative maxima.

14) Relative minimum: $(4, 4)$
Relative maximum: $(0, 0)$

15) No relative minima.
Relative maximum: $\left(0, -\frac{1}{8}\right)$

16) Relative minimum: $\left(-3, -\frac{3}{2}\right)$
Relative maximum: $\left(3, \frac{3}{2}\right)$

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For each problem, use implicit differentiation to find $\frac{dy}{dx}$ in terms of x and y.

17) $3x^3y + 3y = 3x^3$

18) $4x^3 - 2y^3 = x^3y$

19) $3x - 5x^3y^3 = 2y^2$

20) $4y^2 = x^3 - 2x^3y^3$

21) $4x - 4y^3 = 3y^2$

22) $5y = x^2 - 4y^2$

23) $-y^3 + 3y^2 = 2x$

24) $-5y + 2y^2 = 4x$

For each problem, find the indicated derivative with respect to x.

25) $f(x) = 5x$ Find f''

26) $f(x) = -4x^3$ Find f'''

27) $f(x) = -2x$ Find $f^{(4)}$

28) $f(x) = 3x^4$ Find f'''

Differentiate each function with respect to x.

29) $f(x) = (-3x^3 + 1)^5$

30) $f(x) = \left(\frac{-5x^5 - 1}{-4x + 3}\right)^4$

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Answers

Answers to Relative Extrema

17) $\frac{dy}{dx} = \frac{3x^2 - 3x^2y}{x^3 + 1}$ 18) $\frac{dy}{dx} = \frac{3x^2y - 12x^2}{-6y^2 - x^3}$

19) $\frac{dy}{dx} = \frac{-3 + 15x^2y^3}{-15y^2x^3 - 4y}$ 20) $\frac{dy}{dx} = \frac{3x^2 - 6x^2y^3}{8y + 6y^2x^3}$ 21) $\frac{dy}{dx} = -\frac{2}{-6y^2 - 3y}$

22) $\frac{dy}{dx} = \frac{2x}{5 + 8y}$ 23) $\frac{dy}{dx} = \frac{2}{-3y^2 + 6y}$ 24) $\frac{dy}{dx} = \frac{4}{-5 + 4y}$ 25) $f''(x) = 0$

26) $f'''(x) = -24$ 27) $f^{(4)}(x) = 0$ 28) $f'''(x) = 72x$

29) $f'(x) = 5(-3x^3 + 1)^4 \cdot -9x^2$
$= -45x^2(-3x^3 + 1)^4$

30) $f'(x) = 4 \cdot \left(\frac{-5x^5 - 1}{-4x + 3}\right)^3 \cdot \frac{(-4x + 3) \cdot -25x^4 - (-5x^5 - 1) \cdot -4}{(-4x + 3)^2}$
$= \frac{4(-5x^5 - 1)^3(80x^5 - 75x^4 - 4)}{(-4x + 3)^5}$