Calculus and Its Applications 14th edition Goldstein Test Bank

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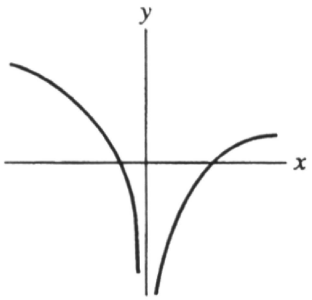
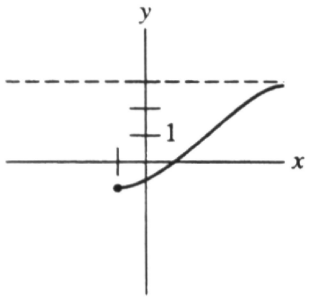
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Is this the graph of a function having the following properties?
   (I) concave down for all x
   (II) asymptotic to the line $x = 0$
   Enter your answer as just the word "yes" or the word "no" (lower case)



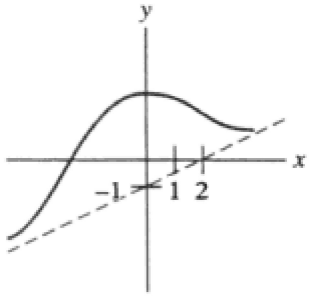
Answer: yes

2) Is this the graph of a function having the following properties?
   (I) defined for $x \geq -1$
   (II) horizontal asymptote at $y = 3$
   (III) increasing for all $x \geq -1$
   Enter just the word "yes" or the word "no" (lower case).



Answer: yes

3) Is this the graph of a function having the following properties?
   (I) asymptotic to the line $y = \frac{1}{2}x - 1$
   (II) relative maximum at $x = 0$
   Enter just the word "yes" or the word "no" (lower case).



Answer: yes

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4) Is this the graph of a function having the following properties?

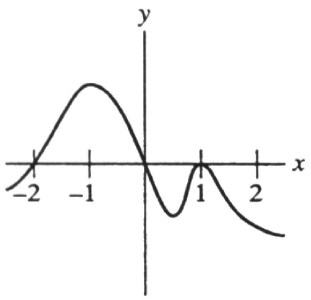
(I) x–intercept at $x = -2$

(II) absolute maximum at $x = -1$

(III) relative maximum at $x = 1$

(IV) concave up for $x \geq 2$

Enter just the word "yes" or the word "no" (lower case).



Answer: yes

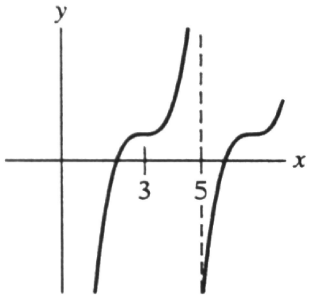
5) Is this the graph of the function having the following properties?

(I) inflection point at $x = 3$

(II) no relative maximum point

(III) asymptote at $x = 5$

Enter just the word "yes" or the word "no" (lower case).



Answer: yes

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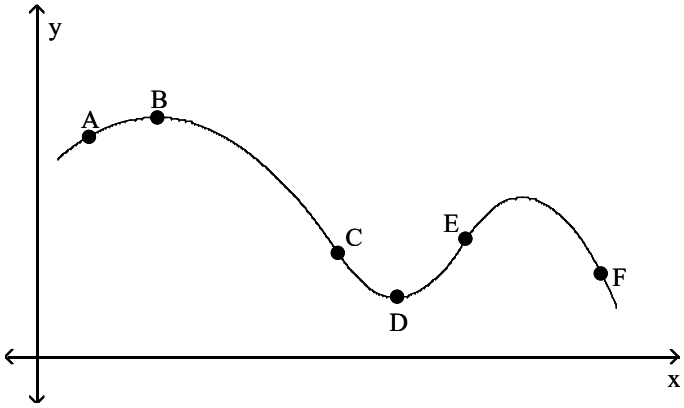
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

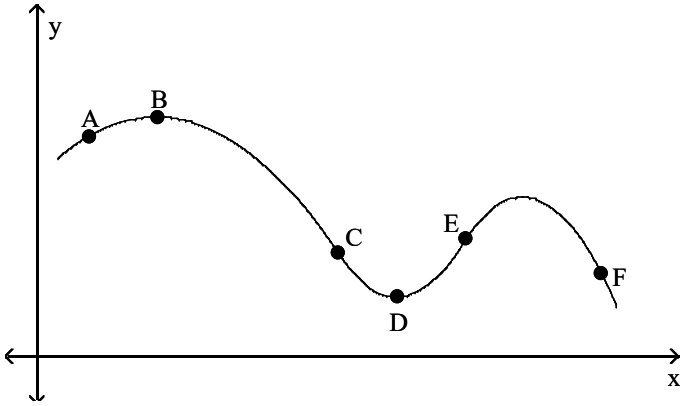
6) At which labeled point(s) is the function increasing?



A) A
B) C, F
C) A, E
D) E

Answer: C

7) At which labeled point(s) is the function decreasing?



A) C
B) A, E
C) C, F
D) F

Answer: C

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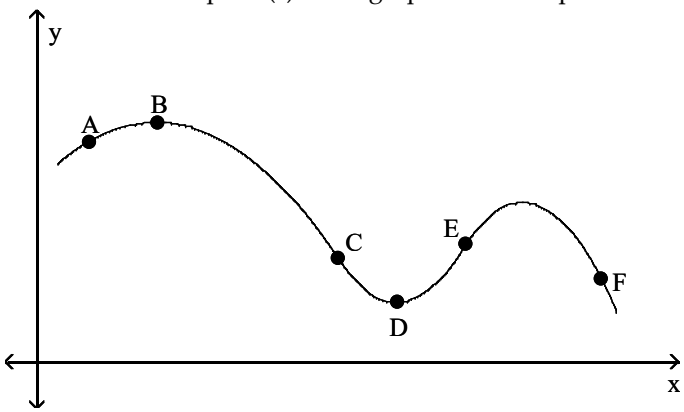
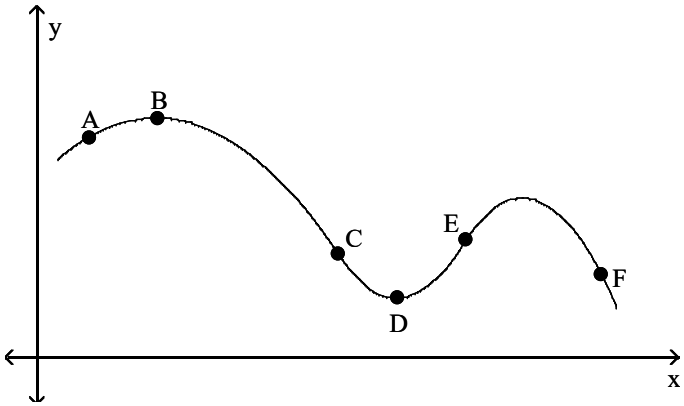
8) At which labeled point(s) is the graph concave up?



A) C, D
B) C, D, E
C) C, E
D) D

Answer: D

9) At which labeled point(s) is the graph concave down?



A) A, F
B) A, B, F
C) B
D) A, B

Answer: B

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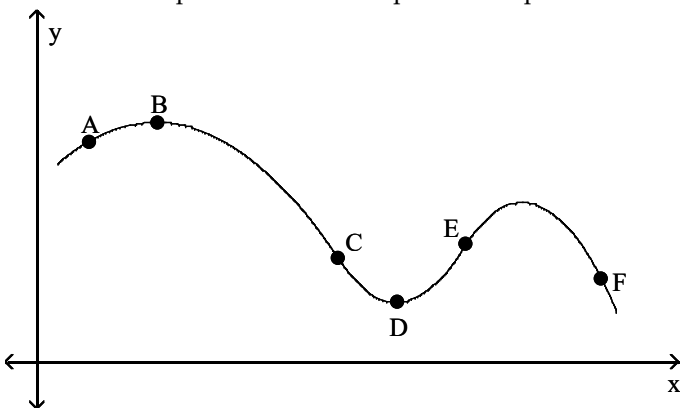
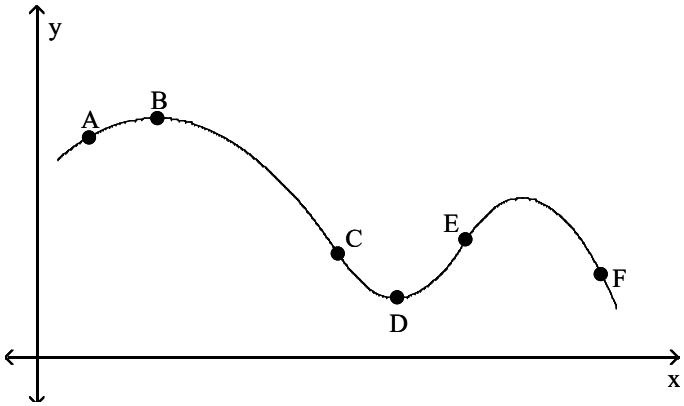
10) Which labeled point has the most positive slope?



A) E
B) B
C) A
D) F

Answer: A

11) Which labeled point has the most negative slope?



A) F
B) D
C) C
D) E

Answer: A

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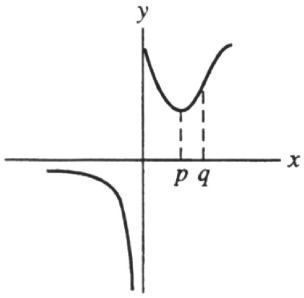
12) Let F(x) be the function graphed below. For what value is F'(x) > 0?

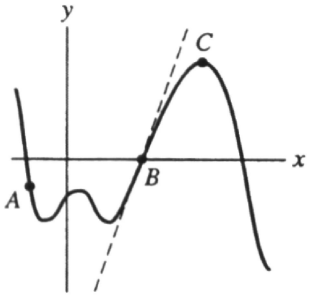


A) x > p
B) x < 0 and x > p
C) p < x < q
D) 0 < x < q
E) none of these

Answer: A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) Points A, B, and C lie on the graph of a function f(x), as shown on the diagram. What are the signs of f(x), f'(x), and f''(x) at the point C? Enter your answer as just "neg", "pos", or 0 in the order given above separated by commas.



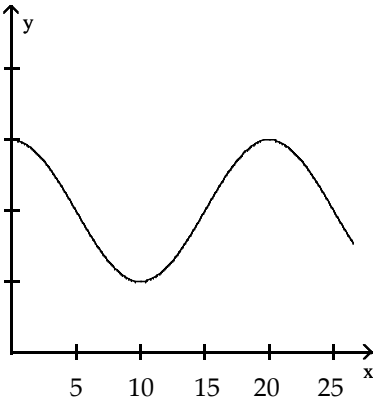
Answer: pos, 0, neg

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Choose the graph of a function having the given properties.

14) Relative minimum points at x = 5 and x = 25; relative maximum point at x = 15; inflection points at x = 10 and x = 20.

A)



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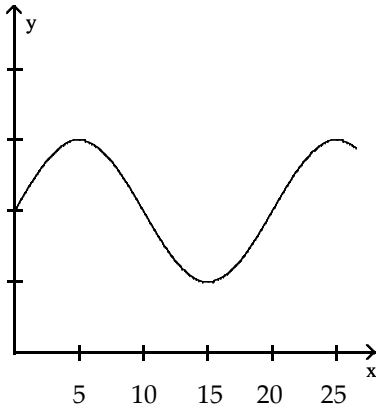
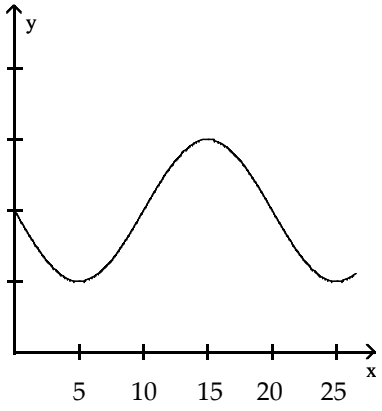
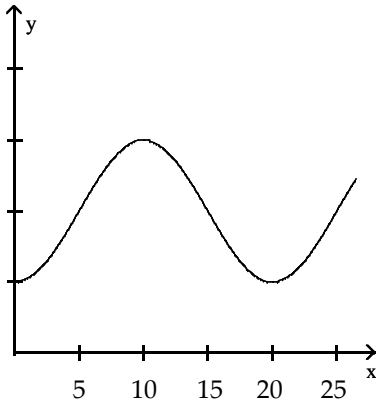
B)



C)



D)



Answer: C

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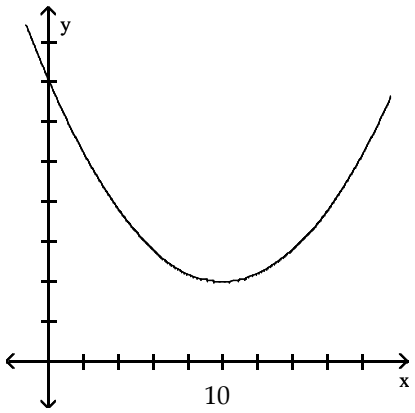
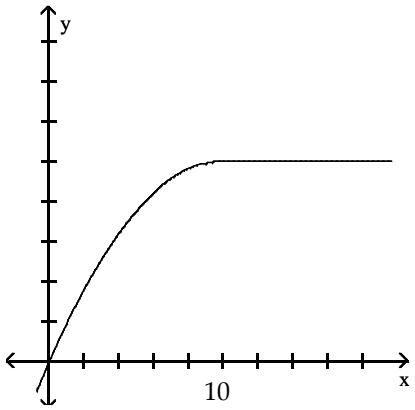
15) From x = 0 to x = 10 the function increases and the slope decreases. When x > 10 the function decreases and the slope decreases (note: the slope is negative and becomes more negative).

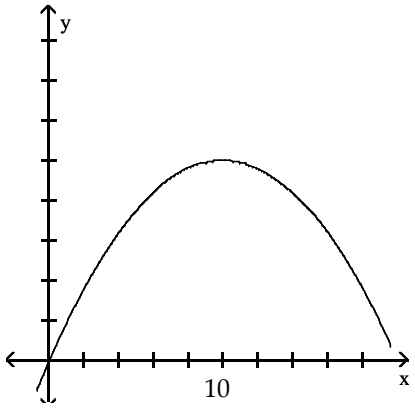
A)



B)



C)



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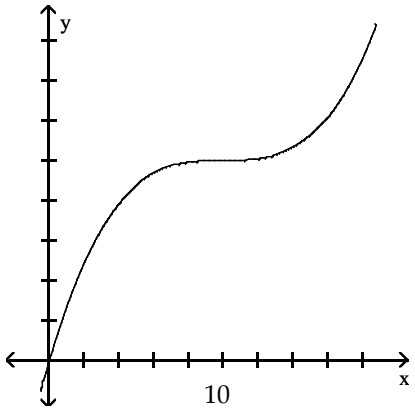
D)



Answer: C

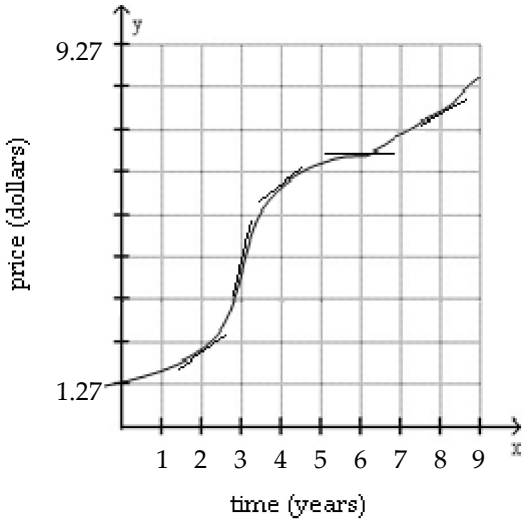
Solve the problem.

