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.

1) $f(x) = x^2 - 8x + 18$
A) Relative minimum at (4, 2)
B) Relative maximum at (2, 4)
C) Relative maximum at (4, 2)
D) Relative minimum at (2, 4)

Answer: A

2) $f(x) = 2x^2 + 20x + 53$
A) Relative minimum at (–5, 3)
B) Relative maximum at (5, –3)
C) Relative minimum at (–3, 5)
D) Relative minimum at (3, –5)

Answer: A

3) $s(x) = -x^2 - 12x - 27$
A) Relative maximum at (–12, –27)
B) Relative maximum at (–6, 9)
C) Relative maximum at (6, 9)
D) Relative minimum at (12, –27)

Answer: B

4) $f(x) = -7x^2 - 2x - 2$
A) Relative minimum at $\left(\frac{1}{7}, \frac{13}{7}\right)$
B) Relative maximum at $\left(-\frac{1}{7}, -\frac{13}{7}\right)$
C) Relative maximum at $\left(-7, -\frac{13}{7}\right)$
D) Relative maximum at $\left(\frac{1}{7}, \frac{13}{7}\right)$

Answer: B

5) $f(x) = 0.4x^2 - 2.9x + 5.8$
A) Relative minimum at (3.625, 0.54375)
B) Relative maximum at (3.625, 0.54375)
C) Relative minimum at (–3.625, 21.56875)
D) Relative minimum at (3.625, 0)

Answer: A

6) $f(x) = x^3 - 3x^2 + 1$
A) Relative maximum at (–2, –19); relative maximum at (0, 1)
B) Relative maximum at (0, 1); relative minimum at (2, –3)
C) Relative maximum at (2, –3)
D) Relative minimum at (0, 1); relative maximum at (2, –3)

Answer: B

7) $y = x^3 - 3x^2 + 7x - 10$

A) Relative maximum at (2, 6)
B) Relative minimum at (1, 6)
C) Relative maximum at (−1, 6)
D) No relative extrema exist

Answer: D

8) $f(x) = x^3 - 12x + 4$

A) Relative maximum at (5, 69); relative minimum at (−3, 13)
B) Relative maximum at (5, 69); relative minimum at (2, −12)
C) Relative minimum at (−2, 20); relative maximum at (2, −12)
D) Relative maximum at (−2, 20); relative minimum at (2, −12)

Answer: D

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

A) Relative maximum at (0, −4)
B) Relative maximum at (0, 4)
C) Relative minimum at (0, 4)
D) No relative extrema exist

Answer: D

10) $f(x) = \frac{2}{3}x^3 + \frac{1}{2}x^2 - 21x + 2$

A) Relative maximum at $\left(-\frac{7}{2}, \frac{1273}{24}\right)$; relative minimum at $\left(\frac{7}{2}, -\frac{883}{24}\right)$
B) Relative maximum at $\left(3, -\frac{77}{2}\right)$
C) Relative maximum at $\left(-\frac{7}{2}, \frac{1273}{24}\right)$; relative minimum at $\left(3, -\frac{77}{2}\right)$
D) Relative maximum at $\left(-3, \frac{103}{2}\right)$; relative minimum at $\left(\frac{7}{2}, -\frac{883}{24}\right)$

Answer: C

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

A) Relative minimum at (−2, 48), relative maximum at (0, 32)
B) Relative minimum at (0, 32)
C) Relative maximum at (−2, 48), relative minimum at (0, 32)
D) Relative minimum at (−2, 48)

Answer: B

12) $f(x) = x^4 - 8x^2 + 6$

A) Relative maximum at (2, −10); relative minimum at (−2, −10)
B) Relative minimum at (0, 6); relative maxima at (2, −10), (−2, −22)
C) Relative maximum at (0, 6); relative minimum at (2, −10)
D) Relative maximum at (0, 6); relative minima at (2, −10), (−2, −10)

Answer: D

13) $f(x) = x^3 - 5x^4$

A) Relative maximum at (0,0); relative minima at $\left(-\frac{3}{20}, -\frac{27}{6400}\right)$ and $\left(\frac{3}{20}, \frac{27}{32000}\right)$

B) Relative maximum at $\left(\frac{3}{20}, \frac{27}{32000}\right)$

C) Relative maximum at $\left(\frac{3}{20}, \frac{27}{32000}\right)$; relative minimum at (0, 0)

D) Relative minimum at $\left(-\frac{3}{20}, -\frac{27}{6400}\right)$; relative maximum at (0, 0)

Answer: B

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

A) No relative extrema exist
B) Relative maximum at (–1, 2); relative minimum at (1, 2)
C) Relative maximum at (0, 1)
D) Relative minimum at (0, 1)

Answer: A

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

A) No relative extrema exist
B) Relative minimum at (0, –4)
C) Relative maximum at (0, 4)
D) Relative maximum at (0, –4)

Answer: D

16) $f(x) = \frac{-6}{x^2 + 1}$

A) Relative maximum at (0, –6)
B) Relative minimum at (0, –6)
C) Relative maximum at (0, 6)
D) No relative extrema exist

Answer: B

17) $f(x) = \frac{6x}{x^2 + 1}$

A) Relative minimum at $(-1, -3)$; relative maximum at $(1, 3)$
B) Relative maximum at (0, 0)
C) Relative minimum at $(-1, -3)$; relative maximum at (0, 0)
D) Relative maximum at $(-1, -3)$; relative minimum at $(1, 3)$

Answer: A

18) $f(x) = \dfrac{x + 1}{x^2 + 3x + 3}$

A) Relative maximum at $\left(0, \dfrac{1}{3}\right)$; relative minimum at $(-2, -1)$

B) Relative minimum at $\left(0, \dfrac{1}{3}\right)$; relative maximum at $\left(-2, \dfrac{1}{3}\right)$

C) No relative extrema exist

D) Relative maximum at (0, 3); relative minimum at $\left(-2, \dfrac{1}{3}\right)$

Answer: A

19) $f(x) = x^{2/5} - 1$

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

Answer: D

20) $f(x) = (x + 5)^{1/3}$

A) Relative minimum at (5, 0)
B) Relative minimum at (–5, 0)
C) No relative extrema exist
D) Relative maximum at (–5, 0)

Answer: C

21) $f(x) = \sqrt[3]{x + 1}$

A) Relative minimum at (1, 0)
B) Relative minimum at (–1, 0)
C) Relative maximum at (–1, 0)
D) No relative extrema exist

Answer: D

22) $f(x) = (x + 2)^{2/3} + 6$

A) Relative minimum at (2, 6)
B) Relative minimum at (–2, 6)
C) No relative extrema exist
D) Relative maximum at (–2, 6)

Answer: B

23) $f(x) = \dfrac{8}{\sqrt{1 - 6x^2}}$

A) Relative maximum at (0, 8)
B) Relative minimum at (2, 8)
C) Relative minimum at (0, 8)
D) No relative extrema exist

Answer: C

24) $f(x) = \sqrt{x^2 + 2x + 2}$

A) Relative minimum at (–1, 1); relative maximum at (1, –1)

B) Relative maximum at (–1, 1)

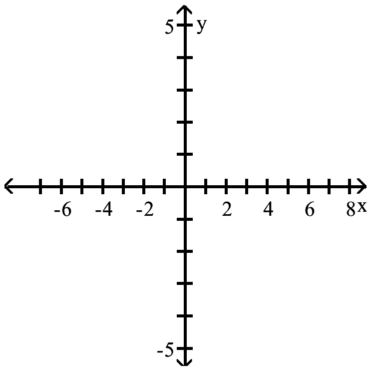
C) No relative extrema exist

D) Relative minimum at (–1, 1)

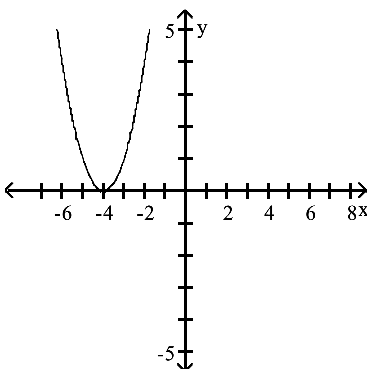
Answer: D

Graph the function by first finding the relative extrema.

