HW 2 Date: ________ Name________________________________

Find the relative extrema of the function, if they exist.

1) $f(x) = x^2 - 4x + 7$ 1) ________________

2) $s(x) = -x^2 - 20x - 19$ 2) ________________

3) $f(x) = -6x^2 - 2x - 7$ 3) ________________

4) $f(x) = 0.2x^2 - 2.4x + 5.9$ 4) ________________

5) $f(x) = x^3 - 3x^2 + 1$ 5) ________________

6) $f(x) = \frac{2}{3}x^3 - \frac{3}{2}x^2 - 9x + 2$ 6) ________________

7) $f(x) = 3x^4 + 16x^3 + 24x^2 + 32$ 7) ________________

8) $f(x) = x^3 - 3x^4$ 8) ________________

9) $f(x) = \frac{4}{x^2 - 1}$ 9) ________________

10) $f(x) = \frac{8x}{x^2 + 1}$ 10) ________________

11) $f(x) = \sqrt[3]{x + 8}$ 11) ________________

12) $f(x) = \sqrt{x^2 + 12x + 72}$ 12) ________________

Find the relative extrema of the function and classify each as a maximum or minimum.

13) $f(x) = 3x^2 - 24x + 49$ 13) ________________

14) $f(x) = x^4 - 18x^2 - 1$ 14) ________________

15) $s(x) = -x^2 - 18x - 32$ 15) ________________

16) $y = x^3 - 3x^2 + 4x - 4$ 16) ________________

17) $f(x) = x^3 - 4x^4$ 17) ________________

18) $f(x) = (x + 3)^3$ 18) ________________

19) $f(x) = 20x^3 - 3x^5$ 19) ________________

Solve the problem.

20) A firm estimates that it will sell N units of a product after spending x dollars on advertising where
$N(x) = -x^2 + 500x + 11, \quad 0 \le x \le 500,$
and x is in thousands of dollars. Find the relative extrema of the function. 20) ________________

21) Assume that the temperature of a person during an illness is given by
$T(t) = -0.1t^2 + 1.4t + 98.6, \quad 0 \le t \le 14,$
where T = the temperature (°F) at time t, in days. Find the relative extrema of the function. 21) ________________

22) The Olympic flame at the 1992 Summer Olympics was lit by a flaming arrow. As the arrow moved d feet horizontally from the archer, assume that its height h, in feet, was approximat the function
$h = -0.002d^2 + 0.6d + 6.4.$
Find the relative maximum of the function. 22) ________________

Graph the function by first finding the relative extrema.

23) $f(x) = x^2 - 10x + 25$ 23) ________________

24) $f(x) = 6 + 4x - x^2$ 24) ________________

25) $f(x) = x^3 + 2x^2 - x - 2$ 25) ________________

26) $f(x) = x^3 + 3x$ 26) ________________

Draw a graph to match the description. Answers will vary.

27) f(x) is decreasing over $(-\infty, 4]$ and increasing over $[4, \infty)$. 27) ________________

28) f(x) has a negative derivative over $(-\infty, -9)$ and a positive derivative over $(-9, \infty)$. 28) ________________

29) G(x) has a positive derivative over $(-\infty, -7)$ and $(-3, 7)$ and a negative derivative over $(-7, -3)$ and $(7, \infty)$. 29) ________________

Graph the function.

30) $f(x) = x^3 + x^2 - 5x - 5$ 30) ______________

31) $f(x) = -x^3 - 4x^2 + 5$ 31) ______________

32) $f(x) = x^3 - 48x$ 32) ______________

Find the points of inflection.

33) $f(x) = 5x^3 + 2x + 5$ 33) ______________

34) $f(x) = -x^3 + 9x + 3$ 34) ______________

35) $f(x) = 4x - x^3$ 35) ______________

36) $f(x) = \frac{4}{3}x^3 - 12x^2 + 10x + 46$ 36) ______________

37) $f(x) = \frac{1}{4}x^4 - x^3 + 10$ 37) ______________

Determine where the given function is increasing and where it is decreasing.

38) $s(x) = -x^2 - 4x + 60$ 38) ______________

39) $f(x) = -4x^2 - 2x - 12$ 39) ______________

40) $y = x^3 - 3x^2 + 6x - 8$ 40) ______________

41) $f(x) = x^4 - 18x^2 + 4$ 41) ______________

Determine where the given function is concave up and where it is concave down.