16) The population of squirrels in a certain forest is increasing. Let P(t) be the population of squirrels at time t and suppose that P(t) has the line y = 300,000 as an asymptote. What does this imply about the size of the population?

A) The population is 300,000 at any given time t.
B) The population will not drop below 300,000.
C) The population will grow to 300,000 then begin to drop.
D) The population will not rise above 300,000.

Answer: D

17) The graph below shows the price of a bushel of a certain crop over a span of 9 years. In what year was the rate of price increase the least?



A) 2
B) 3
C) 8
D) 6

Answer: D

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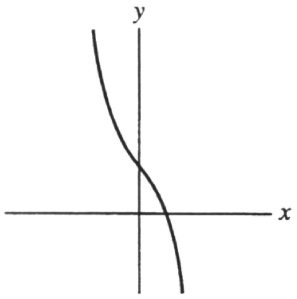
18) Which of the following graphs could represent a function with the following properties?

I. $f(x) > 0$, for $x < 0$

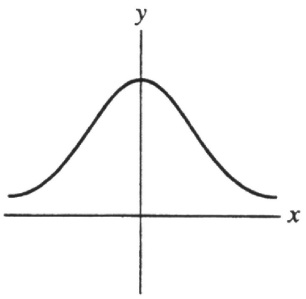
II. $f'(x) \leq 0$, for all x

III. $f'(0) = 0$

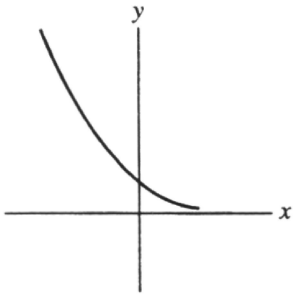
A)



B)



C)



D) none of these

Answer: D

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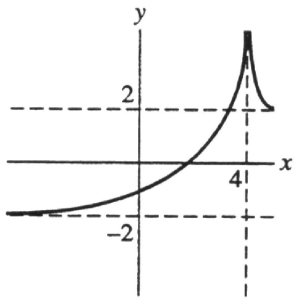
19) Which of the following graphs could represent a function having the given properties?

(I) asymptotes $x = 2$ and $x = -2$

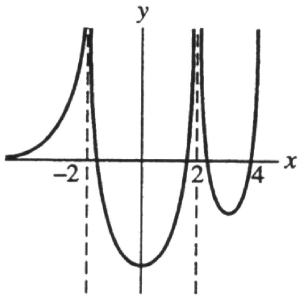
(II) $f''(x) > 0$ for all x

(III) $f(x) > 0$ for all $x > 4$

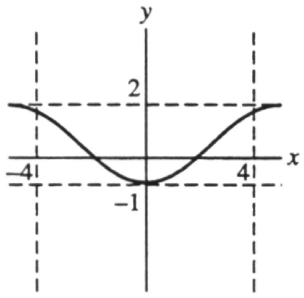
A)



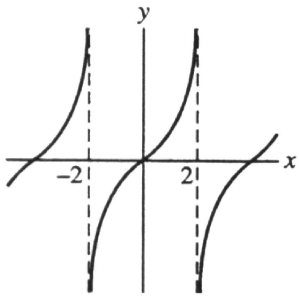
B)



C)



D)



Answer: B

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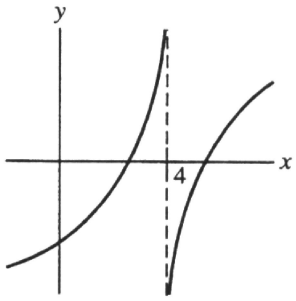
20) Which of the following could represent a function having the given properties?

(I) increasing slope for $x < 4$

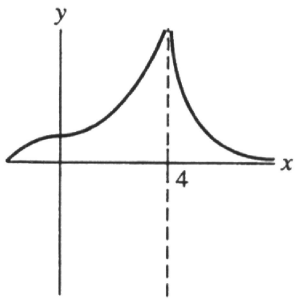
(II) $f'(x) > 0$ for all x ($x \neq 4$)

(III) asymptote at $x = 4$

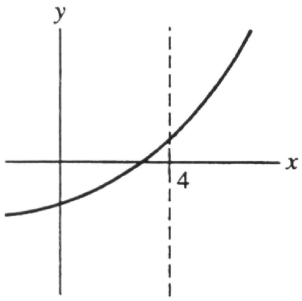
A)



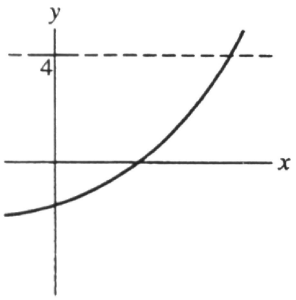
B)



C)



D)



Answer: A

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

21) Is this the graph of a function having the following properties ?

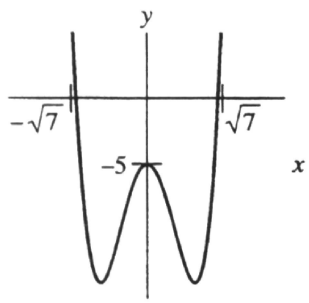
(I) $f(0) = -5$

(II) $f'(0) = 0$

(III) $f''(0) = 12$

(IV) $f(\sqrt{7}) = f(-\sqrt{7}) = -12$

Enter your answer as just "yes" or "no" (lower case).



Answer: no

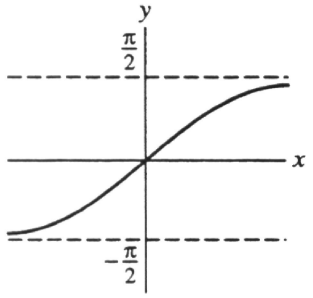
22) Is this the graph of a function having the following properties?

(I) $f'(x) > 0$ for all x

(II) $f''(x) > 0$ for all $x < 0$, $f''(x) < 0$ for $x > 0$

(III) asymptotes at $y = \frac{\pi}{2}$, $y = -\frac{\pi}{2}$

Enter your answer as just "yes" or "no" (lower case).



Answer: yes

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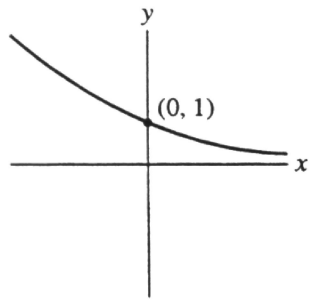
23) Is this the graph of a function having the following properties?

(I) $f'(x) < 0$ for all x

(II) $f''(x) > 0$ for all $x < 0$

(III) (0, 1) is a point on the graph

Enter your answer as just "yes" or "no" (lower case).



Answer: yes

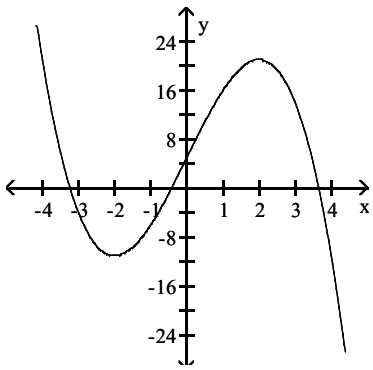
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

24) Using the following properties of a twice–differentiable function $y = f(x)$, select a possible graph of f.

x	y	Derivatives
$x < 2$		$y' > 0,\ y'' < 0$
-2	11	$y' = 0,\ y'' < 0$
$-2 < x < 0$		$y' < 0,\ y'' < 0$
0	-5	$y' < 0,\ y'' = 0$
$0 < x < 2$		$y' < 0,\ y'' > 0$
2	-21	$y' = 0,\ y'' > 0$
$x > 2$		$y' > 0,\ y'' > 0$

A)



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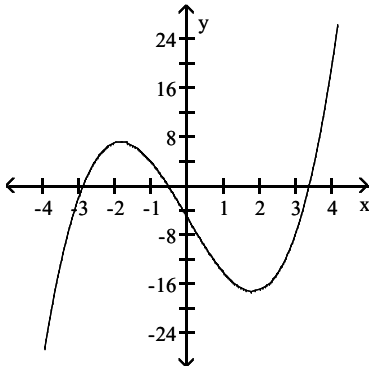
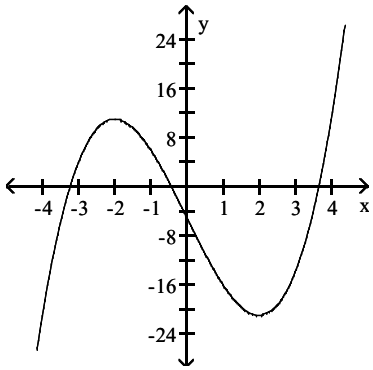
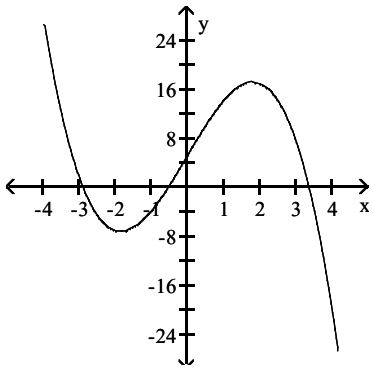
B)



C)



D)



Answer: C

25) Let a, b, and c be fixed numbers with $a > 0$ and let $f(x) = ax^2 + bx + c$. Which of the following properties is true of the graph of f(x) ?

A) f(x) is always concave up
B) f(x) has one inflection point
C) f(x) has either a relative maximum or inflection point
D) f(x) has one relative maximum
E) none of these

Answer: A

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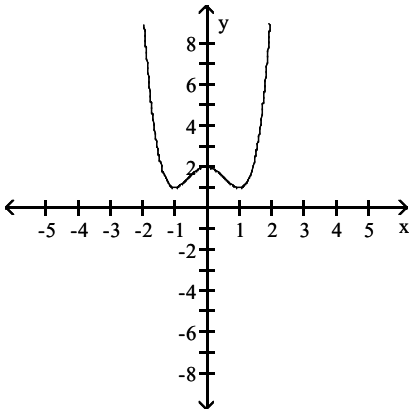
Suppose that the function with the given graph is not f(x), but f′(x). Find the open intervals where the function is concave upward or concave downward, and find the location of any inflection points.

26)

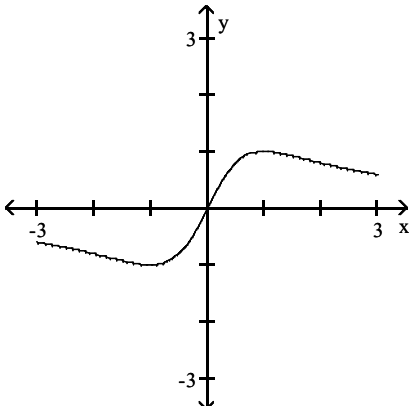


A) Concave upward on (-∞, 0); concave downward on (0, ∞); inflection point at 0
B) Concave upward on (-∞, –1) and (0, 1); concave downward on (–1, 0) and (1, ∞;); inflection points at –1, 0, and 1
C) Concave upward on (–1, 0) and (1, ∞); concave downward on (-∞, –1) and (0, 1); inflection points at –1, 0, and 1
D) Concave upward on (–1, 0) and (1, ∞); concave downward on (-∞, –1) and (0, 1); inflection points at –2, 0, and 2

Answer: C

Suppose that the function with the given graph is not f(x), but f′(x). Find the locations of all extrema, and tell whether each extremum is a relative maximum or minimum.

27)



A) Relative minimum at 0
B) Relative maximum at 3; relative minimum at –3
C) Relative maximum at 1; relative minimum at –1
D) No relative extrema

Answer: A

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Solve the problem.

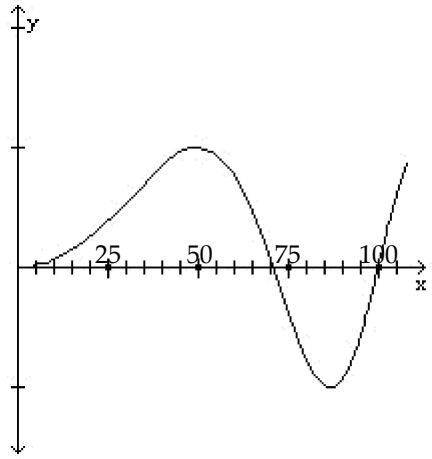
28) The first and second derivatives of the function f(x) have the values given in the table. (a) Find the x–coordinates of all relative extreme points. (b) Find the x–coordinates of all inflection points.

x	f′(x)	f″(x)
$0 \le x < 3$	Positive	Negative
3	0	0
$3 < x < 5$	Positive	Positive
5	Positive	0
$5 < x < 7$	Positive	Negative
7	0	Negative
$7 < x \le 10$	Negative	Negative

A) (a) $x = 3, x = 7$
(b) $x = 3, x = 5$
B) (a) $x = 3, x = 5$
(b) $x = 3, x = 7$
C) (a) $x = 3, x = 5$
(b) $x = 7$
D) (a) $x = 7$
(b) $x = 3, x = 5$

Answer: D

29) The following graph represents f′(x). At x = 70, does the graph of f(x) have a relative minimum, a relative maximum, an inflection point, or none of these?



A) inflection point
B) none of these
C) relative maximum
D) relative minimum

Answer: C

30) Where is the function $f(x) = \dfrac{5}{(2x - 4)^3}$ increasing?

A) for all x
B) at x = 30
C) for x > 2
D) none of these

Answer: D

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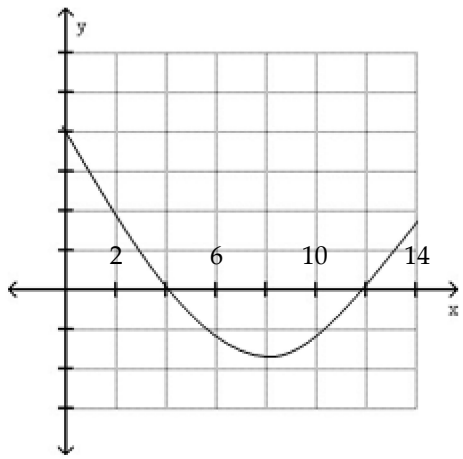
Solve the problem.

31) The following graph shows f′(x). On what interval is f(x) decreasing?



A) $0 < x < 4$
B) $8 < x < 14$
C) $0 < x < 8$
D) $4 < x < 12$

Answer: D

32) T(t) is the temperature on a cold day at time t hours. If T′(8) = –4, by approximately how much will the temperature drop from 8:00 to 8:15?

A) 2 degrees
B) 0.25 degrees
C) 1 degrees
D) 4 degrees

Answer: C

33) Find the x coordinates of all relative extreme points of $f(x) = \frac{2}{3}x^3 - 7x^2 + 24x - 72$

A) x = –4, –3
B) x = –4, –3, 0
C) x = 2, 6
D) x = 3, 4
E) x = 0, 3, 4

Answer: D

34) Find the x coordinates of all relative extreme points of $f(x) = \frac{1}{4}x^4 + \frac{2}{3}x^3 - \frac{3}{2}x^2 + 4$

A) x = –1, 3
B) x = 0
C) x = –1, 0, 3
D) x = –3, 0, 1
E) x = –3, 1

Answer: D

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35) Find the x coordinates of all relative extreme points of $f(x) = \frac{1}{2}x^4 - \frac{2}{3}x^3 - 6x^2 - 100$

A) $x = -3, 2$
B) $x = 0$
C) $x = -2, 3$
D) $x = -2, 0, 3$
E) $x = -3, 0, 2$

Answer: D

36) Find the x coordinates of all relative extreme points of $f(x) = \frac{2}{3}x^3 - 7x^2 + 24x - 72$

A) $x = 2, 6$
B) $x = -4, -3$
C) $x = 0, 3, 4$
D) $x = -4, -3, 0$
E) $x = 3, 4$

Answer: E

37) Find the relative extreme points for $f(x) = x^3 + 6x^2 - 15x$.