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



A)



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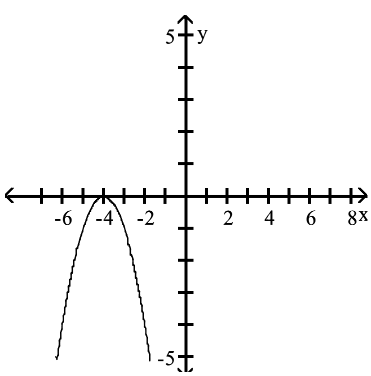

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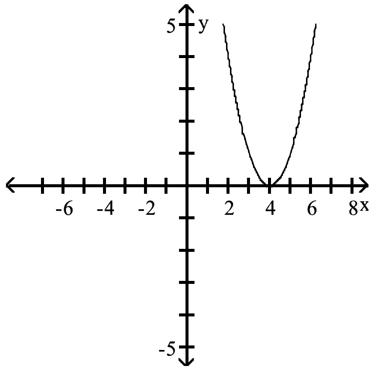
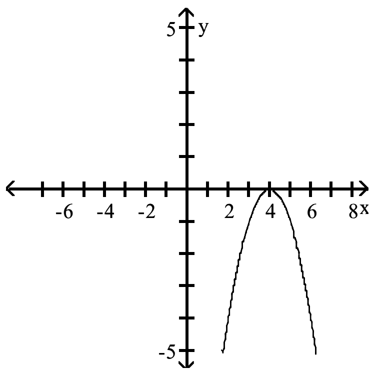
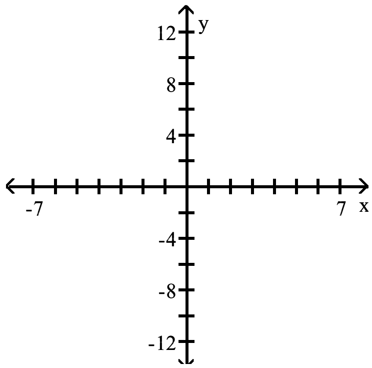


D)

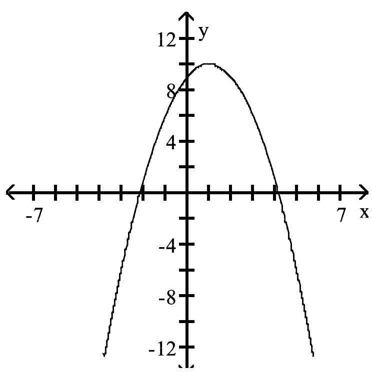


Answer: C

26) $f(x) = 9 + 2x - x^2$



A)



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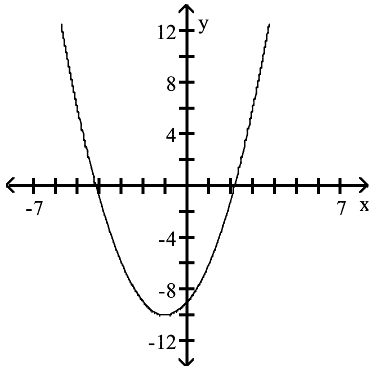
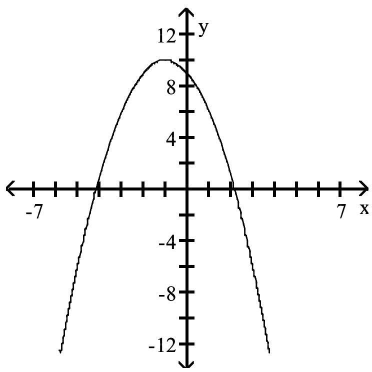
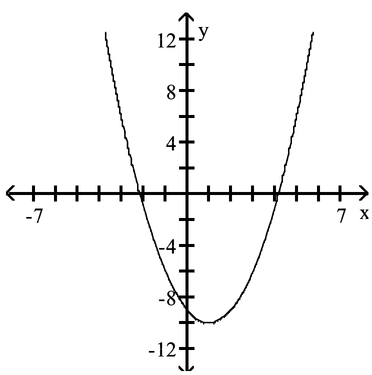


C)

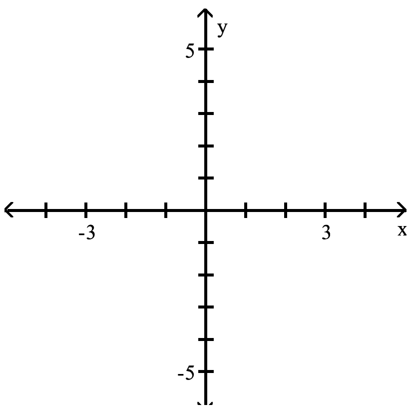


D)

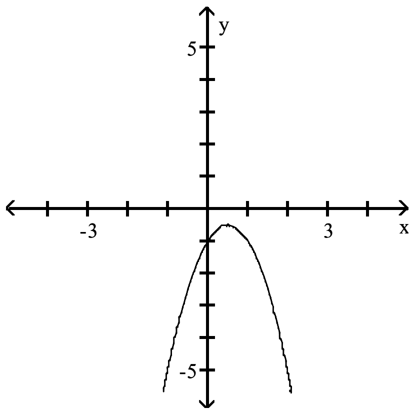


Answer: A

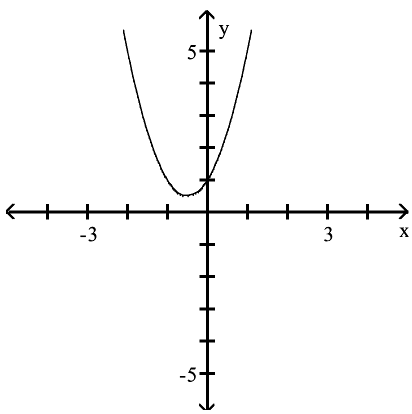
27) $f(x) = 2x^2 + 4x + 1$



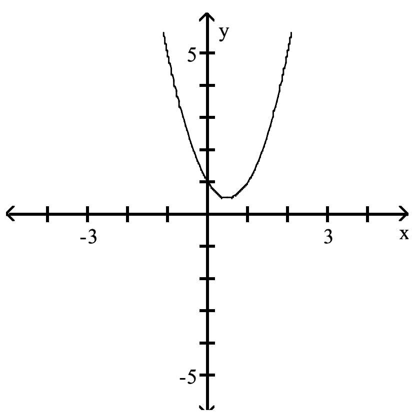
A)



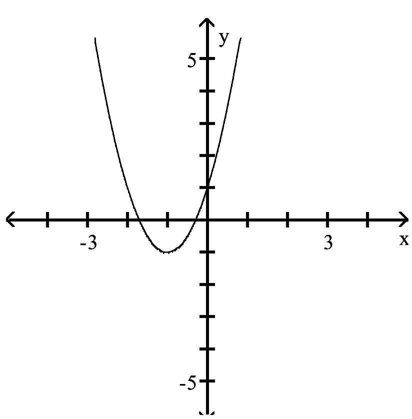
B)



C)

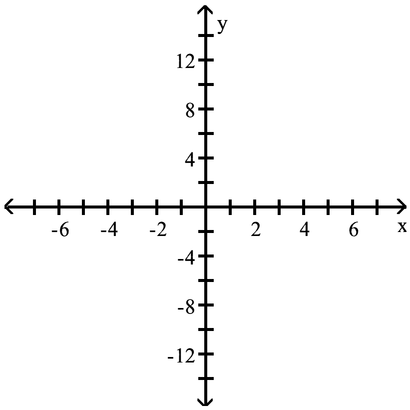


D)

