Find the open interval(s) where the function is changing as requested.

1) Increasing: \( y = x^4 - 18x^2 + 81 \)

2) Decreasing: \( f(x) = \frac{x + 4}{x - 6} \)

3) Increasing: \( y = 7x - 5 \)

4) Increasing: \( f(x) = \frac{1}{x^2 + 1} \)

5) Increasing: \( y = \sqrt{x^2 + 2} \)

Identify the intervals where the function is changing as requested.

6) Increasing

\[ f(x) = x^2 + 2x - 3 \]

7) Decreasing

\[ f(x) = \frac{x^2 + 1}{x^2} \]

Find all relative maxima or minima.

14) \( y = xe^{8x} \)

15) \( y = 2xe^{-x} \)

Solve the problem.

16) The annual revenue and cost functions for a manufacturer of precision gauges are approximately \( R(x) = 520x - 0.01x^2 \) and \( C(x) = 120x + 100,000 \), where \( x \) denotes the number of gauges made. What is the maximum annual profit?

17) An architect needs to design a rectangular room with an area of 74 \( \text{ft}^2 \). What dimensions should he use in order to minimize the perimeter?

18) Find the dimensions that produce the maximum floor area for a one-story house that is rectangular in shape and has a perimeter of 131 ft.

19) Find the maximum profit \( P(P = R - C) \) if \( C(x) = 65 + 48x \) and \( p = 80 - 2x \).

20) The annual revenue and cost functions for a manufacturer of grandfather clocks are approximately \( R(x) = 500x - 0.02x^2 \) and \( C(x) = 200x + 100,000 \), where \( x \) denotes the number of clocks made. What is the maximum annual profit?
Find the location of the indicated absolute extremum for the function.

21) Maximum

Find the location of the indicated absolute extremum within the specified domain.

23) Minimum of \( f(x) = (x^2 + 4)^{2/3} \); \([-2, 2]\)

24) Minimum of \( f(x) = \frac{1}{x + 2} \); \([-4, 1]\)

25) Maximum of \( f(x) = 3x^4 + 16x^3 + 24x^2 + 32 \); \([-3, 1]\)

26) Maximum of \( f(x) = \frac{x + 3}{x - 3} \); \([-4, 4]\)

Solve the problem.

27) The velocity of a particle \( \left( \text{in } \frac{\text{ft}}{\text{s}} \right) \) is given by \( v = t^2 - 9t + 5 \), where \( t \) is the time (in seconds) for which it has traveled. Find the time at which the velocity is at a minimum.

28) \( S(x) = -x^3 - 9x^2 + 165x + 1300 \), \( 5 \leq x \leq 20 \) is an approximation to the number of salmon swimming upstream to spawn, where \( x \) represents the water temperature in degrees Celsius. Find the temperature that produces the maximum number of salmon.

29) The price \( P \) of a certain computer system decreases immediately after its introduction and then increases. If the price \( P \) is estimated by the formula \( P = 150t^2 - 1800t + 6300 \), where \( t \) is the time in months from its introduction, find the time until the minimum price is reached.

30) A rectangular field is to be enclosed on four sides with a fence. Fencing costs \$7 per foot for two opposite sides, and \$8 per foot for the other two sides. Find the dimensions of the field of area 670 ft\(^2\) that would be the cheapest to enclose.

31) A company wishes to manufacture a box with a volume of 52 cubic feet that is open on top and is twice as long as it is wide. Find the width of the box that can be produced using the minimum amount of material.

32) Find the dimensions of the rectangular field of maximum area that can be made from 500 m of fencing material.

33) Find two numbers whose sum is 280 and whose product is as large as possible.
1) $(-3, 0), (3, \infty)$
2) $(-\infty, 6), (6, \infty)$
3) $(-\infty, \infty)$
4) $(-\infty, 0)$
5) $(0, \infty)$
6) $(0, 3)$
7) $(1, 2)$
8) $(-3, -2)$
9) Relative minimum of $-1$ at 0.
10) Relative maximum of 1 at 0; Relative minimum of $-3$ at 2.
11) Relative maximum of 1 at 0.
12) Relative minimum of $-4$ at $-1$.
13) No relative extrema.
14) $(-1/8, -1/(8e))$, relative minimum
15) $(1, 2/e)$, relative maximum
16) $3,900,000$
17) $8.6 \text{ ft} \times 8.6 \text{ ft}$
18) $32.75 \text{ ft} \times 32.75 \text{ ft}$
19) $63$
20) $1,025,000$
21) $x = 0$
22) $x = -3$
23) $x = 0$
24) No minimum
25) $x = 1$
26) No maximum
27) $4.5 \text{ s}$
28) $5^\circ \text{C}$
29) 6 months
30) $27.7 \text{ ft} \times \$7 \text{ by } 24.2 \text{ ft} \times \$8$
31) $3.6 \text{ ft}$
32) $125 \text{ m by } 125 \text{ m}$
33) 140 and 140