A) $(-5, f(-5))$ is a relative extreme maximum point, $(1, f(1))$ a relative extreme minimum
B) $(5, f(5))$ is a relative extreme minimum point, $(-1, f(-1))$ a relative extreme maximum
C) $(-5, f(-5))$ is a relative extreme minimum point, $(1, f(1))$ a relative extreme maximum
D) $(5, f(5))$ is a relative extreme maximum point, $(-1, f(-1))$ a relative extreme minimum
E) $(0, f(0))$ is a relative extreme minimum point

Answer: A

38) Find the relative minimum point(s) of $f(x) = \frac{x^4}{4} - x^3 - 5x^2 - 10$.

A) $(-2, f(-2))$ and $(0, f(0))$
B) $(0, f(0))$
C) $(2, f(2))$ and $(-5, f(-5))$
D) $(-2, f(-2))$ and $(5, f(5))$
E) none of these

Answer: D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

39) Determine the relative minimum point of $f(x) = x^2 + 4x + 5$.
Enter your answer exactly as just an ordered pair of integers: (a, b)

Answer: (–2, 1)

40) Determine the relative maximum point of $f(x) = -2x^2 + 4x + 1$.
Enter your answer exactly as just an ordered pair of integers: (a, b)

Answer: (1, 3)

41) Determine the relative minimum point of $f(x) = x^3 - 3x^2 + 1$.
Enter your answer as exactly just an ordered pair of integers: (a, b)

Answer: (2, –3)

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42) Determine the relative maximum point of $f(x) = x^3 - 6x^2 + 9x - 3$.
Enter your answer as exactly just an ordered pair of integers: (a, b)

Answer: (1, 1)

43) Determine all the values of x where relative maximum and minimum points of the function $f(x) = \frac{1}{3}x^3 - \frac{3}{2}x^2 - 10x$ occur. Distinguish the maxima from the minima using the second derivative rule. Enter your answer exactly as: f(a) rel max, f(b) rel min in that order.

Answer: f(–2) rel max, f(5) rel min

44) Find the maximum value of the function $f(x) = -x^3 + 6x^2 + 10$ for $x \geq 0$.
Enter your answer exactly as: f(a) = b rel max

Answer: f(4) = 42 rel max

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

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

45) $f(x) = x^2 - 2x + 11$

A) Relative minimum at (10, 1)
B) Relative maximum at (10, 1)
C) Relative minimum at (1, 10)
D) Relative maximum at (1, 10)

Answer: C

46) $f(x) = 2x^2 + 8x + 9$

A) Relative minimum at (–2, 1)
B) Relative maximum at (2, –1)
C) Relative minimum at (–1, 2)
D) Relative minimum at (1, –2)

Answer: A

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

A) Relative minimum at (4, 60)
B) Relative maximum at (–2, 64)
C) Relative maximum at (2, 64)
D) Relative maximum at (–4, 60)

Answer: B

48) $f(x) = x^3 - 12x - 1$

A) Relative maximum at (5, 64); relative minimum at (–3, 8)
B) Relative maximum at (5, 64); relative minimum at (2, –17)
C) Relative minimum at (–2, 15); relative maximum at (2, –17)
D) Relative maximum at (–2, 15); relative minimum at (2, –17)

Answer: D

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

A) Relative maximum at $\left(-\frac{3}{2}, \frac{79}{8}\right)$; relative minimum at $\left(\frac{3}{2}, -\frac{101}{8}\right)$

B) Relative maximum at $\left(-3, -\frac{5}{2}\right)$; relative minimum at $\left(\frac{3}{2}, -\frac{101}{8}\right)$

C) Relative maximum at $\left(3, -\frac{41}{2}\right)$

D) Relative maximum at $\left(-\frac{3}{2}, \frac{79}{8}\right)$; relative minimum at $\left(3, -\frac{41}{2}\right)$

Answer: D

Find the points of inflection.

50) $f(x) = 7x^3 + 2x + 7$

A) (7, 0)
B) (0, 7)
C) (2, 0)
D) (0, 2)

Answer: B

51) $f(x) = x^3 + 7x + 2$

A) (2, 7)
B) (0, 7)
C) (2, 0)
D) (0, 2)

Answer: D

52) $f(x) = -x^3 + 10x + 3$

A) (0, 10)
B) (0, 3)
C) (3, –3)
D) (–3, 10)

Answer: B

53) $f(x) = 8x - x^3$

A) (0, 0), (1, 8)
B) (1, 8)
C) (0, 0)
D) No points of inflection exist

Answer: C

54) $f(x) = x^3 - 3x^2 + 2x + 15$

A) (–1, –3)
B) (1, –1)
C) (1, –3)
D) (1, 15)

Answer: D

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55) $f(x) = x^3 + 12x^2 - x - 24$

A) (–4, 0)
B) (–4, 108)
C) (4, 143)
D) (–4, 132)

Answer: B

56) $f(x) = 2x^3 + 3x^2 - 12x$

A) $(-2,32)$
B) $(0, 0)$
C) $\left(-\frac{1}{2}, \frac{13}{2}\right)$
D) No points of inflection exist

Answer: C

57) $f(x) = \frac{4}{3}x^3 - 12x^2 + 10x + 44$

A) (3, –26)
B) (0, 2)
C) (3, 2)
D) (3, 0)

Answer: C

58) Find the inflection point(s) of $f(x) = \frac{x^3}{3} - \frac{5}{2}x^2 + 6x - 36$.

A) $\left(\frac{5}{2}, f\left(\frac{5}{2}\right)\right)$
B) (10, f (10))
C) (2, f(2)) and (3, f(3))
D) $\left(\frac{2}{5}, f\left(\frac{2}{5}\right)\right)$
E) x = –2, –3

Answer: A

59) Find the inflection point(s) of $f(x) = \frac{2}{3}x^3 - 7x^2 + 24x - 16$.

A) (2, f (2)) and (6, f (6))
B) (3, f (3)) and (4, f (4))
C) $\left(\frac{7}{2}, f\left(\frac{7}{2}\right)\right)$
D) $\left(\frac{2}{7}, f\left(\frac{2}{7}\right)\right)$
E) (56, f (56))

Answer: C

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60) Find the inflection point(s) of $y = 2x^3 - 3x^2 - 12x + 17$.

A) $\left(\frac{1}{2}, \frac{21}{2}\right)$

B) $\left(\frac{7}{2}, 24\right)$ and $\left(\frac{1}{2}, \frac{21}{2}\right)$

C) $(2, -3)$

D) $\left(\frac{1}{2}, \frac{21}{2}\right)$ and $\left(-\frac{1}{2}, 22\right)$

E) none of these

Answer: A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

61) Determine the inflection point of $f(x) = 2x^3 - 9x^2 + 12x - 1$.

Enter your answer exactly as just an ordered pair of fractions: $\left(\frac{a}{b}, \frac{c}{d}\right)$

Answer: $\left(\frac{3}{2}, \frac{7}{2}\right)$

62) If a function has second derivative $f''(x) = x^2(x^2 - 4)$ is $(0, 0)$ an inflection point?
Enter just the word "yes" or "no" (lower case).

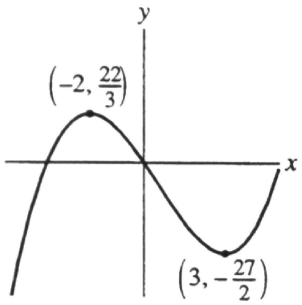
Answer: no

63) If the second derivative of a function is $f''(x) = (x - 2)^2(x^2 - 9)$ is $(2, f(2))$ an inflection point?
Enter just the word "yes" or "no" (lower case).

Answer: no

64) This is the graph of $f(x) = \frac{1}{3}x^3 - \frac{1}{2}x^2 - 6x$. What is the inflection point?

Enter your answer exactly as just an ordered pair of reduced fractions of form $\frac{a}{b}$, or integers (a, b), or the word "none".



Answer: $\left(\frac{1}{2}, \frac{-37}{12}\right)$

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

65) Find the interval(s) where f is concave up for $f(x) = 4x^4 - 3x^3 + 5x - 10$.

A) $\left(0, \frac{3}{8}\right)$

B) $\left(-\infty, \frac{3}{8}\right)$

C) $(-\infty, \infty)$

D) $(-\infty, 0) \cup \left(\frac{3}{8}, \infty\right)$

E) $\left(\frac{3}{8}, \infty\right)$

Answer: D

66) Find the interval(s) where f is concave down for $f(x) = -4x^4 + 3x^3 - 5x + 10$.

A) $(-\infty, 0) \cup \left(\frac{3}{8}, \infty\right)$

B) $\left(0, \frac{3}{8}\right)$

C) $\left(-\infty, \frac{3}{8}\right)$

D) $(-\infty, 0) \cup (3, \infty)$

E) $(-\infty, 0)$

Answer: A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

67) Determine the values of x for which $f(x) = x^3 - 6x$ is concave down.
Enter your answer as just an interval in standard interval notation.

Answer: $(-\infty, 0)$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

68) Which of the following is (are) true of $f(x) = 5 + 3x^2 - x^3$?

(I) (1, 7) is a point of inflection

(II) f(2) is a relative maximum point

(III) f has a relative minimum point at $x = 0$

(IV) f is increasing on $(2, \infty)$

A) II, III, and IV

B) II and III

C) I, II, and III

D) all of these

E) none of these

Answer: C

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69) Which of the following is (are) true of $f(x) = x^4 - x^3$?
(I) (0, 0) is an inflection point
(II) $\left(\frac{1}{2}, -\frac{1}{16}\right)$ is an inflection point
(III) (0, f(0)) is a relative minimum point
(IV) f is increasing on (0, 2)
A) I, III, and IV
B) I, II, and III
C) I and II
D) I, II, and IV
E) all of these

Answer: C

70) Which of the following is (are) true of $f(x) = x^3 - 3x^2 + 3x$?
(I) f increasing on $(1, \infty)$
(II) (1, 1) is a relative extreme point
(III) (1, 1) is an inflection point
(IV) f is concave up on $(-\infty, 1)$
A) I and III
B) II, III, and IV
C) I, II, and III
D) I, II, and IV
E) all of these

Answer: A

71) Which of the following is (are) true of $f(x) = 3x^{2/3} - 2x$?
(I) f is decreasing on $(1, \infty)$
(II) (1, f(1)) is a relative minimum point
(III) f is concave down everywhere
(IV) (0, 0) is an inflection point
A) I, II, and III
B) I, III, and IV
C) II, III, and IV
D) I and III
E) all of these

Answer: D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

72) Find the interval(s) where f is decreasing and concave up for $f(x) = x^3 - 3x^2 - 24x + 3$.
Enter your answer in standard interval notation as either : (a, b) or $(a, b)\cup(c,d)$ for $a<c$.

Answer: (1, 2)

73) Find the interval(s) where f is increasing and concave down for $f(x) = \frac{1}{4}x^4 - x^3 + x^2$.

Enter your answer in standard interval notation as either: (a, b) or $(a, b)\cup(c, d)$ where $a<c$ with any irrational numbers in lowest terms of form: $e \pm \frac{\sqrt{f}}{g}$

Answer: $\left(1 - \frac{\sqrt{3}}{3}, 1\right)$

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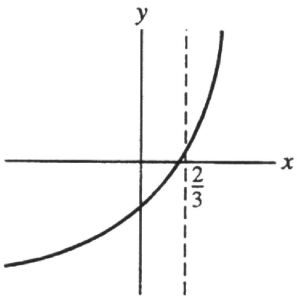
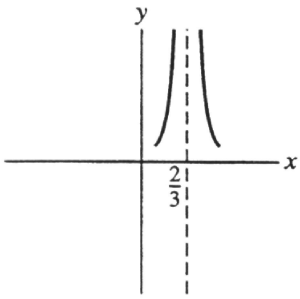
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

74) Which of the following most resembles the graph of $f(x) = \dfrac{1}{(2 - 3x)^3}$ near $x = \dfrac{2}{3}$?

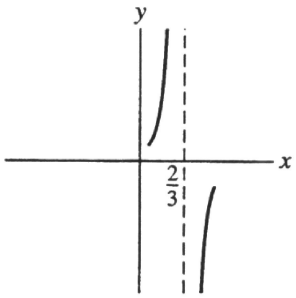
A)



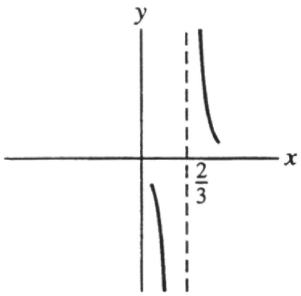
B)



C)



D)



Answer: C

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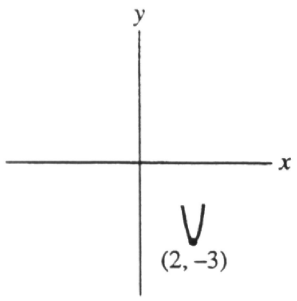
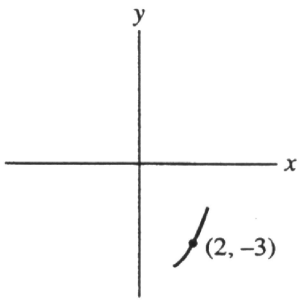
75) Which of the following best represents the graph of $y = 2x^3 - 3x^2 - 12x + 17$ near the point (2, –3)?

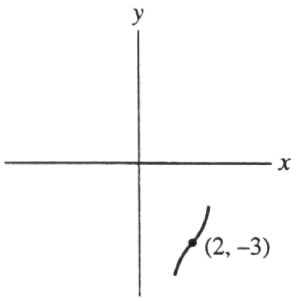
A)



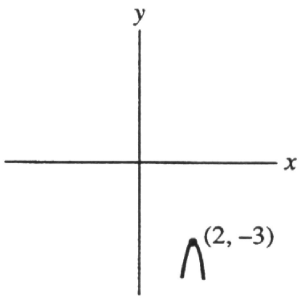
B)



C)



D)



Answer: A

Graph the function by first finding the relative extrema.