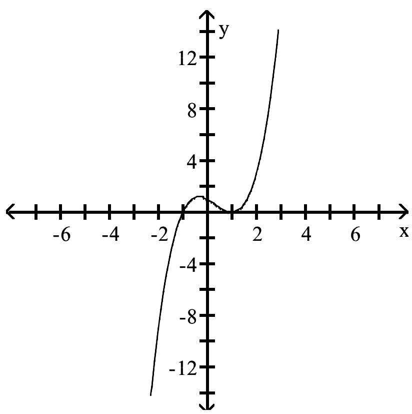


Answer: D

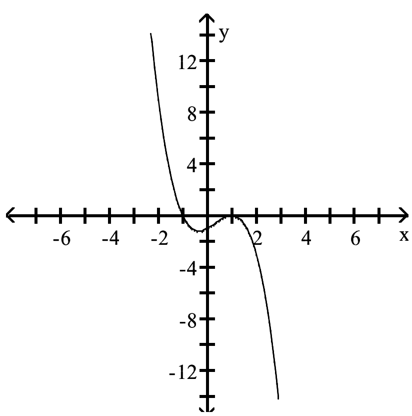
28) $f(x) = x^3 + 3x^2 - x - 3$



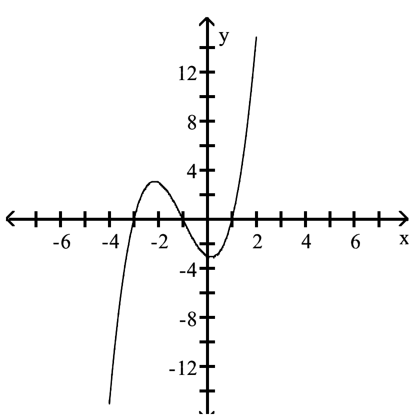
A)



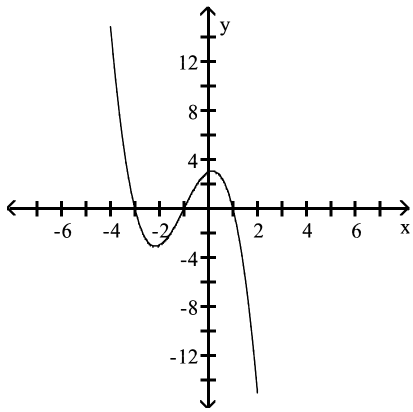
B)



C)

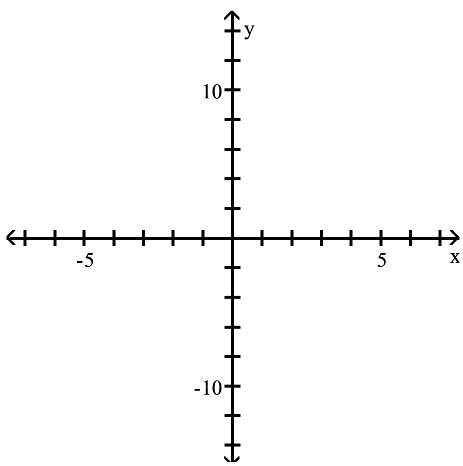


D)

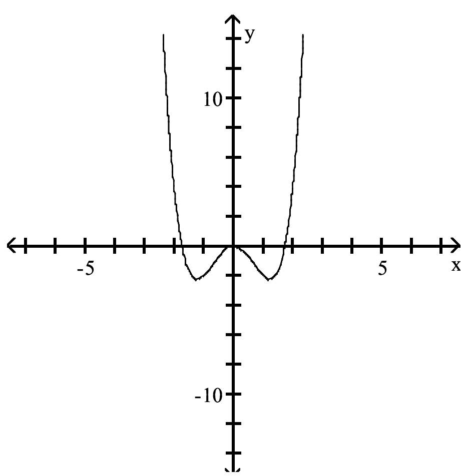


Answer: C

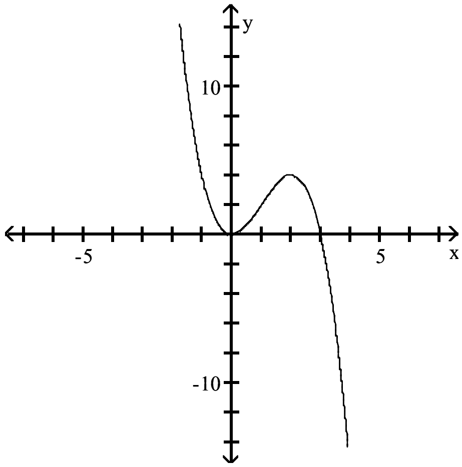
29) $f(x) = x^3 - 3x^2$



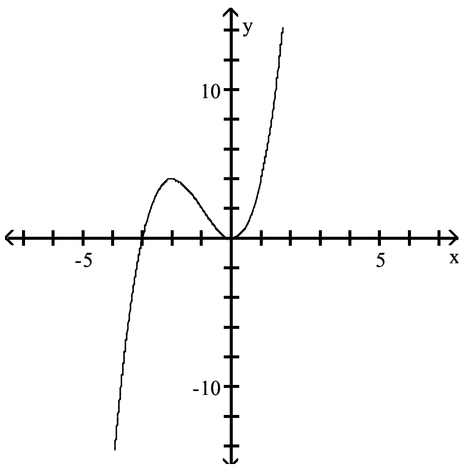
A)



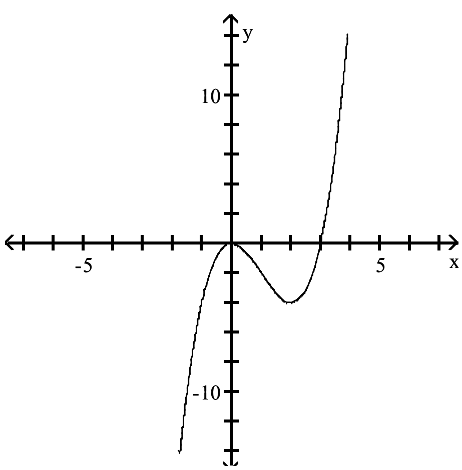
B)



C)

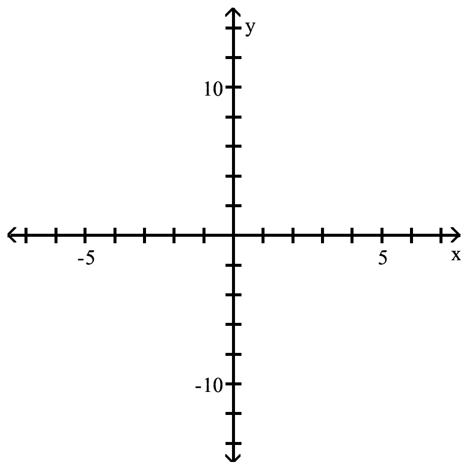


D)