42) $f(x) = x^2 - 20x + 104$ 42) ______________

43) $q(x) = 7x^3 + 2x + 5$ 43) ______________

44) $f(x) = 6x - x^3$ 44) ______________

45) $f(x) = x^3 + 3x^2 - x - 24$ 45) ______________

Draw a graph to match the description. Answers will vary.

46) f(x) is decreasing and concave up on $(-\infty, -10)$; f(x) is decreasing and concave down on $(-10, \infty)$. 46) ______________

47) f(x) is increasing and concave up on $(-\infty, -5)$; f(x) is increasing and concave down on $(-5, \infty)$. 47) ______________

48) f(x) is decreasing and concave down on $(-\infty, 10)$; f(x) is decreasing and concave up on $(10, \infty)$. 48) ______________

49) f(x) is increasing and concave down on $(-\infty, 8)$; f(x) is increasing and concave up on $(8, \infty)$. 49) ______________

Solve the problem.

50) The annual revenue and cost functions for a manufacturer of grandfather clocks are approximately $R(x) = 500x - 0.01x^2$ and $C(x) = 160x + 100{,}000$, where x denotes the number of clocks made. What is the maximum annual profit? 50) ______________

51) The annual revenue and cost functions for a manufacturer of precision gauges are approximately $R(x) = 500x - 0.03x^2$ and $C(x) = 160x + 100{,}000$, where x denotes the number of gauges made. What is the maximum annual profit? 51) ______________

52) Because of material shortages, it is increasingly expensive to produce 6.0L diesel engines. In fact, the profit in millions of dollars from producing x hundred thousand engines is approximated by $P(x) = -x^3 + 14x^2 + 15x - 55$, where $0 \le x \le 20$. Find the inflection point of this function to determine the point of diminishing returns. 52) ______________

53) The function $R(x) = 5000 - x^3 + 30x^2 + 600x$, $0 \le x \le 20$, represents revenue in thousands of dollars where x represents the amount spent on advertising in tens of thousands of dollars. Find the inflection point for the function to determine the point of diminishing returns. 53) ______________

Find the absolute maximum and absolute minimum values of the function, if they exist, over the indicated interval. When no interval is specified, use the real line $(-\infty, \infty)$.

54) $f(x) = -21$; $[-7, 7]$ 54) ______________

55) $f(x) = 6x + 2$; $[-1, 2]$ 55) ______________

56) $f(x) = 4x^2 - 5x^3$; $[0, 5]$ 56) ______________

57) $f(x) = \frac{1}{3}x^3 - 4x$;   [-8, 8]   57) _______________

Find the absolute maximum and absolute minimum values of the function, if they exist, on the indicated interval.

58) $f(x) = x^3 - 4x^2 - 16x + 1$; [-9, 0]   58) _______________

Find the absolute maximum and absolute minimum values of the function, if they exist, over the indicated interval. When no interval is specified, use the real line ($-\infty$, ∞).

59) $f(x) = x^3 + x^2 - 5x + 6$; $(0, \infty)$ 59) _______________

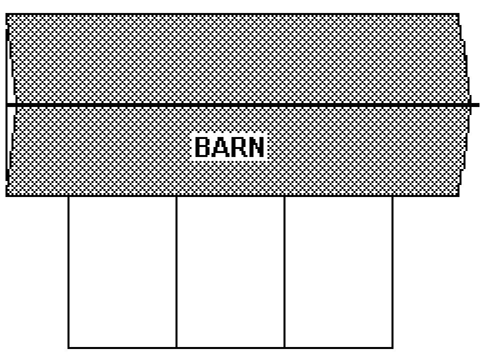
Solve the problem.

60) A carpenter is building a rectangular room with a fixed perimeter of 420 ft. What are the dimensions of the largest room that can be built? What is its area?   60) _______________

61) Find the dimensions that produce the maximum floor area for a one-story house that is rectangular in shape and has a perimeter of 166 ft. Round to the nearest hundredth, if necessary.   61) _______________

62) An architect needs to design a rectangular room with an area of 83 ft^2. What dimensions should he use in order to minimize the perimeter? Round to the nearest hundredth, if necessary.   62) _______________

63) A farmer decides to make three identical pens with 136 feet of fence. The pens will be next t each other sharing a fence and will be up against a barn. The barn side needs no fence.   63) _______________



PENS

What dimensions for the total enclosure (rectangle including all pens) will make the area as as possible?