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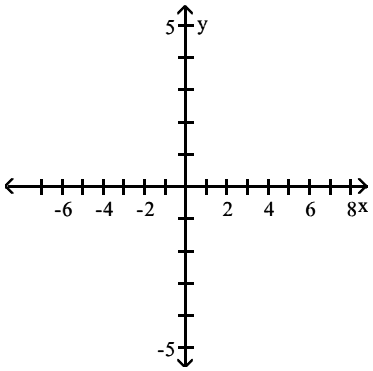
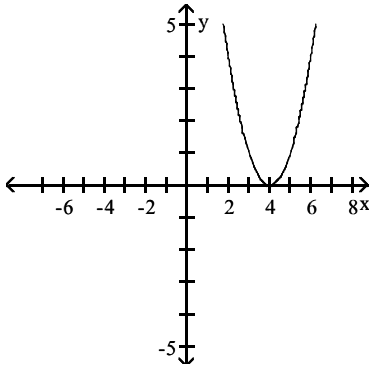
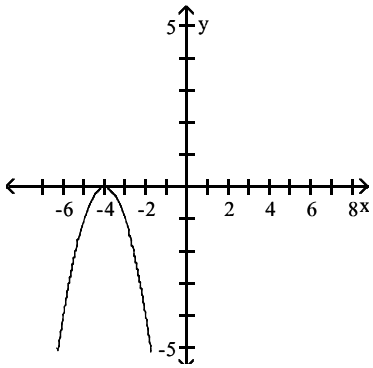
76) $f(x) = x^2 - 8x + 16$



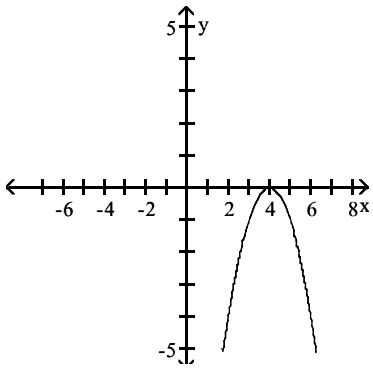
A)



B)



C)



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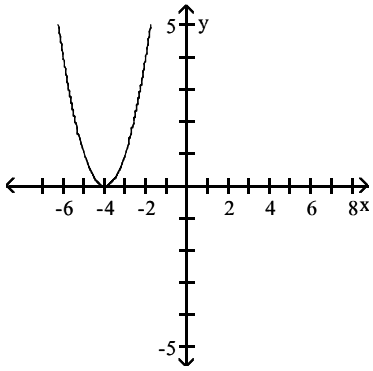
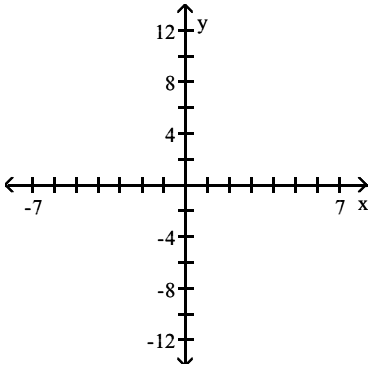
D)

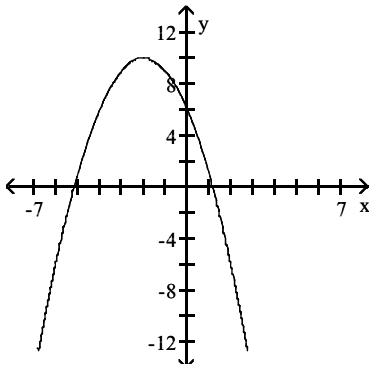


Answer: A

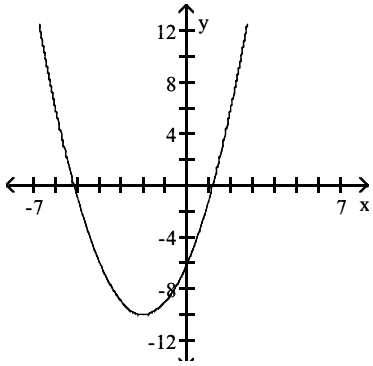
77) $f(x) = 6 + 4x - x^2$



A)



B)



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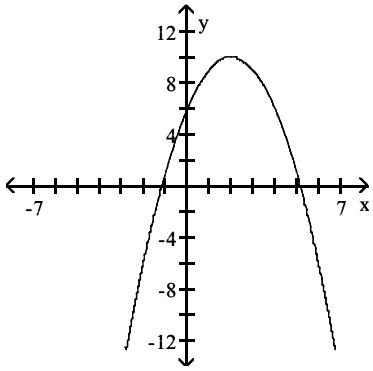
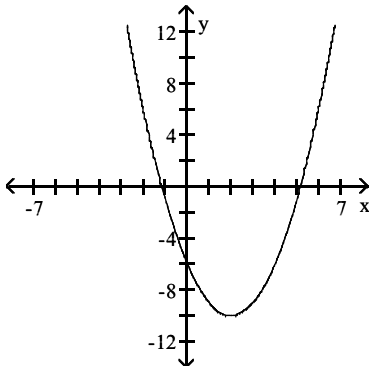
C)

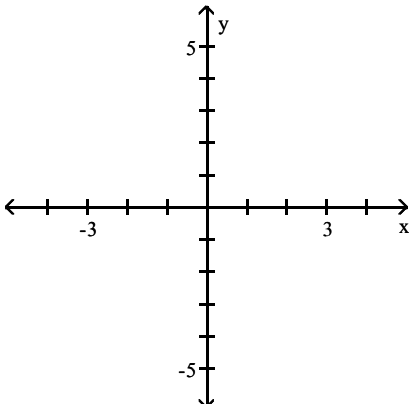


D)

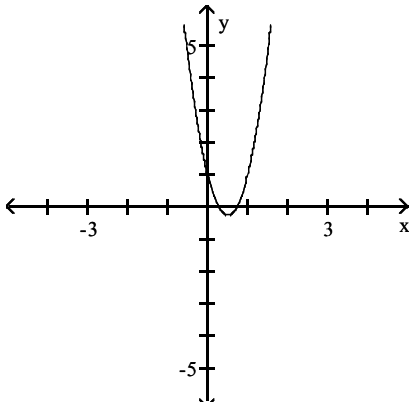


Answer: C

78) $f(x) = 5x^2 + 10x + 1$



A)



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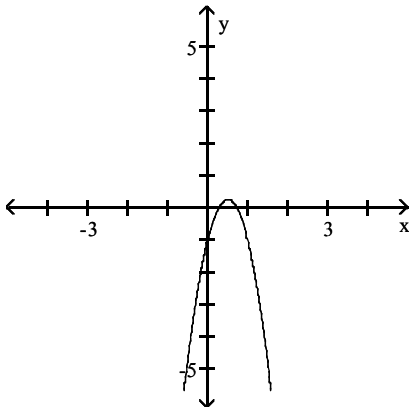

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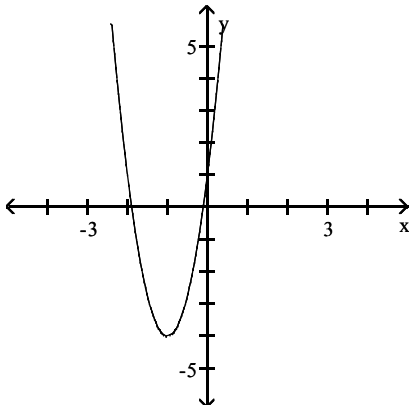

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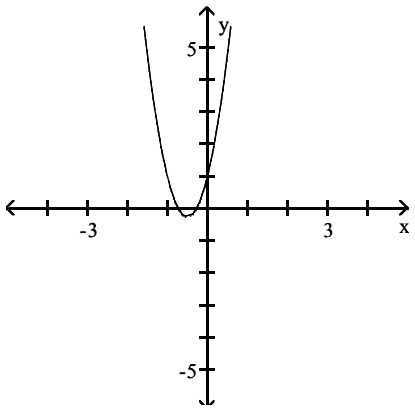

Answer: C

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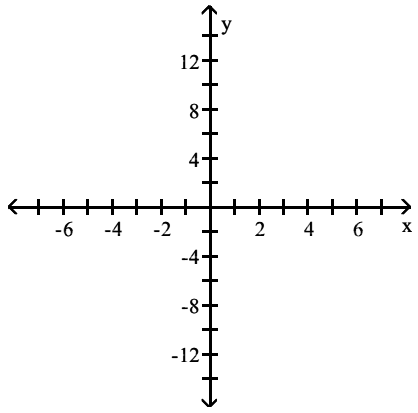
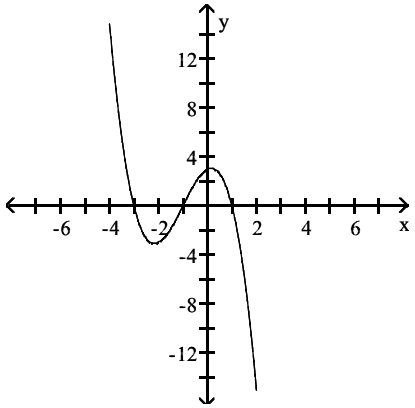
79) $f(x) = x^3 + 3x^2 - x - 3$



A)



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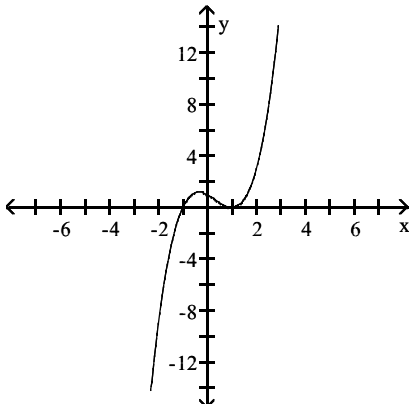

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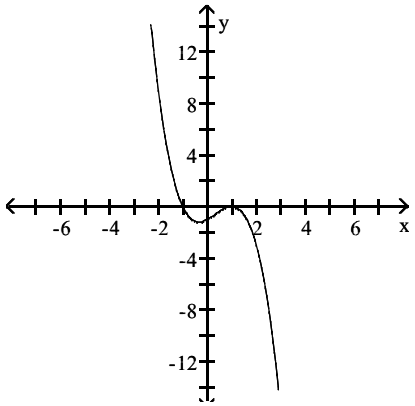

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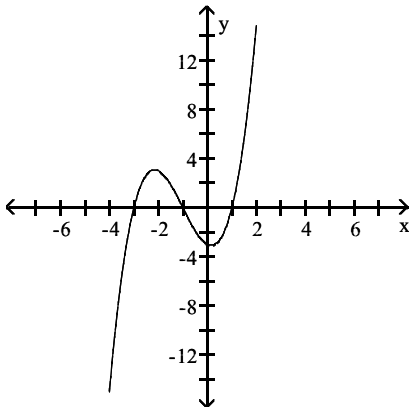
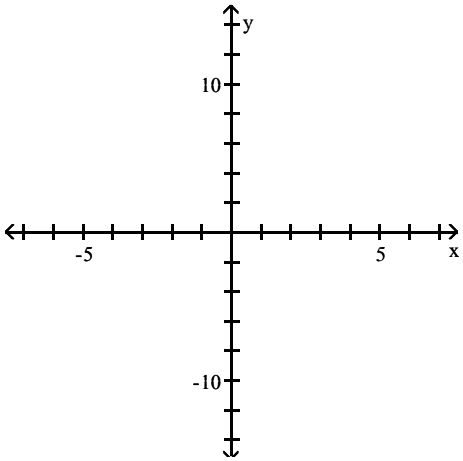
D)

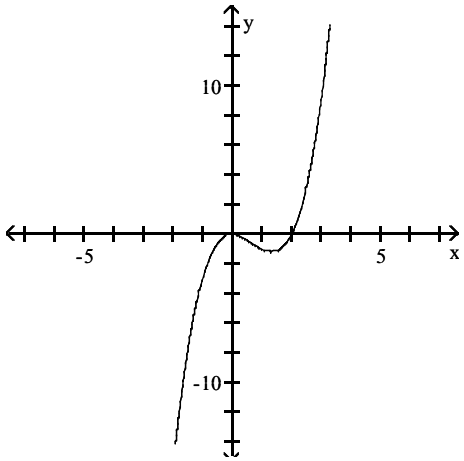


Answer: D

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



A)



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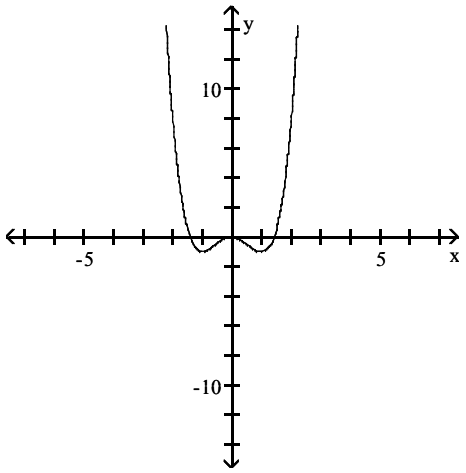
B)



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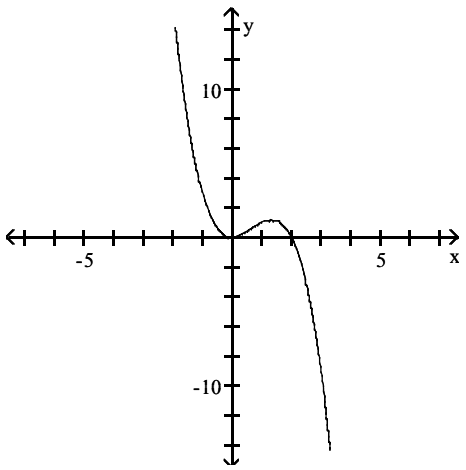
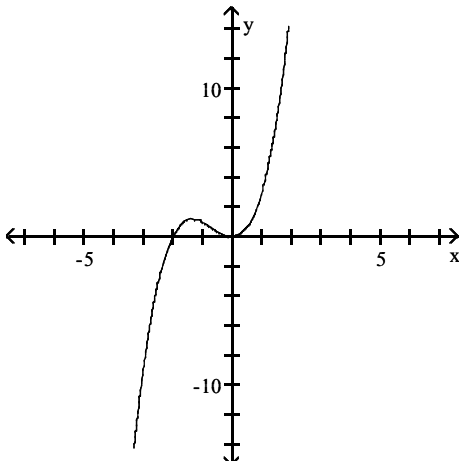


D)



Answer: A

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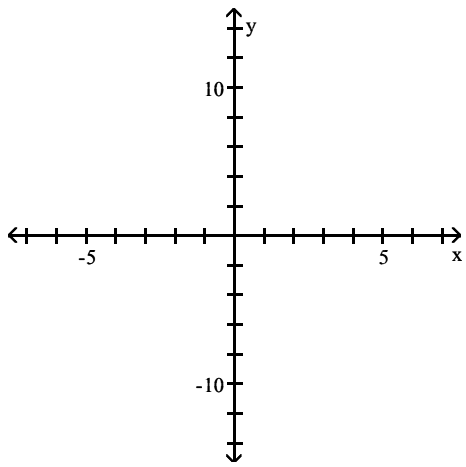
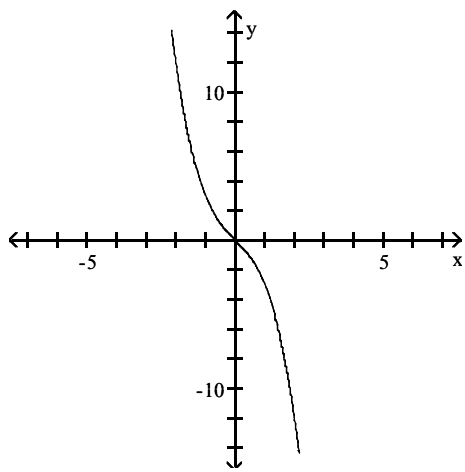
81) $f(x) = x^3 + 2x$



A)



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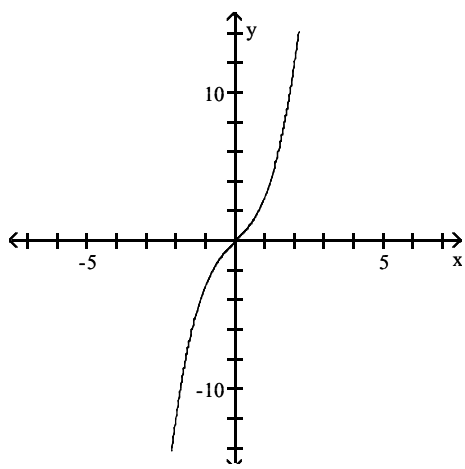

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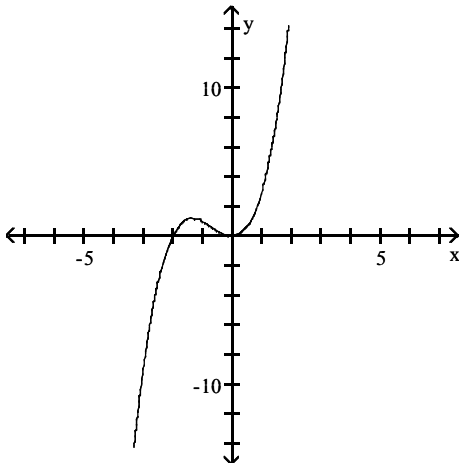
C)