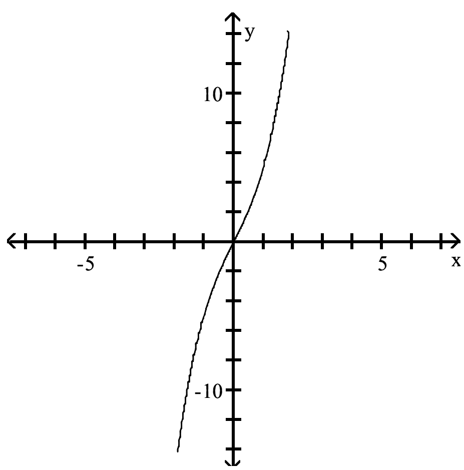


Answer: D

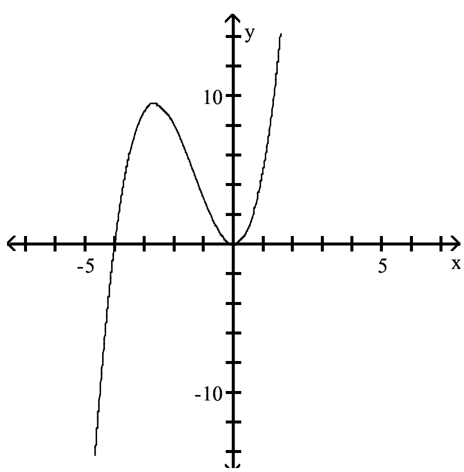
30) $f(x) = x^3 + 4x$



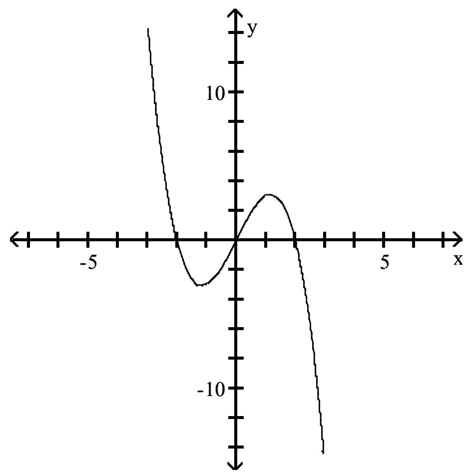
A)



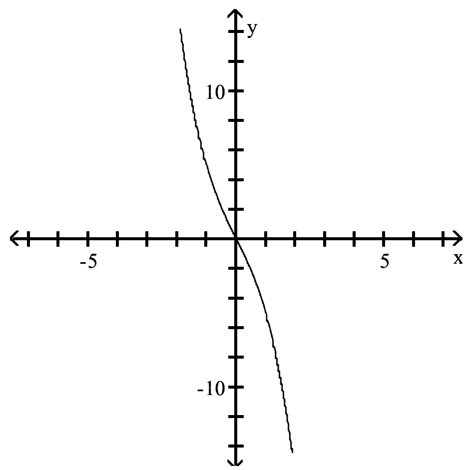
B)



C)

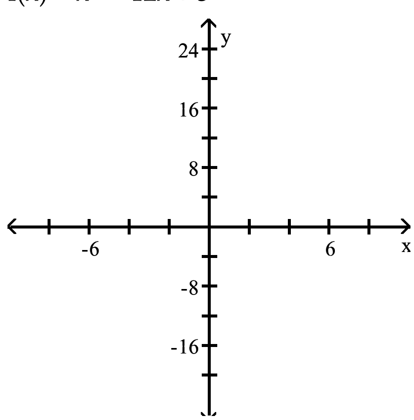


D)

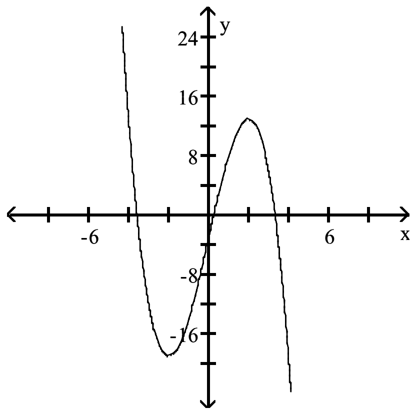


Answer: A

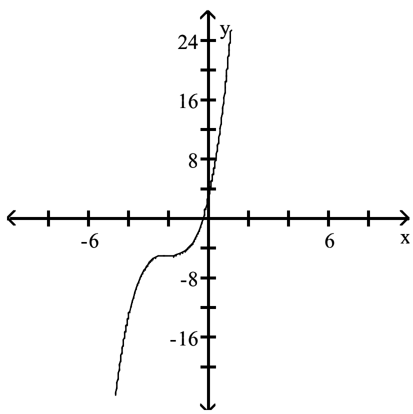
31) $f(x) = x^3 - 12x + 3$



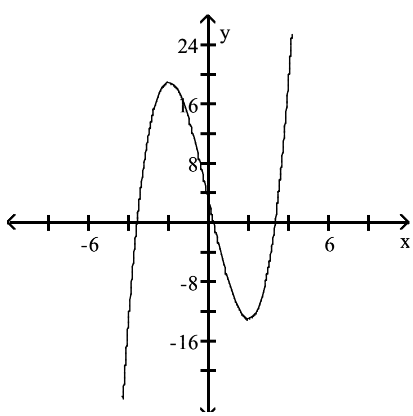
A)



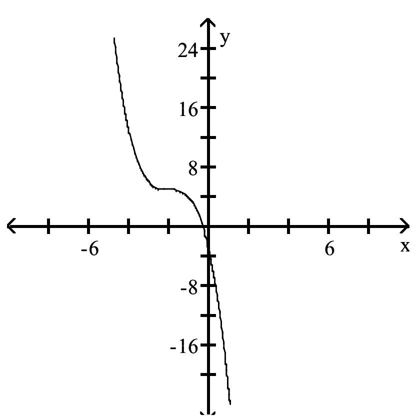
B)



C)

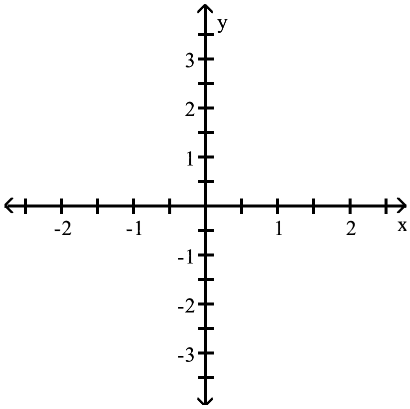


D)

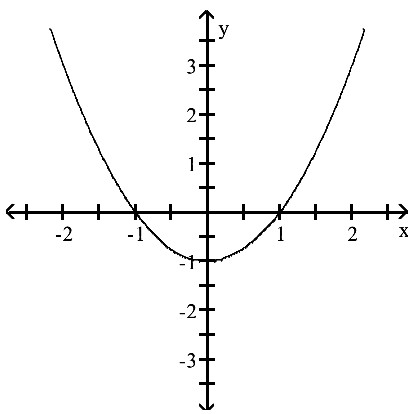


Answer: C

32) $f(x) = x^3 - 1$



A)



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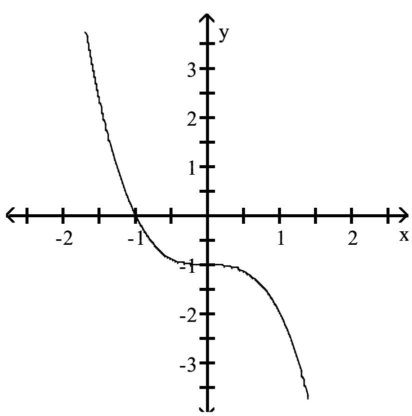
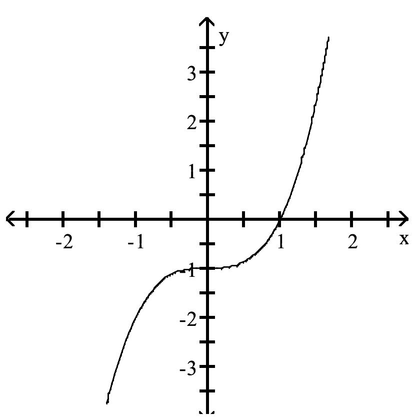
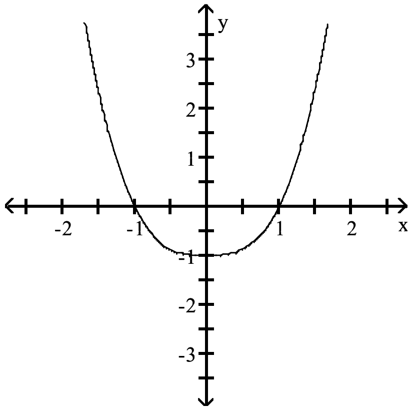


C)