64) A company wishes to manufacture a box with a volume of 40 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. Round to the nearest tenth, if necessary.   64) _______________

65) Find the number of units that must be produced and sold in order to yield the maximum pr given the following equations for revenue and cost: 65) _______________

$R(x) = 60x - 0.5x^2$

$C(x) = 4x + 7$.

66) Find the number of units that must be produced and sold in order to yield the maximum pı given the following equations for revenue and cost:
$R(x) = 7x$
$C(x) = 0.001x^2 + 0.8x + 80$.

66) ______________

67) An appliance company determines that in order to sell x dishwashers, the price per dishwa: must be
$p = 660 - 0.3x$.
It also determines that the total cost of producing x dishwashers is given by
$C(x) = 4000 + 0.3x^2$.
How many dishwashers must the company produce and sell in order to maximize profit?

67) ______________

68) A hotel has 230 units. All rooms are occupied when the hotel charges $110 per day for a room. For every increase of x dollars in the daily room rate, there are x rooms vacant. Each occupied room costs $34 per day to service and maintain. What should the hotel charge per day in order to maximize daily profit?

68) ______________

69) An outdoor sports company sells 896 kayaks per year. It costs $14 to store one kayak for a year. Each reorder costs $8, plus an additional $9 for each kayak ordered. In what lot size should the store order kayaks in order to minimize inventory costs?

69) ______________

70) A bookstore has an annual demand for 38,000 copies of a best-selling book. It costs $0.60 to store one copy for one year, and it costs $55 to place an order. Find the optimum number of copies per order.

70) ______________

71) A company estimates that the daily revenue (in dollars) from the sale of x cookies is given by $R(x) = 885 + 0.02x + 0.0003x^2$.
Currently, the company sells 900 cookies per day. Use marginal revenue to estimate the increase in revenue if the company increases sales by one cookie per day.

71) ______________

72) A grocery store estimates that the weekly profit (in dollars) from the production and sale of x cases of soup is given by
$P(x) = -5600 + 9.5x - 0.0017x^2$
and currently 1300 cases are produced and sold per week. Use the marginal profit to estimate the increase in profit if the store prodcues and sells one additional case of soup per week.

72) ______________

73) A company estimates that the daily cost (in dollars) of producing x chocolate bars is given by $C(x) = 1635 + 0.02x + 0.0004x^2$.
Currently, the company produces 600 chocolate bars per day. Use marginal cost to estimate the increase in the daily cost if one additional chocolate bar is produced per day.

73) ______________

74) The total cost, in dollars, to produce x DVD players is $C(x) = 70 + 7x - x^2 + 2x^3$. Find the marginal cost when $x = 3$.

74) ______________

75) The profit, in dollars, from the sale of x compact disc players is $P(x) = x^3 - 8x^2 + 9x + 7$. Find the marginal profit when $x = 10$.

75) ______________

76) Suppose that the daily cost, in dollars, of producing x televisions is 76) ______________

$C(x) = 0.003x^3 + 0.1x^2 + 62x + 620$,

and currently 60 televisions are produced daily. Use C(60) and the marginal cost to estimate the daily cost of increasing production to 63 televisions daily. Round to the nearest dollar.

77) A supply function for a certain product is given by 77) ______________

$S(p) = 0.08p^3 + 5p^2 + 15p + 4$,

where S(p) is the number of items produced when the price is p dollars. Use $S'(p)$ to estima how many more units a producer will supply when the price changes from $13.00 per unit to $13.40 per unit.

78) Suppose the demand for a certain item is given by 78) ______________

$D(p) = -4p^2 + 3p + 8$,

where p represents the price of the item in dollars. Currently the price of the item is $20. U marginal demand to estimate the change in demand when the price is increased by one dollar.

79) The volume of a sphere is given by the formula $V = \frac{4}{3}\pi r^3$ where r is the radius. A tumor is approximately spherical in shape. Use $V'(r)$ to estimate the increase in volume of the tumor if its radius increases from 7 mm to 8 mm. Round to the nearest 100 mm^3. 79) ______________