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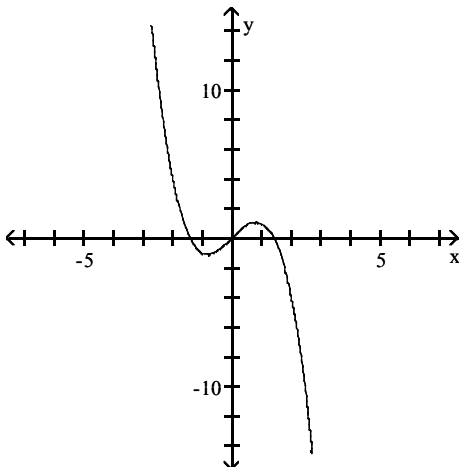
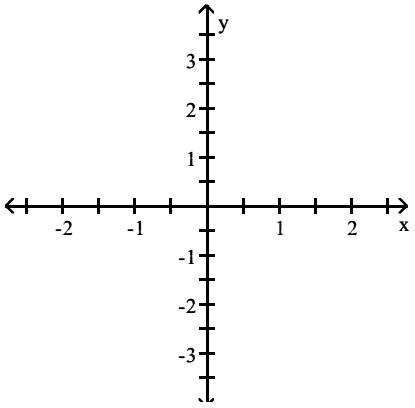


Answer: B

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



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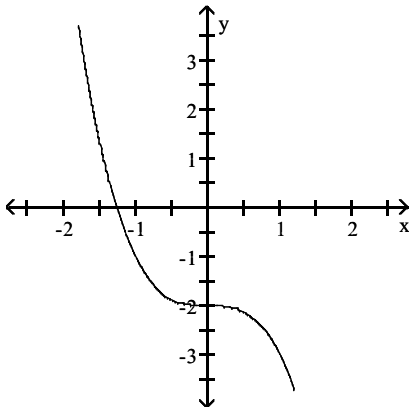
A)



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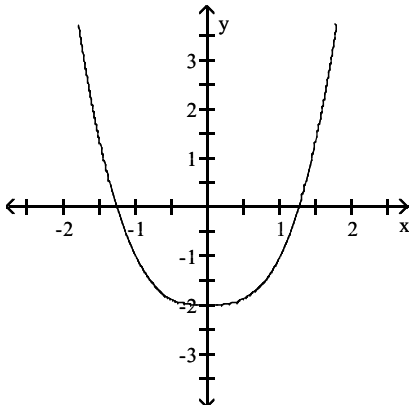

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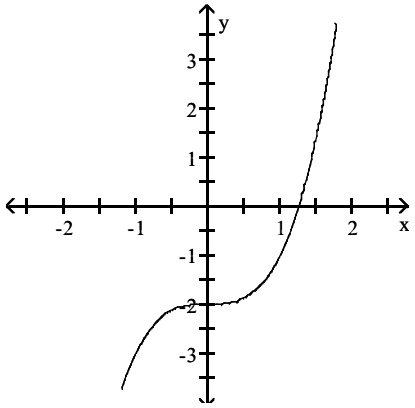
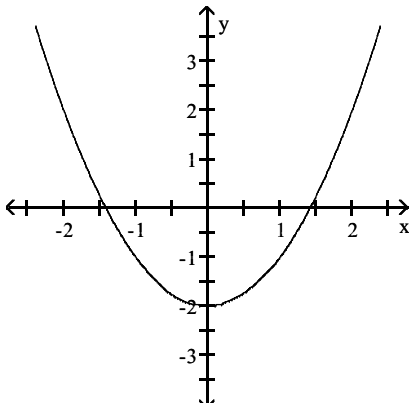


D)



Answer: C

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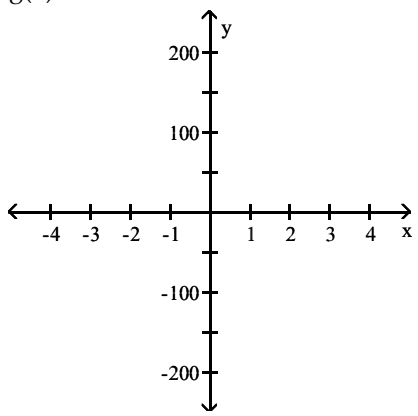
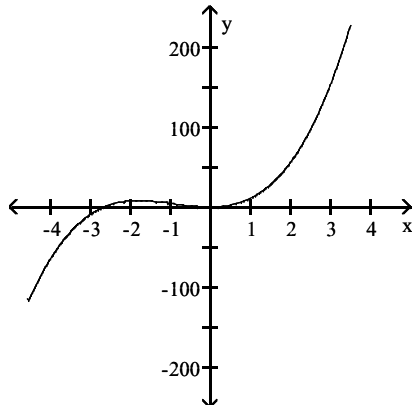
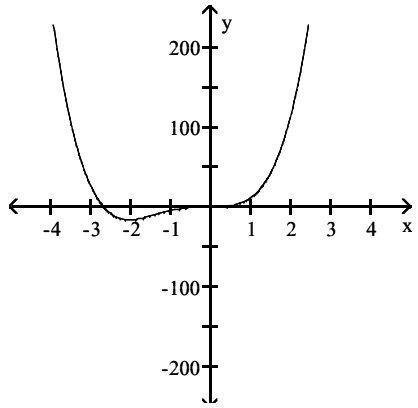
83) $g(x) = 3x^4 - 8x^3$



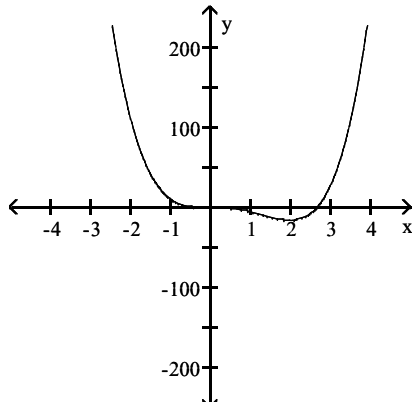
A)



B)



C)



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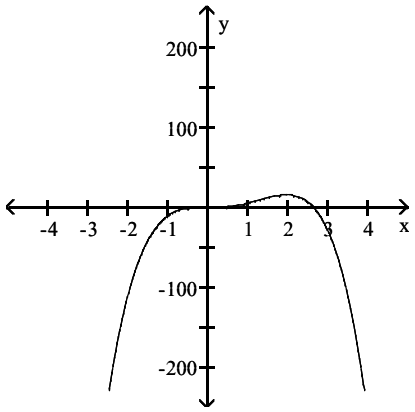
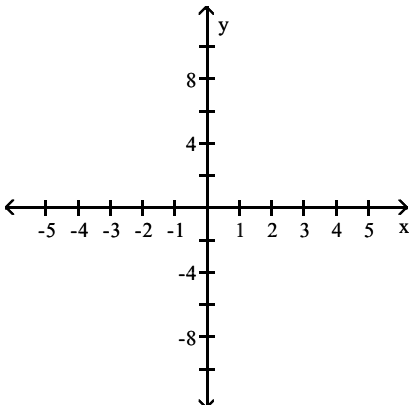
D)

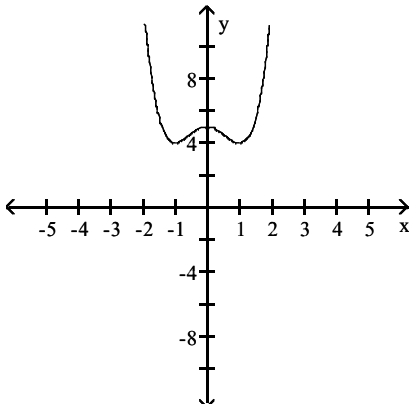


Answer: C

84) $h(x) = x^4 - 2x^2 + 5$



A)



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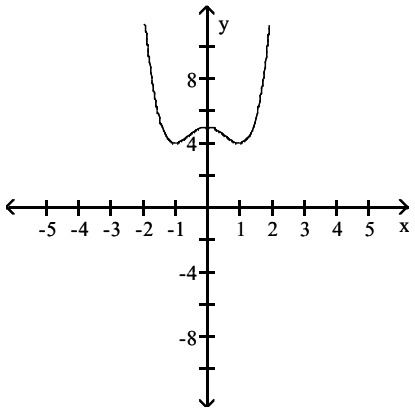
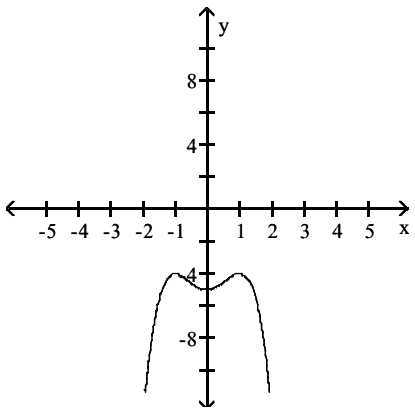
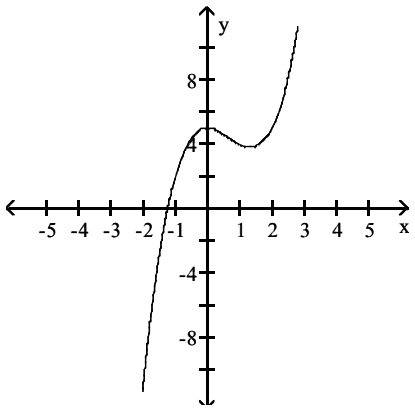
B)



C)



D)



Answer: A

Sketch the graph and show all extrema, inflection points, and asymptotes where applicable.

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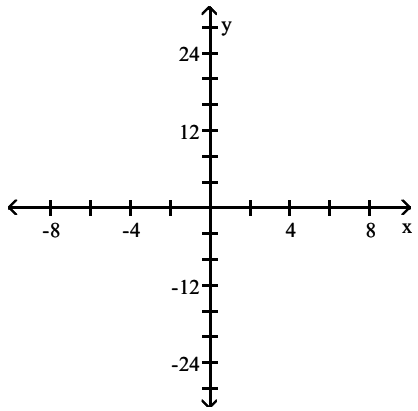
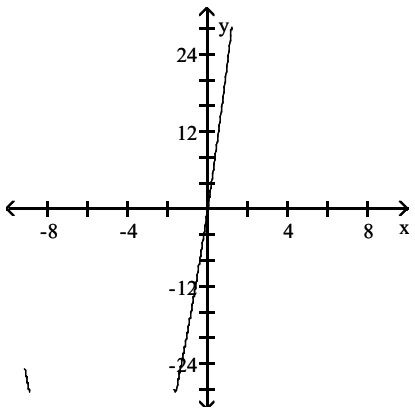
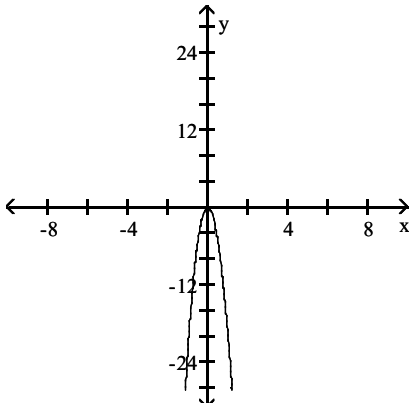
85) $f(x) = 2x^3 + 12x^2 + 18x$



A) No extrema
Inflection point: (0, 0)



B) Rel max: (0, 0), Rel min: (–7, 343)
Inflection point: (–3.5, 171.5)



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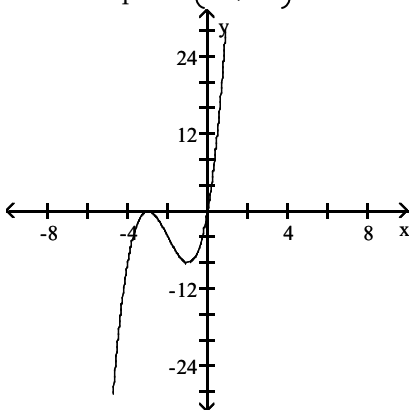
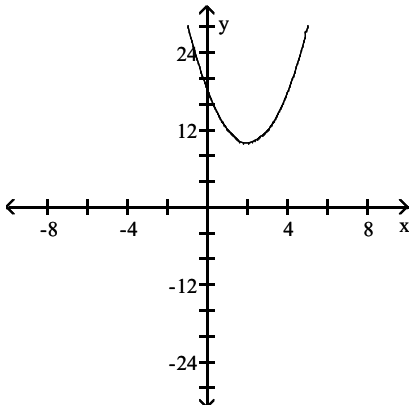
C) Rel max (–3, 0), Rel min: (–1, –8)
Inflection point: (– 2, – 4)

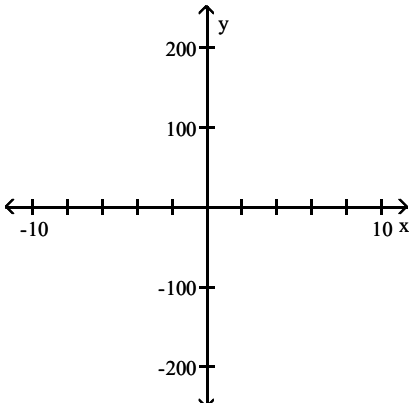


D) Rel min: (2, 10)
No inflection points



Answer: C

86) $f(x) = 8x^2 + 16x$



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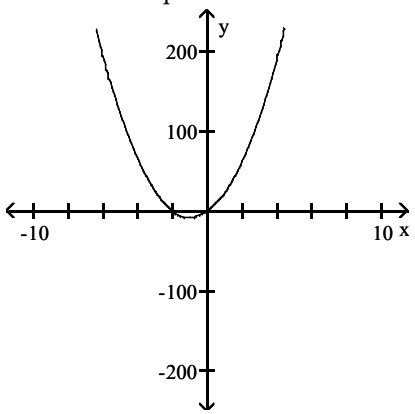
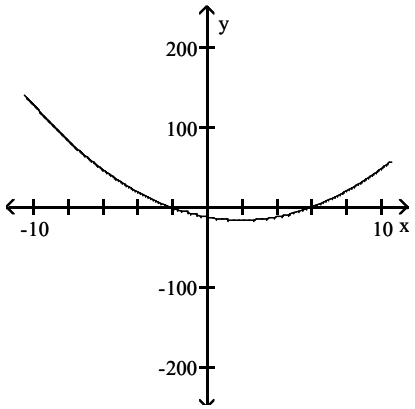
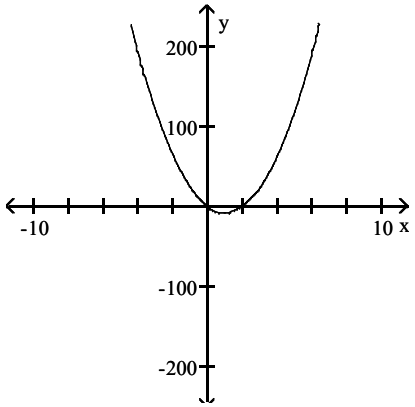
A) Rel min: (–1, –8)
No inflection points



B) Rel min: (2, –16)
No inflection points



C) Rel min: (1, –8)
No inflection points



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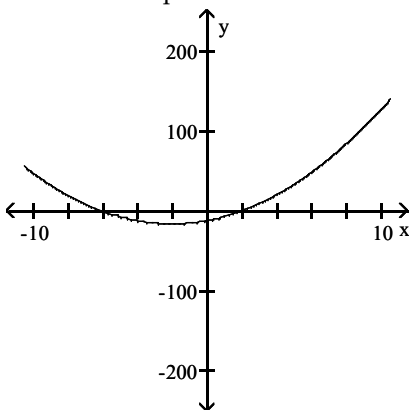
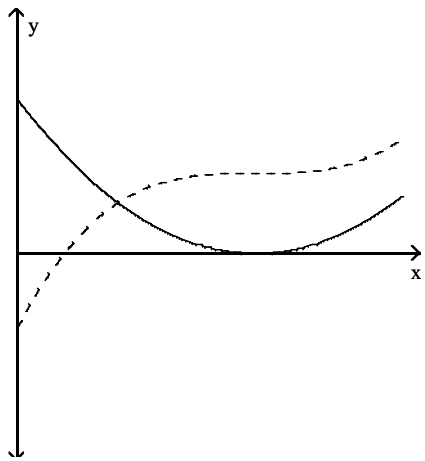
D) Rel min: (–2, –16)
No inflection points



Answer: A

Use the graph to answer the question.