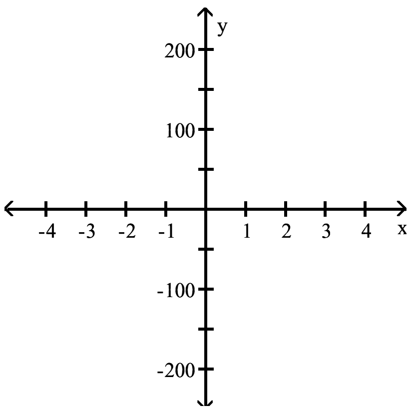


D)

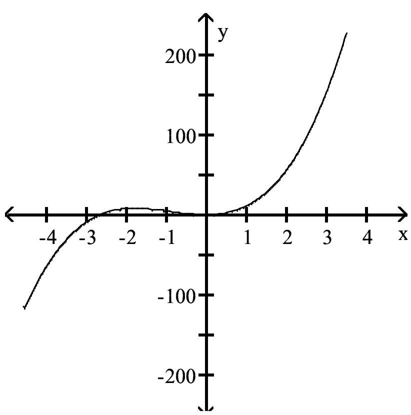


Answer: C

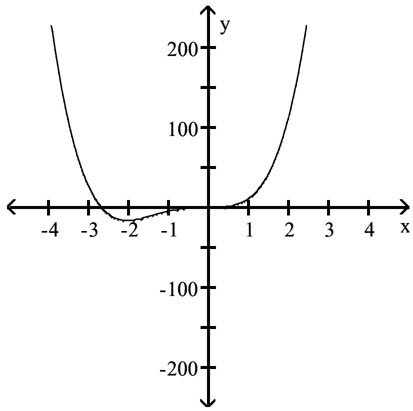
33) $g(x) = 3x^4 - 8x^3$



A)



B)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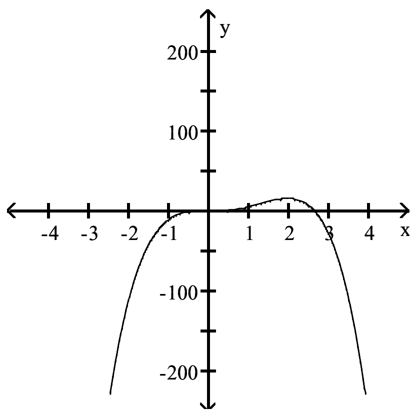
-3
-2
-1
1
2
3
4
x
-100
-200

C)


y
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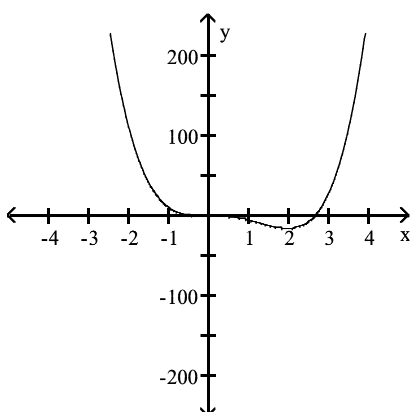
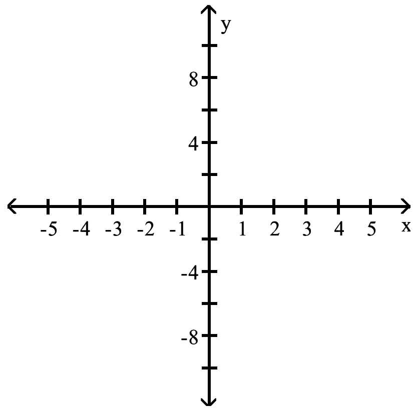
100
-4
-3
-2
-1
1
2
3
4
x
-100
-200

D)

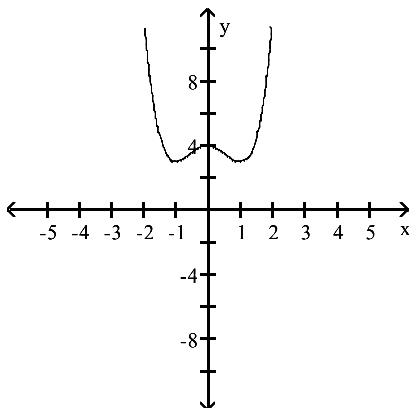

y
200
100
-4
-3
-2
-1
1
2
3
4
x
-100
-200

Answer: D

34) $h(x) = x^4 - 2x^2 + 4$



A)



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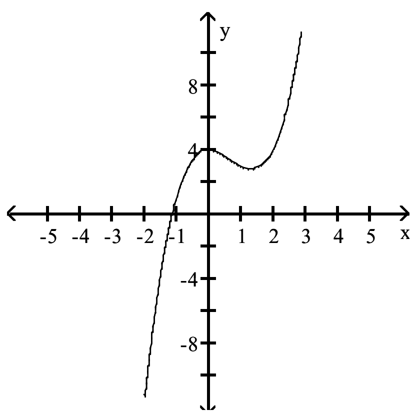
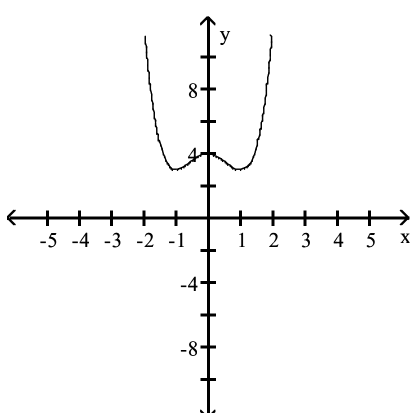
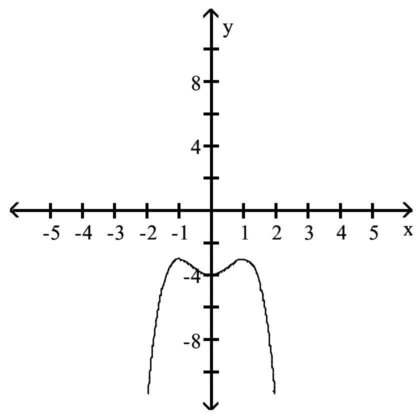


C)

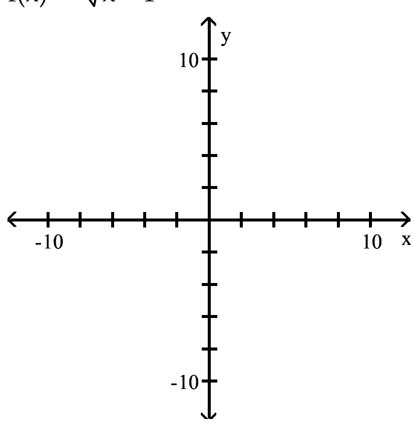


D)

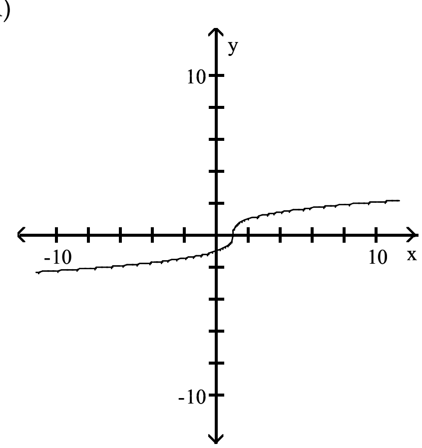


Answer: C

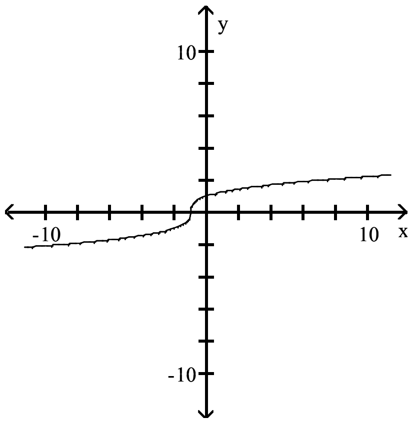
35) $f(x) = \sqrt[3]{x - 1}$



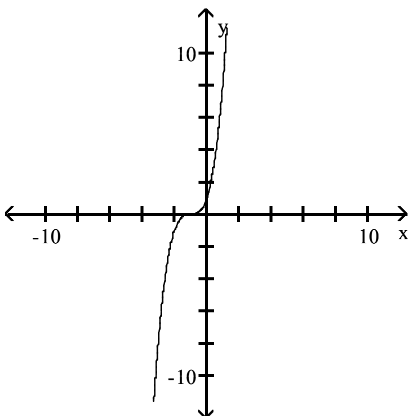
A)