87) In the graph below the solid line represents y = f(x) and the dashed line represents y = g(x). Determine which function is the derivative of the other.



A) g(x) = f′(x)
B) f(x) = g′(x)

Answer: B

Solve the problem.

88) The cost of a computer system increases with increased processor speeds. The cost C of a system as a function of processor speed is estimated as $C = 6S^2 - 5S + 1100$, where S is the processor speed in MHz. Find the processor speed for which cost is at a minimum. Round to the nearest tenth if necessary.

A) 0.4 MHz
B) 8.3 MHz
C) 3.3 MHz
D) 0.3 MHz

Answer: A

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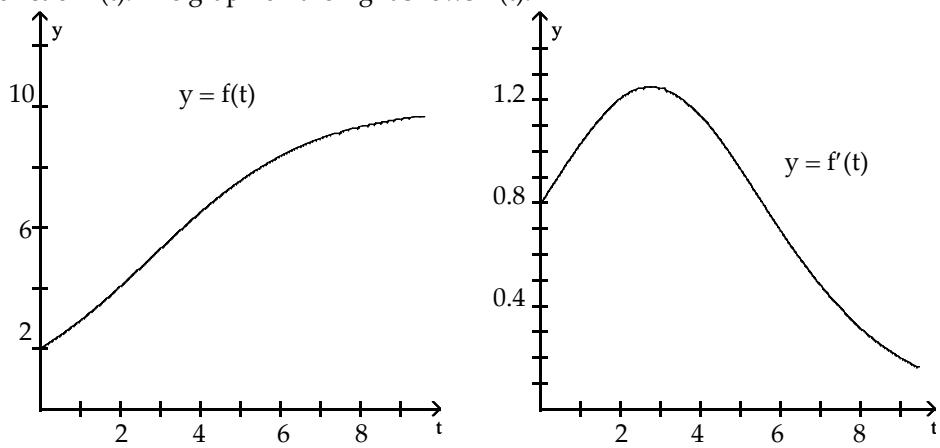
89) Suppose $c(x) = x^3 - 22x^2 + 20{,}000x$ is the cost of manufacturing x items. Find a production level that will minimize the average cost of making x items.

A) 13 items
B) 12 items
C) 11 items
D) 10 items

Answer: C

90) The graph on the left shows the population (in millions) of a colony of bacteria after t hours as given by the function f(t). The graph on the right shows f′(t).

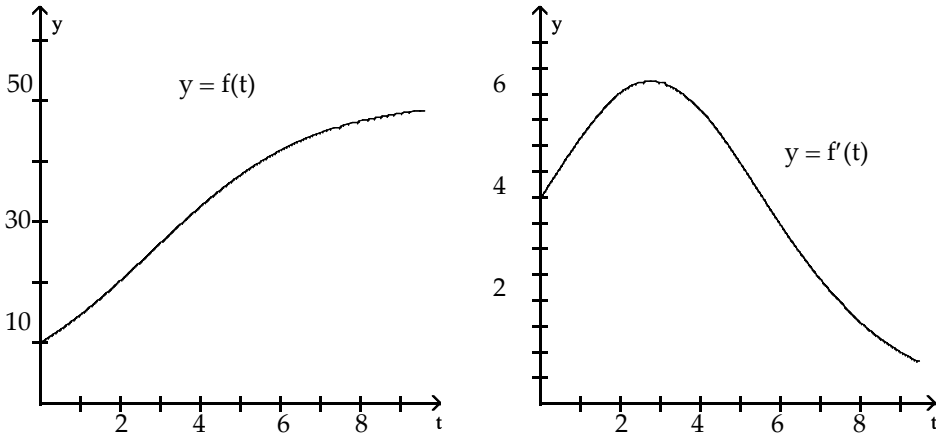


After how many hours was the population 9 million?

A) 6 hr
B) 8 hr
C) 7 hr
D) 4 hr

Answer: C

91) The graph on the left shows the population (in millions) of a colony of bacteria after t hours as given by the function f(t). The graph on the right shows f′(t).



How fast was the population growing after 8 hours?

A) 2.5 million per hour
B) 3.5 million per hour
C) 0.5 million per hour
D) 1.5 million per hour

Answer: D

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92) What are the x–intercepts of the graph of $y = 3x^3 + 24$?

A) (0, –2)
B) (0, 24)
C) (24, 0)
D) (2, 0)
E) none of these

Answer: E

Find the x–intercepts of the function.

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

A) $(-2 \pm \sqrt{7}, 0)$
B) $(-1 \pm \sqrt{7}, 0)$
C) $(2 + \sqrt{7}, 0)$
D) $(-2 \pm 2\sqrt{7}, 0)$

Answer: A

94) $f(x) = -x^2 + 5 - 6x$

A) $(3 + \sqrt{14}, 0)$
B) $(-3 \pm \sqrt{14}, 0)$
C) $(-1 \pm \sqrt{14}, 0)$
D) $(-3 \pm 2\sqrt{14}, 0)$

Answer: B

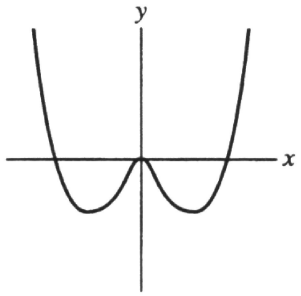
95) $f(x) = x^2 + 4x - 3$

A) $(-2 \pm 2\sqrt{7}, 0)$
B) $(-2 \pm \sqrt{7}, 0)$
C) $(2 + \sqrt{7}, 0)$
D) $(-1 \pm \sqrt{7}, 0)$

Answer: B

96) Which of the following is the graph of $f(x) = x^4 - 9$?

A)



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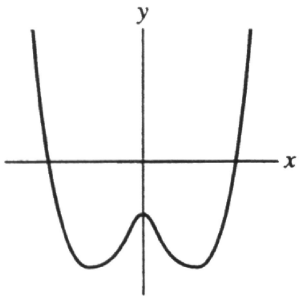
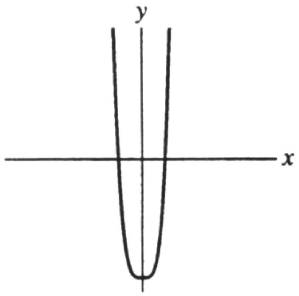
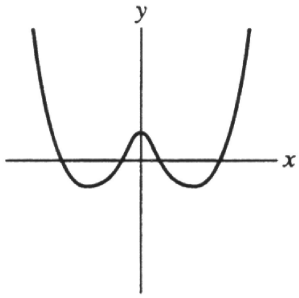
B)



C)



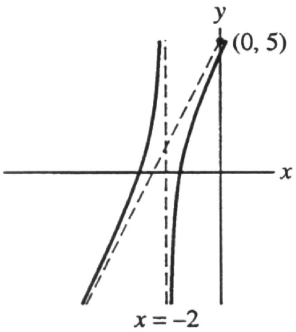
D)



Answer: C

97) Which of the following is the graph of $F(x) = 2x - \frac{1}{x+2} + 5$?

A)



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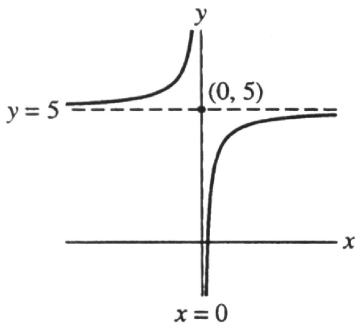
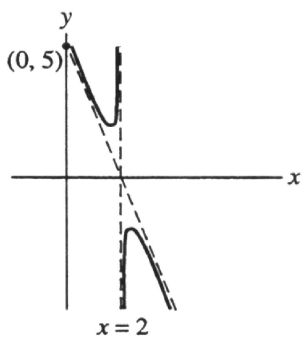
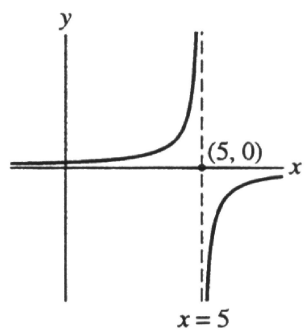
B)



C)



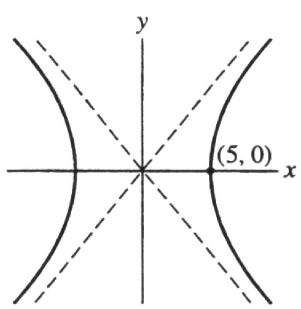
D)



Answer: A

98) Which of the following is the graph of $y = \frac{1}{x} + 2x + 5$?

A)



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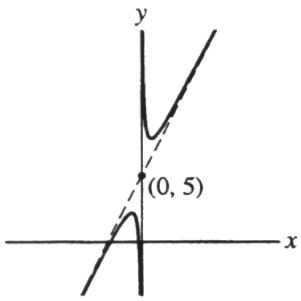
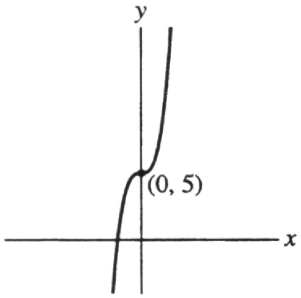
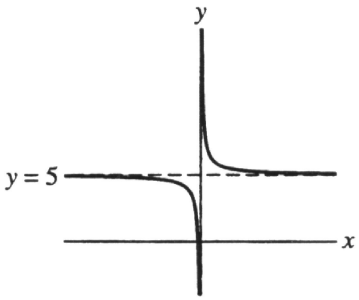
B)



C)



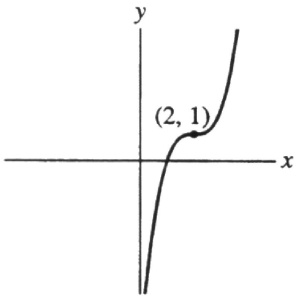
D)



Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

99) Is this the graph of $f(x) = (x - 2)^3 + 1$?
Enter just the word "yes" or "no" (lower case).



Answer: yes

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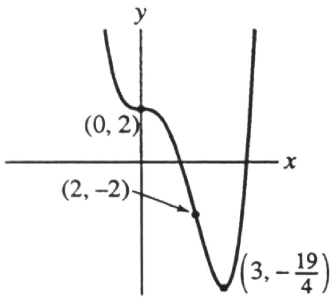
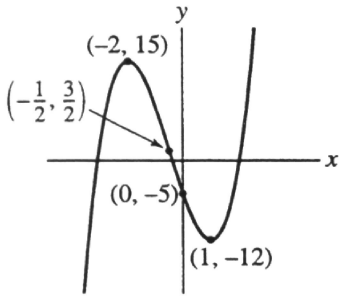
100) Is this the graph of $f(x) = \frac{1}{4}x^4 - x^3 + 2$?

Enter just the word "yes" or "no" (lower case).



Answer: yes

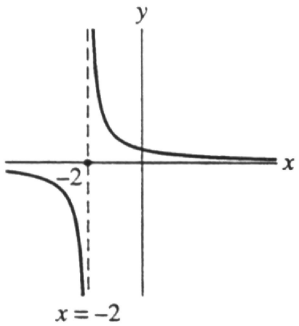
101) Is this the graph of $g(x) = 2x^3 + 3x^2 - 12x - 5$?
Enter just "yes" or "no" (lower case).



Answer: yes

102) Is this the graph of $f(x) = \frac{1}{x + 2}$?

Enter just the word "yes" or "no" (lower case).



Answer: yes

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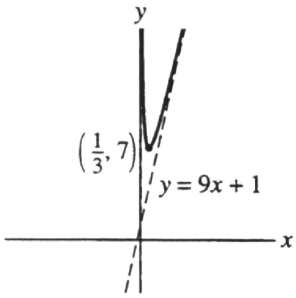
103) Is this the graph of $f(x) = 9x + 1 + \frac{1}{x}$, $x > 0$?

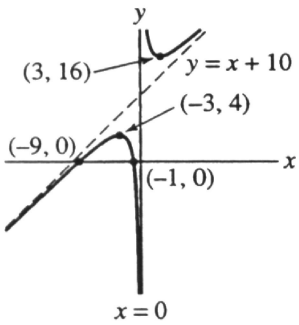
Enter just "yes" or "no" (lower case).



Answer: yes

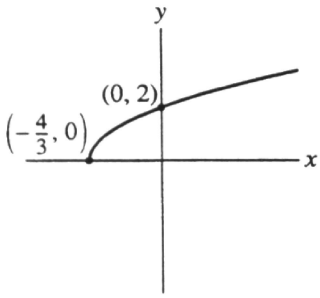
104) Is this the graph of $h(x) = x + 10 + \frac{9}{x}$?

Enter just the word "yes" or "no" (lower case).



Answer: yes

105) Is this the graph of $y = \sqrt{3x + 4}$?
Enter just the word "yes" or "no" (lower case).



Answer: yes

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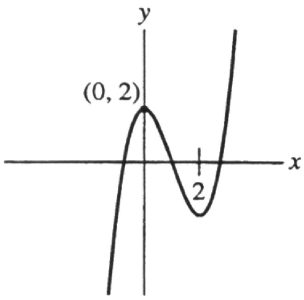
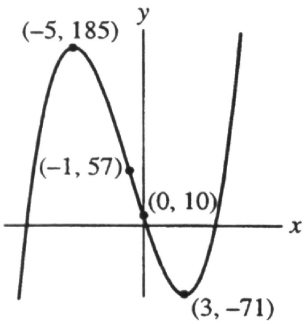
106) Is this the graph of $f(x) = x^3 - 3x^2 + 2$?
Enter just the word "yes" or "no" (lower case).



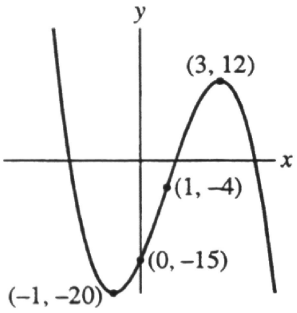
Answer: yes

107) Is this the graph of the function $f(x) = x^3 + 3x^2 - 45x + 10$?
Enter your answer as just the word "yes" or "no" (lower case).



Answer: yes

108) Is this the graph of the function $f(x) = -x^3 + 3x^2 + 9x - 15$?
Enter just the word "yes" or "no" (lower case).



Answer: yes

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Graph the function.

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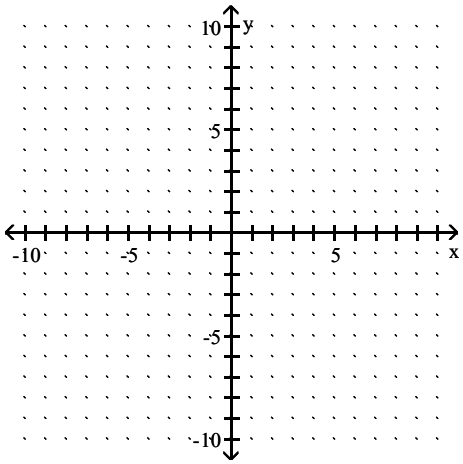
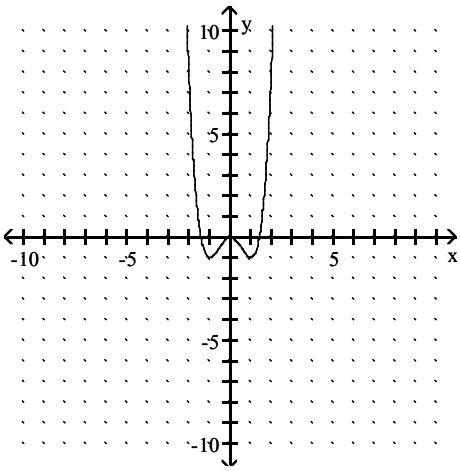
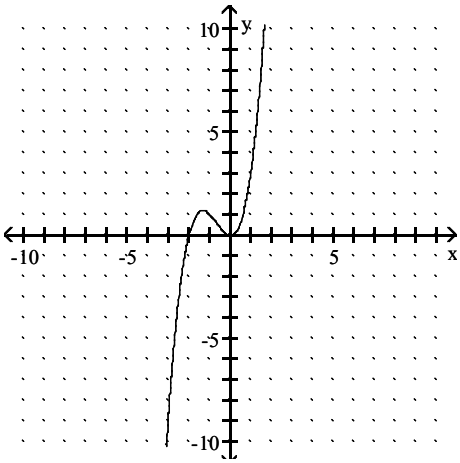
109) $f(x) = x^3 - 2x^2$



A)



B)



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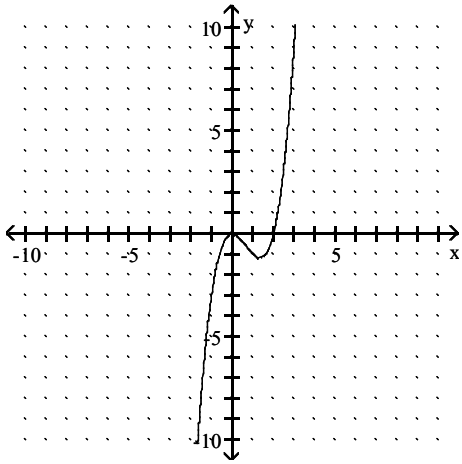
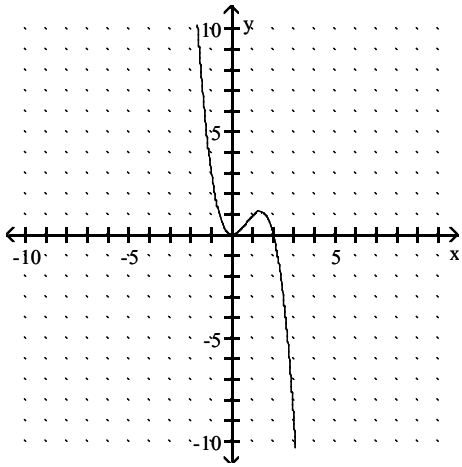
C)

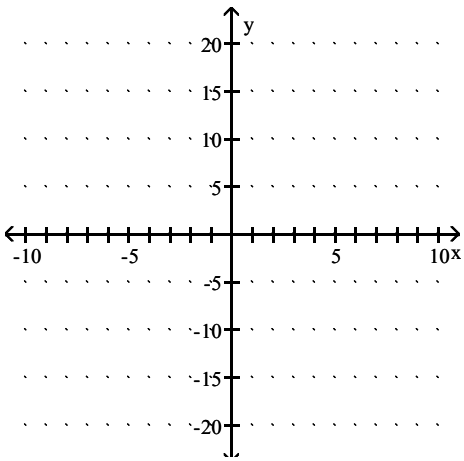


D)



Answer: C

110) $f(x) = -x^4 - 2x^2$



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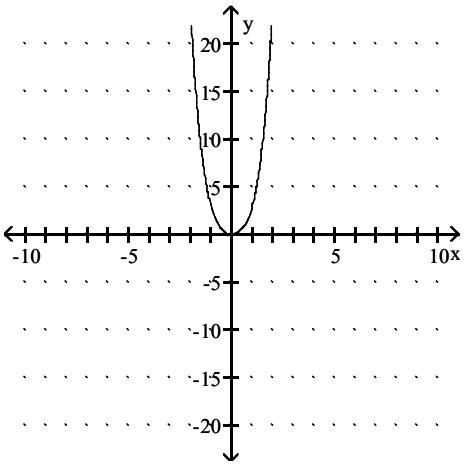
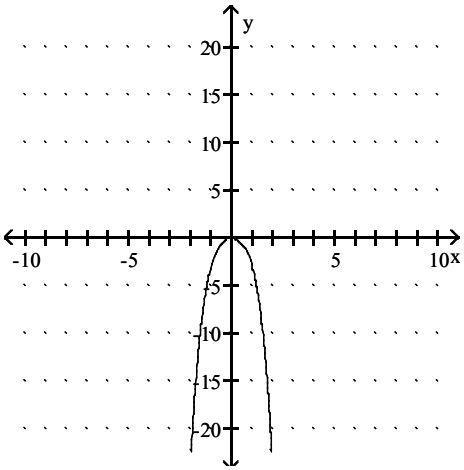
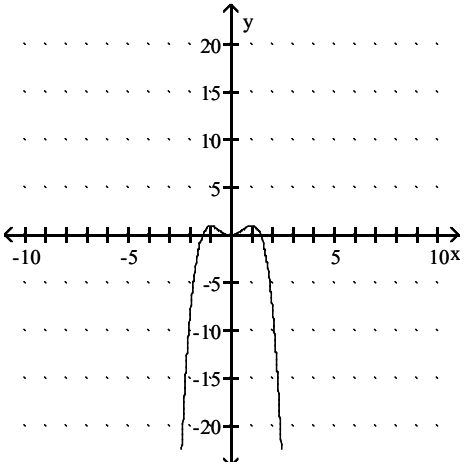
A)



B)



C)



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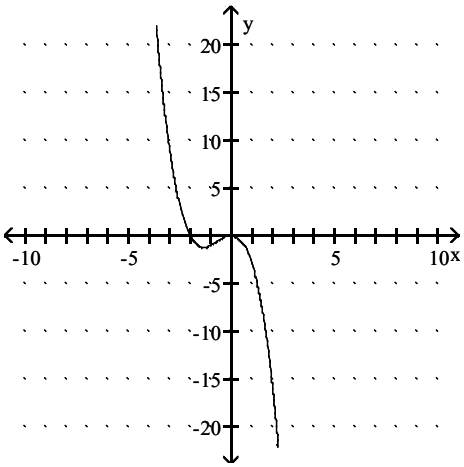
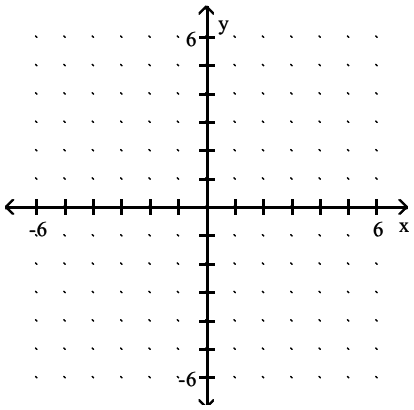
D)

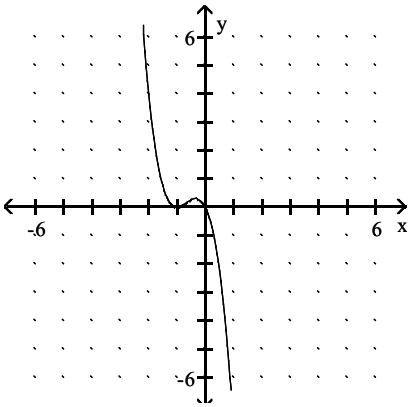


Answer: B

111) $f(x) = -2x(x - 1)^2$



A)



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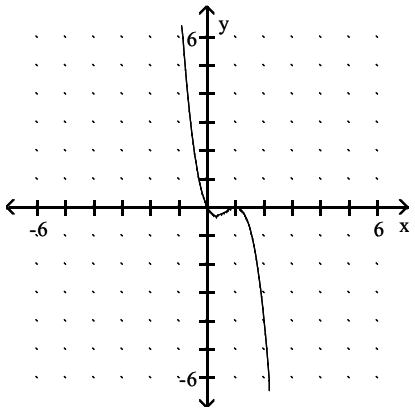
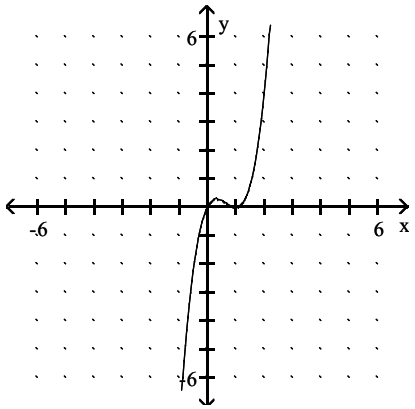
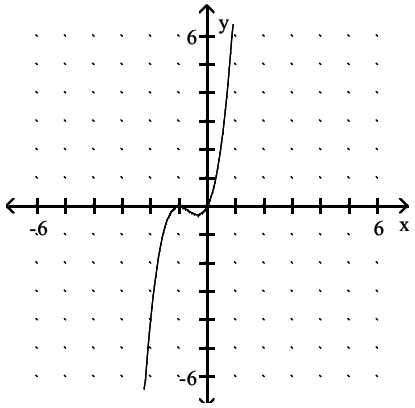
B)



C)



D)



Answer: B

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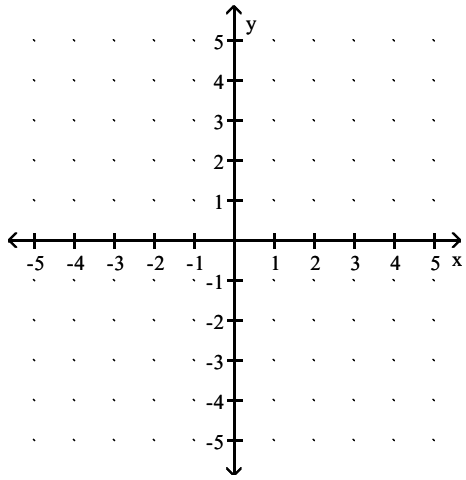
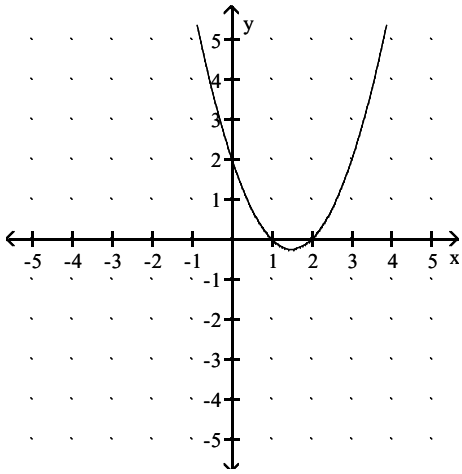
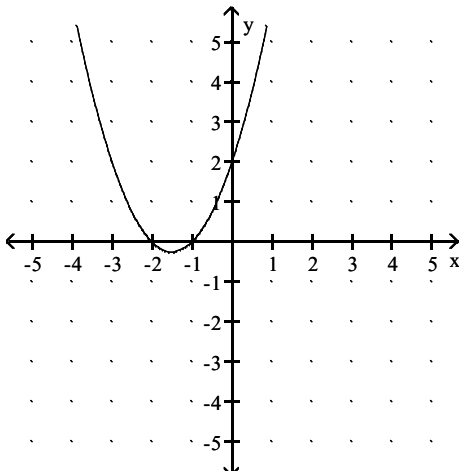
112) $f(x) = x^2 + 3x - 2$



A)



B)



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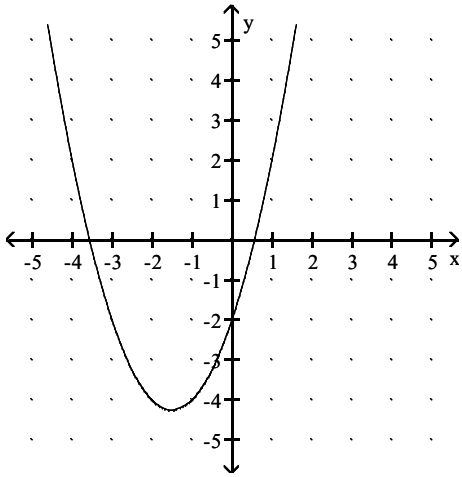
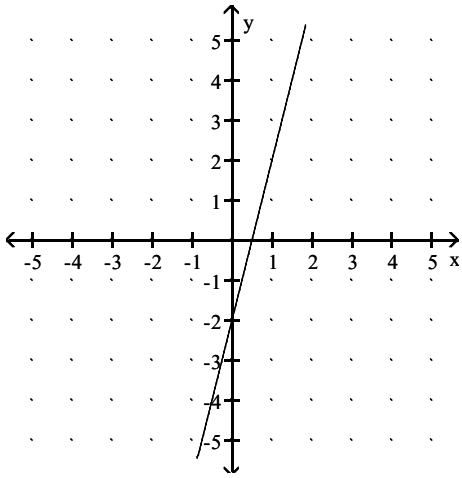
C)

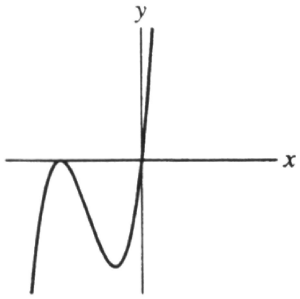


D)



Answer: C

113) Suppose f(x) is the function graphed below. Which of the following is f(x)?



A) $f(x) = x^3 + 5$

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

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

D) $f(x) = -x^2 + 2x + 5$

E) $f(x) = x^2 + 3x$

Answer: C

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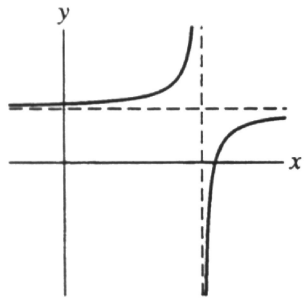
114) The graph of a function f(x) is sketched below. Which of the following is f(x)?



A) $f(x) = \frac{1}{5 - x} + 2$

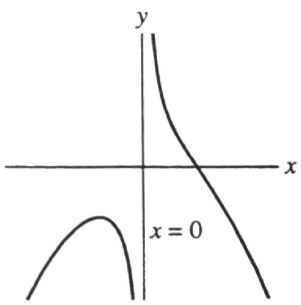
B) $f(x) = \sqrt{x - 5} - 2$

C) $f(x) = x^2 - 5x - 2$

D) $f(x) = \frac{1}{x - 5}$

Answer: A

115) The graph of a function f(x) is sketched below. Which of the following is f(x)?



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

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

C) $f(x) = \frac{1}{x + 2} - x$

D) $f(x) = \frac{1}{x^2}$

Answer: B

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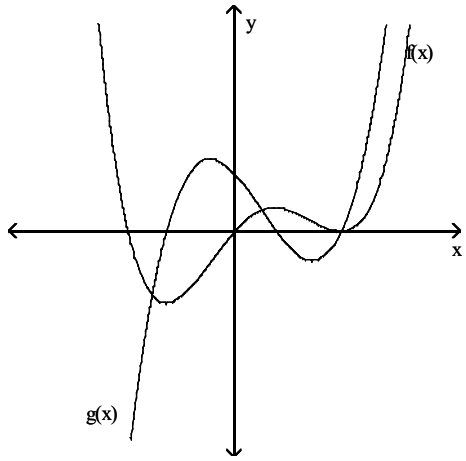
Use the graph to answer the question.

116) Determine which function is the derivative of the other.



A) $f(x) = g'(x)$
B) $g(x) = f'(x)$

Answer: B

117) Goes through (0, –4) and has a local maximum at (1, 1)

A) $f(x) = -5x^2 - 2x - 4$
B) $f(x) = 5x^2 - 10x - 4$
C) $f(x) = -5x^2 + 10x - 4$
D) $f(x) = -5x^2 + 10x + 4$

Answer: C

118) A manufacturer estimates that the profit from producing x units of a commodity is $-x^2 + 40x - 100$ dollars per week. What is the maximum profit he can realize in one week?