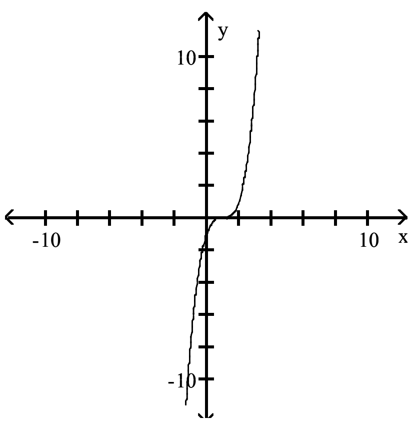
B)



C)

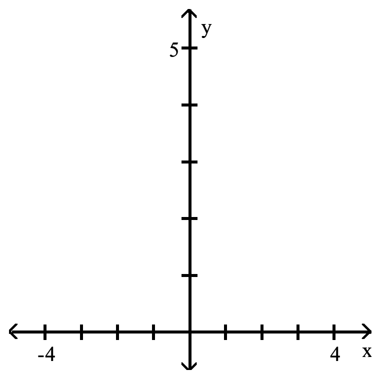


D)

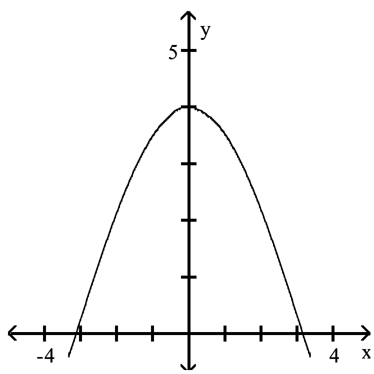


Answer: A

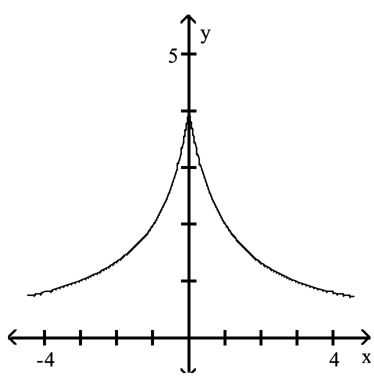
36) $f(x) = \frac{4}{x^2 + 1}$



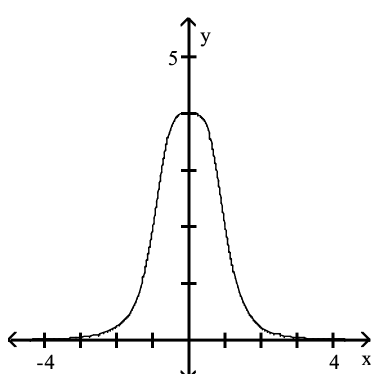
A)



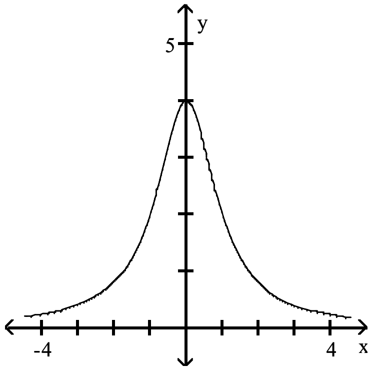
B)



C)

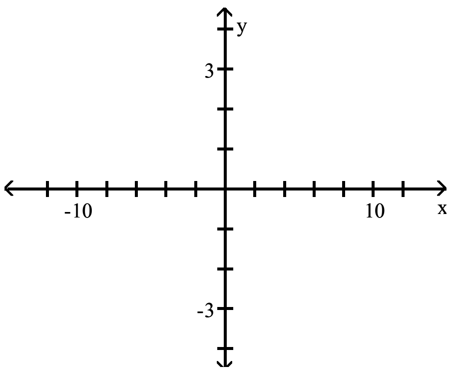


D)

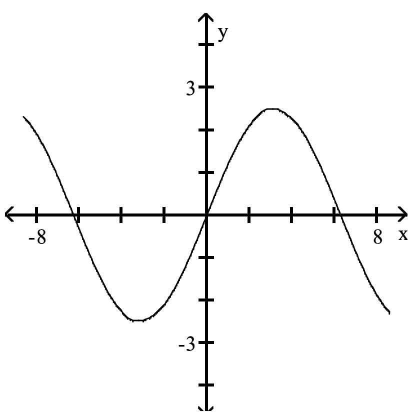


Answer: D

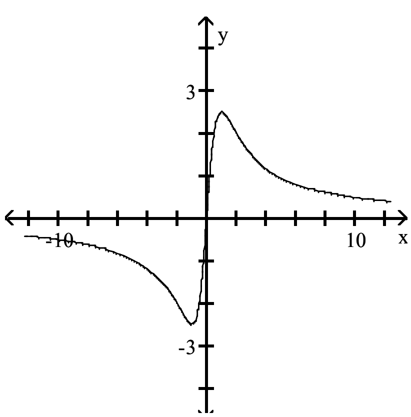
37) $f(x) = \dfrac{5x}{x^2 + 1}$



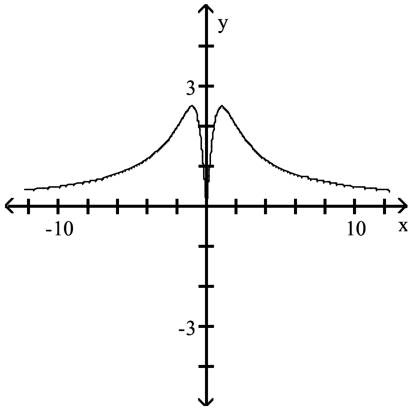
A)



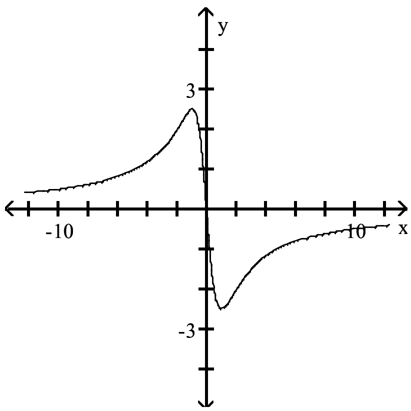
B)



C)

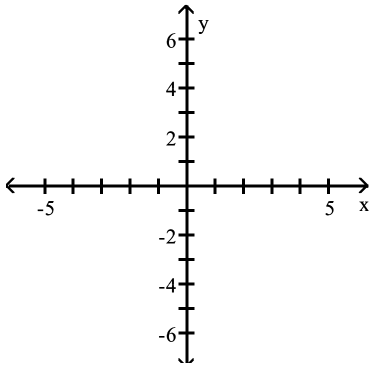


D)