A) \$300
B) \$500
C) \$400
D) \$275
E) none of these

Answer: A

119) Suppose a ball is thrown into the air and after t seconds has a height of $h(t) = -16t^2 + 80t$ feet. When will it reach its maximum height?

A) 5 sec
B) 300 sec
C) 2.5 sec
D) 0.5 sec
E) none of these

Answer: C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

120) Determine the minimum value of $x + y$ when $xy = 100$ ($x > 0$, $y > 0$).
Enter just an integer.

Answer: 20

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121) Determine all maximum and minimum values of $f(x) = -x^3 + 3x^2 + 9x - 1$ on $-2 \le x \le 2$.
Enter your answer exactly as: a,b both integers where a is the minimum of f and b is the maximum of f.

Answer: −6, 21

122) Determine the maximum and minimum values of $f(x) = x^3 - 3x^2 - 9x$ on $-4 \le x \le 4$.
Enter your answer exactly as: a,b both integers where a is the minimum of f and b is the maximum of f.

Answer: −76, 5

123) Determine the minimum value of $f(x) = x^3 - 3x^2 + 2$ on $1 \le x \le 3$.
Enter just an integer.

Answer: −2

124) Determine the maximum value of $f(x) = -2x^3 + 6x + 3$ on $0 \le x \le 2$.
Enter just an integer.

Answer: 7

125) Determine the maximum and minimum values of $f(x) = 1 - x^3 + 3x + 2$ on $0 \le x \le 3$.
Enter your answer exactly as: a,b both integers where a is the minimum of f and b is the maximum of f.

Answer: −15, 5

126) Determine the minimum value of $f(x) = (x^2 - 2x + 2)^2 + 2(x^2 - 2x + 2)$.
Enter just an integer.

Answer: 3

127) Determine the minimum value of $f(x) = x + \dfrac{1}{x - 1}$ on $x > 1$.

Enter just an integer.

Answer: 3

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

128) Of all numbers whose sum is 180, find the two that have the maximum product. That is, maximize $Q = xy$, where $x + y = 180$.
A) 10 and 170
B) 89 and 91
C) 90 and 90
D) 1 and 179

Answer: C

129) The cost of a computer system increases with increased processor speeds. The cost C of a system as a function of processor speed is estimated as $C = 5S^2 - 2S + 1800$, where S is the processor speed in MHz. Find the processor speed for which cost is at a minimum. Round to the nearest tenth if necessary.
A) 0.1 MHz
B) 1.6 MHz
C) 4 MHz
D) 0.2 MHz

Answer: D

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130) Suppose $c(x) = x^3 - 16x^2 + 30{,}000x$ is the cost of manufacturing x items. Find a production level that will minimize the average cost of making x items.

A) 10 items
B) 7 items
C) 8 items
D) 9 items

Answer: C

131) A rectangular garden of area 50 square feet is to be surrounded on three sides by a fence costing \$2 per running foot and on one side by a brick wall costing \$6 per running foot. Let x be the length of the brick wall side. Which of the following represents the total cost of the material?

A) $\frac{3x}{50} + \frac{1}{50x}$

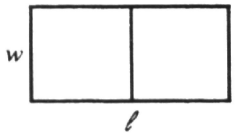
B) $6x + \frac{300}{x}$

C) $6x + \frac{50}{x}$

D) $3x + (50 - x)$
E) none of these

Answer: E

132) A rectangular corral with a total area of 60 square meters is to be fenced off and then divided into 2 rectangular sections by a fence down the middle.



The fencing for the outside costs \$9 per running meter, whereas that for the interior dividing fence costs \$12 per running meter. Which of the following statements hold, if the cost (c) of the fencing is to be maximized?

(I) The constraint equation is $3w + 2l = 60$.
(II) The objective equation is $2l \cdot w = 60$.
(III) The constraint equation is $w \cdot l = 60$.
(IV) The objective equation is $C = 30w + 18l$.
(V) The constraint equation is $C = 12w + 9wl$.
(VI) The objective equation is $C = 60 - lw$.

A) V and VI
B) III and IV
C) I and II
D) none of these

Answer: B

133) What is the maximum area that can be enclosed in a rectangular shape with 100 feet of fence if one of the two long sides is not fenced (there is a natural boundary there)?

A) 1000 square feet
B) 625 square feet
C) 2500 square feet
D) 1250 square feet
E) none of these

Answer: D

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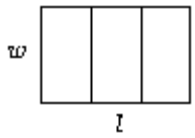
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

134) A homebuilder's advertisement promises a house with a finished recreation room of 300 square feet. Two perpendicular walls of the room are to be paneled at a cost of $5 per running foot. A third side will be built out of windows at a cost of $10 per running foot. What dimensions should the room have to minimize the homebuilder's cost? Enter your answer as: length of side using cinder, length of other side.

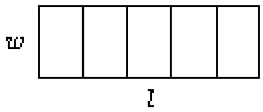
Answer: 30 ft, 10 ft

135) A rectangular garden is to be fenced in and divided into three parallel sections. The fencing for the boundary costs $20 per foot whereas the fencing for the dividing fences costs $5 per foot. Consider the problem of finding the dimensions of the largest garden possible if the gardener can spend $2000 for the fencing. Find the values of l and w for which the total area of the garden is as large as possible.



Answer: l = 25 ft, w = 20 ft

136) A large rectangular garden is to be enclosed by a fence and divided into 5 regions by 4 parallel fences across the interior of the garden as shown below.



Find the values of l and w for which the total area of the garden is as large as possible, assuming that 120 ft of fencing is available.

Answer: l = 30 ft, w = 10 ft

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

137) A carpenter is building a rectangular room with a fixed perimeter of 480 ft. What are the dimensions of the largest room that can be built? What is its area?

A) 48 ft by 432ft; 20,736 ft^2

B) 120 ft by 120 ft; 14,400 ft^2

C) 120 ft by 360 ft; 43,200 ft^2

D) 240 ft by 240 ft; 57,600 ft^2

Answer: B

138) Find the dimensions that produce the maximum floor area for a one–story house that is rectangular in shape and has a perimeter of 161 ft. Round to the nearest hundredth, if necessary.

A) 80.5 ft x 80.5 ft

B) 13.42 ft x 40.25 ft

C) 40.25 ft x 161 ft

D) 40.25 ft x 40.25 ft

Answer: D

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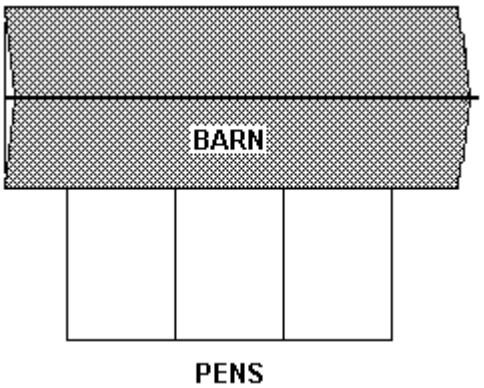
139) A farmer decides to make three identical pens with 136 feet of fence. The pens will be next to each other sharing a fence and will be up against a barn. The barn side needs no fence.



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

A) 17 ft by 68 ft
B) 17 ft by 17 ft
C) 22.67 ft by 113.33 ft
D) 34 ft by 34 ft

Answer: A

140) 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.

A) 3.6 ft
B) 7.2 ft
C) 6.4 ft
D) 3.2 ft

Answer: D

141) A company is constructing an open–top, square–based, rectangular metal tank that will have a volume of 68 ft^3. What dimensions yield the minimum surface area? Round to the nearest tenth, if necessary.

A) 4.1 ft by 4.1 ft. by 4.1 ft
B) 11.7 ft by 11.7 ft. by 0.5 ft
C) 5.1 ft by 5.1 ft. by 2.6 ft
D) 5.9 ft by 5.9 ft. by 2 ft

Answer: C

142) Compute the maximum product for two positive numbers with the property that the sum of the first plus five times the second is 5000.

A) 50,000
B) 600
C) 25,000
D) 1,250,000
E) none of these

Answer: D

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143) Compute the maximum product for two positive numbers with the property that the sum of the first plus three times the second is 3000.

A) 750,000
B) 30,000
C) 15,000
D) 25,000
E) none of these

Answer: A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

144) An open box with square ends is to be constructed with a volume of 125 cubic inches. The bottom is to be made of a material that weighs twice as much per square inch as the material used for the sides. What should the dimensions of the box be in order to minimize its weight? (Note: the actual weights of the materials do not matter.)
Enter your answer exactly as a, b, c where these integers represent length, width, and height (no units or × symbols)

Answer: 5, 5, 5

145) A fast food restaurant is establishing its inventory policy for ordering frozen french fries. In the coming year, they expect to sell 2500 lbs of french fries. It costs $4 to place an order and the carrying costs for a year are $2 per pound based on the average amount in storage. The restaurant wishes to determine how many pounds of fries to order to minimize its ordering and inventory costs. Determine the optimal number of orders that should be placed and the optimal size of those orders.
Enter your answer exactly as just: a, b (both integers) where a represents the orders and b represents the lbs/orde (no words or units).

Answer: 25, 100

146) A sports retailer expects to sell 120 sweat suits at a steady rate over the course of the coming year. The cost of placing an order with the wholesaler is $40. The annual inventory cost per sweat suit is $6 based on the average inventory level. Determine the economic order quantity for the suits (i.e., determine the order size that minimizes ordering and inventory expenses).
Enter just an integer (no words or units).

Answer: 40

147) A health food store stocks bottles of multivitamins. It orders equal quantities of stock from its wholesaler at equally spaced points throughout the year. The cost of replacing each order is $250. Moreover, the cost of keeping a jar of vitamins in inventory is $1 per year. The store predicts that it will sell 12,500 bottles of vitamins in the next year. How many orders of how many bottles each will result in a minimum cost to the health food store?
Enter your answer exactly as: a, b (integers) where a represents the number of orders and b represents the number of bottles in each order (no units or words).

Answer: 5, 2500

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MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

148) A bookstore has an annual demand for 64,000 copies of a best–selling book. It costs $0.90 to store one copy for one year, and it costs $30 to place an order. Find the optimum number of copies per order.
A) 2066 copies
B) 2177 copies
C) 1859 copies
D) 2122 copies

Answer: A

149) A certain company produces potting soil and sells it in 50 lb bags. Suppose that 200,000 bags are to be produced each year. It costs $4 per year to store a bag of potting soil, and it costs $1000 to set up the facility to produce a batch of bags. Find the number of bags per batch that should be produced.
A) 9574
B) 14,121
C) 10,000
D) 100,000

Answer: C

150) A local office supply store has an annual demand for 40,000 cases of photocopier paper per year. It costs $1 per year to store a case of photocopier paper, and it costs $40 to place an order. Find the optimum number of cases of photocopier paper per order.
A) 3,200,000
B) 1265
C) 566
D) 1789

Answer: D

151) A book publisher wants to know how many times a year a print run should be scheduled. Suppose it costs $2000 to set up the printing process, and the subsequent cost per book is so low it can be ignored. Suppose further that the annual warehouse cost is $9 times the maximum number of books stored. Assuming 6000 copies of the book are needed per year how many books should be printed in each print run?
A) 1155
B) 1633
C) 365
D) 1732

Answer: B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

152) Compute the maximum profit when the demand function is $p(x) = x^2 - 3x + 2$ and the total cost function is $C(x) = \frac{2x^3}{3} - \frac{1}{2}x^2 - 2x$.

Enter just a reduced fraction of form $\frac{a}{b}$.

Answer: $\frac{11}{6}$

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153) Compute the minimal average cost if the total cost function is $C(x) = 9x^2 + 5x + 100$.
Enter just an integer.

Answer: 65

154) Compute the maximum profit for the profit function $P(x) = \frac{x^3}{3} - \frac{9}{2}x^2 + 8x$.

Enter your answer as just a real number rounded off to two decimal places (no label).

Answer: 3.83

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

155) A toll road averages 36,000 cars per day when charging $1 (100 cents) per car. A survey concludes that changing the toll will result in 300 fewer cars for each cent of increase in price. Which of the following represents the revenue that will result from an increase of x cents in the price of the toll?

A) $36{,}000 + 300x + (100 + x)$
B) $36{,}000(100 + x) - 300x$
C) $(36{,}000 - 300x)(100 + x)$
D) $36{,}000 \cdot 100 - x(300 - x)$
E) none of these

Answer: C

156) Suppose that 20,000 fans will go to a ball game when the price of a ticket is $5.00, and that 500 fewer fans will go for each $1.00 increase in ticket price. By how much should ticket prices be increased (or decreased) in order to maximize revenue?

A) increase price by $45.00
B) increase price by $17.50
C) increase price by $22.50
D) decrease price by $1.00

Answer: B

157) A health club offers memberships at the rate of $300, provided that at least 50 people join. For each member in excess of 50, the membership fee will be reduced by $2 for all members. Due to space limitations, at most 125 memberships will be sold. How many memberships should the club sell in order to maximize its revenue?

A) 100
B) 75
C) 50
D) 125
E) none of these

Answer: A

158) In planning a sidewalk cafe, it is estimated that if there are 28 tables, the daily profit will be $8 per table and that, if the number of tables is increased by x, the profit per table will be reduced by $\frac{1}{4}x$ dollars (due to overcrowding). How many tables should be present in order to maximize the profit?

A) 10
B) 30
C) 20
D) can't do the problem without cost information

Answer: B

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SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

159) An airline flies 120,000 passengers per week to Florida when charging $100 per flight. It estimates that for each $1 increase in price it will lose 400 passengers. By how much should the fare be increased (or decreased) to maximize total revenue? Enter your answer as just an integer (no symbols or words).

Answer: 100

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

160) The annual revenue and cost functions for a manufacturer of grandfather clocks are approximately $R(x) = 520x - 0.03x^2$ and $C(x) = 160x + 100{,}000$, where x denotes the number of clocks made. What is the maximum annual profit?

A) $980,000
B) $1,280,000
C) $1,180,000
D) $1,080,000

Answer: A

161) The annual revenue and cost functions for a manufacturer of precision gauges are approximately $R(x) = 500x - 0.02x^2$ and $C(x) = 120x + 100{,}000$, where x denotes the number of gauges made. What is the maximum annual profit?

A) $1,805,000
B) $2,005,000
C) $1,905,000
D) $1,705,000

Answer: D

162) Find the number of units, x, that produces the maximum profit P, if $C(x) = 10 + 28x$ and $p = 100 - 2x$.

A) 18 units
B) 112 units
C) 28 units
D) 72 units

Answer: A

163) Find the maximum profit P if $C(x) = 5 + 16x$ and $p = 52 - 2x$.

A) $162
B) $843
C) $157
D) $838

Answer: C

164) Find the price p per unit that produces the maximum profit P if $C(x) = 30 + 80x$ and $p = 84 - 2x$.

A) $4
B) $8
C) $82
D) $78

Answer: C

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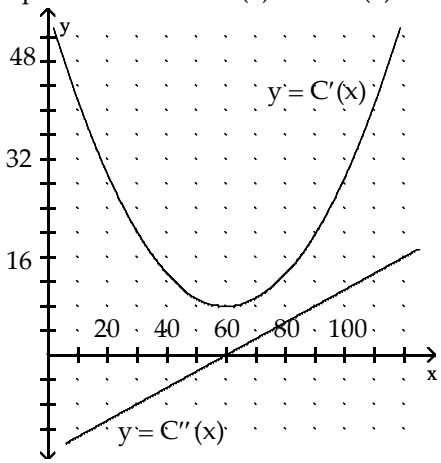
165) The cost function for a manufacturer is C(x) dollars, where x is the number of units of goods produced. The graph below shows C′(x) and C″(x).



What is the marginal cost when 30 units of good are produced?

A) $36 per unit
B) $28 per unit
C) $56 per unit
D) $20 per unit

Answer: D

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