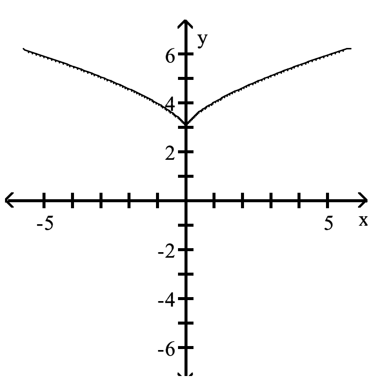


Answer: B

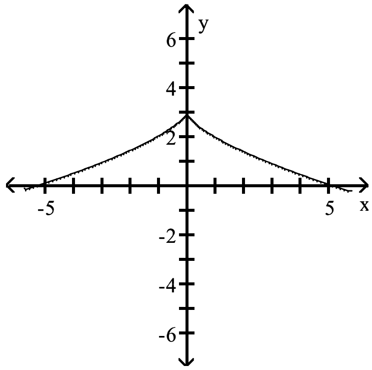
38) $f(x) = x^{2/3} + 3$



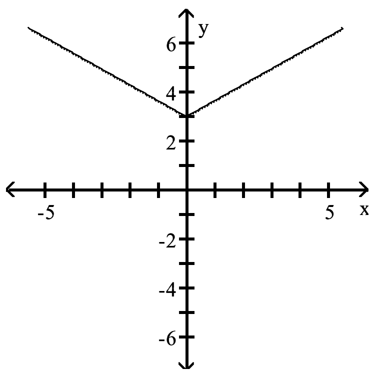
A)



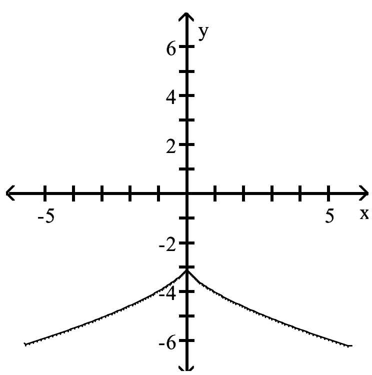
B)



C)

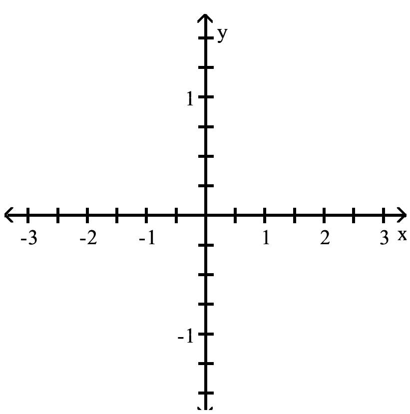


D)

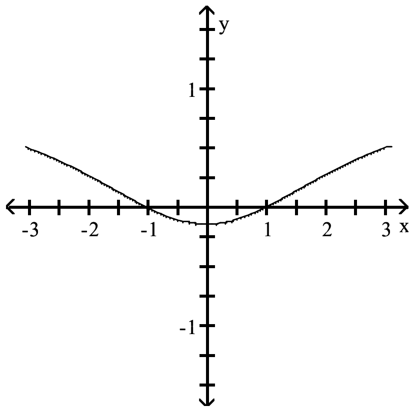


Answer: A

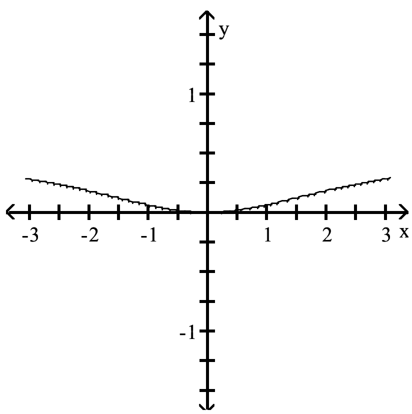
39) $f(x) = \dfrac{x^2}{x^2 + 7}$



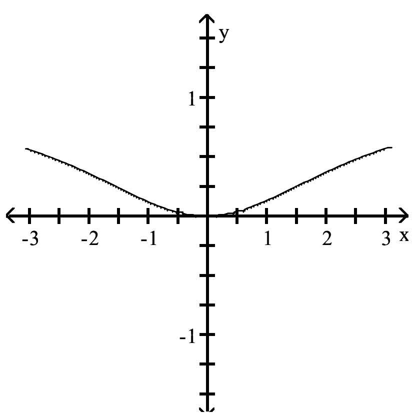
A)



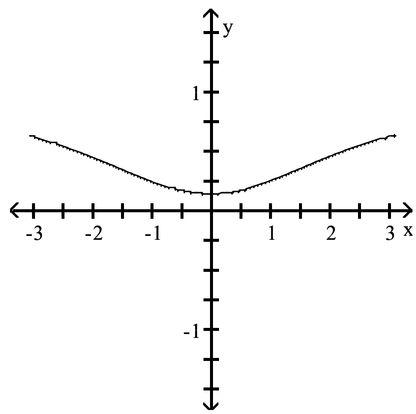
B)



C)



D)

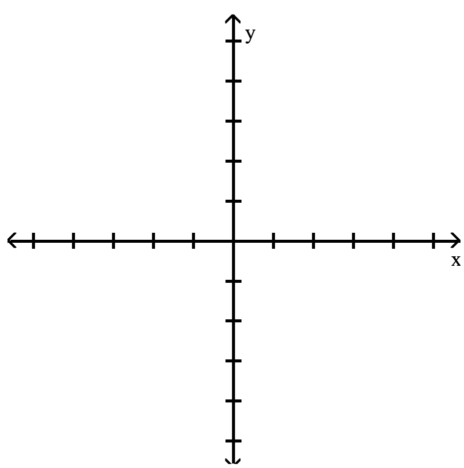


Answer: C

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

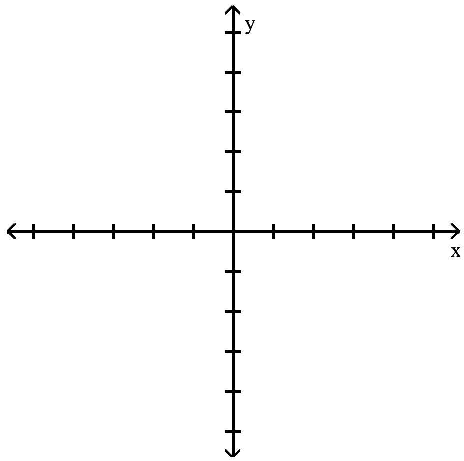
Draw a graph to match the description. Answers will vary.

40) f(x) is decreasing over $(-\infty, 2]$ and increasing over $[2, \infty)$.



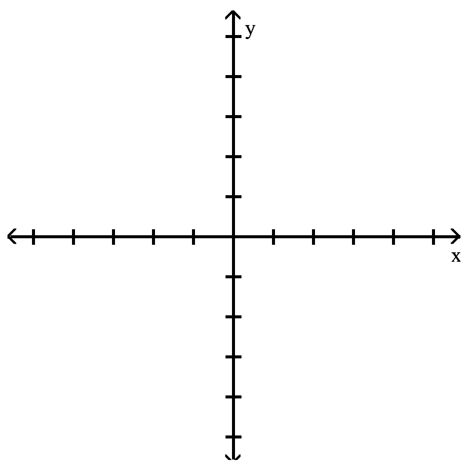
Answer: Answers will vary.

41) g(x) is increasing over (-∞, –2] and decreasing over [–2, ∞).



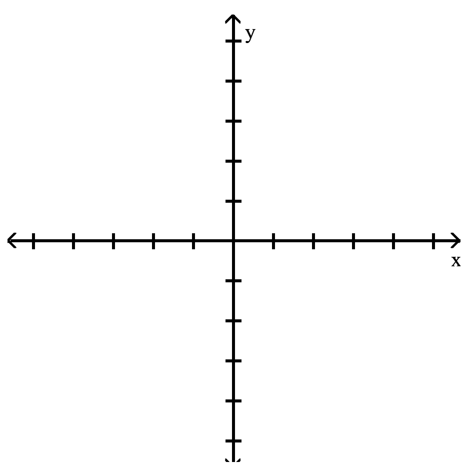
Answer: Answers will vary.

42) f(x) has a positive derivative over (-∞, 6) and a negative derivative over (6, ∞).



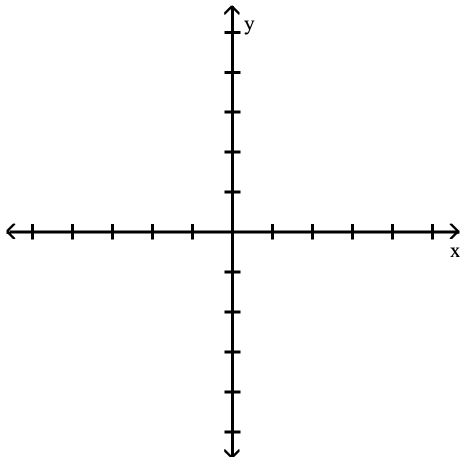
Answer: Answers will vary.

43) f(x) has a negative derivative over (-∞, –3) and a positive derivative over (–3, ∞).



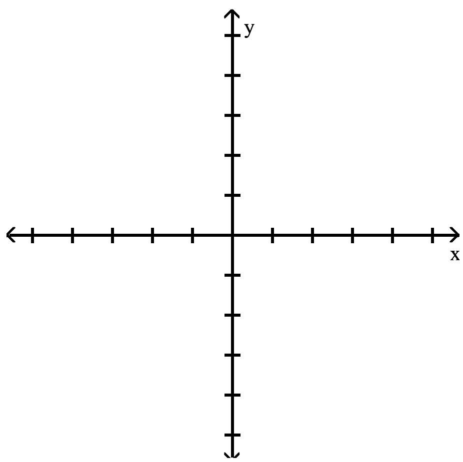
Answer: Answers will vary.

44) G(x) is decreasing over (-∞, –2] and [6, ∞) and increasing over [–2, 6]



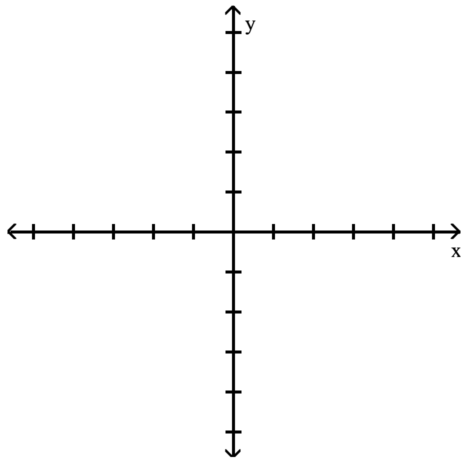
Answer: Answers will vary.

45) f(x) is increasing over (-∞, –5] and [–3, ∞) and decreasing over [–5, –3].



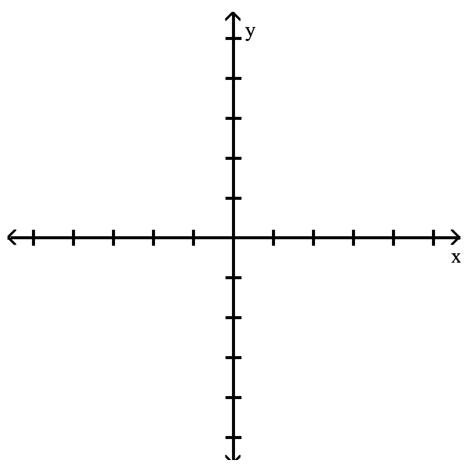
Answer: Answers will vary.

46) g(x) has a negative derivative over $(-\infty, -5)$ and $(2, 5)$ and a positive derivative over $(-5, 2)$ and $(5, \infty)$.



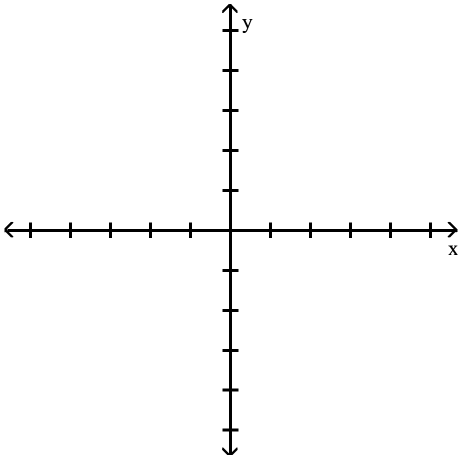
Answer: Answers will vary.

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



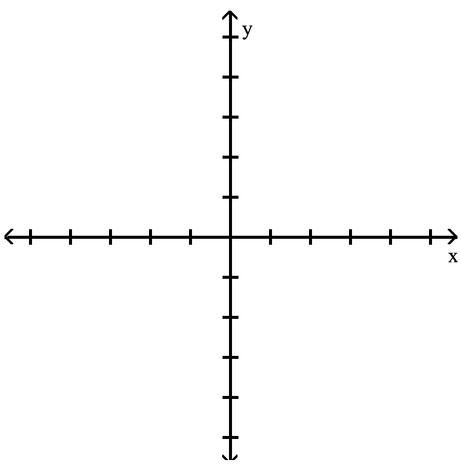
Answer: Answers will vary.

48) F(x) has a positive derivative over $(-\infty, -6)$ and $(-6, 2)$ and a negative derivative over $(2, \infty)$, and a derivative equal to 0 at $x = -6$.



Answer: Answers will vary.

49) f(x) has a positive derivative over $(-\infty, -7)$ and a negative derivative over $(-7, -2)$ and $(-2, \infty)$, and a derivative equal to 0 at $x = -2$.



Answer: Answers will vary.

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

Solve the problem.

50) A firm estimates that it will sell N units of a product after spending x dollars on advertising, where

$N(x) = -x^2 + 50x + 8, \quad 0 \le x \le 50,$

and x is in thousands of dollars. Find the relative extrema of the function.

A) relative maximum at (25, 633)
B) relative maximum at (25, 1883)
C) relative minimum at (25, 1883)
D) relative minimum at (25, 633)

Answer: A

51) 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.

A) relative minimum at (7, 103.5)
B) relative maximum at (7, 103.5)
C) relative minimum at (7, 102.5)
D) relative maximum at (7, 104.5)

Answer: B

52) 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 approximated by the function

$h = -0.002d^2 + 0.7d + 6.7.$

Find the relative maximum of the function.

A) relative maximum at (175, 61.25)
B) relative maximum at (350, 129.2)
C) relative maximum at (0, 6.7)
D) relative maximum at (175, 67.95)

Answer: D

Use a graphing calculator to find the approximate location of all relative extrema.

53) $f(x) = 0.1x^3 - 15x^2 + 27x - 82$

A) Relative minimum at x = –99.092; relative maximum at x = –0.908
B) Relative minimum at x = 0.908; relative maximum at x = 99.092
C) Relative maximum at x = –99.092; relative minimum at x = –0.908
D) Relative maximum at x = 0.908; relative minimum at x = 99.092

Answer: D

54) $f(x) = 0.1x^4 - x^3 - 15x^2 + 59x + 14$

A) Relative maximum at x = 1.702; relative minima at x = –6.681 and x = 12.491
B) Relative maximum at x = 1.735; relative minima at x = –6.777 and x = 12.542
C) Relative maximum at x = 1.792; relative minima at x = –6.694 and x = 12.455
D) Relative maximum at x = 1.764; relative minima at x = –6.783 and x = 12.64

Answer: B

55) $f(x) = x^4 - 3x^3 - 21x^2 + 74x + 79$

A) Relative maximum at x = 1.668; Relative minima at x = –3.169 and x = 3.82
B) Relative maximum at x = 1.535; Relative minima at x = –3.013 and x = 3.776
C) Relative maximum at x = 1.604; Relative minima at x = –3.089 and x = 3.735
D) Relative maximum at x = 1.56; Relative minima at x = –3.011 and x = 3.816

Answer: C

56) $f(x) = x^4 - 4x^3 - 53x^2 - 86x + 72$

A) Relative maximum at x = –0.944; relative minima at x = –3.192 and x = 7.136
B) Relative maximum at x = 0.894; relative minima at x = –3.193 and x = 7.212
C) Relative maximum at x = 0.957; relative minima at x = –3.114 and x = 7.213
D) Relative maximum at x = 0.923; relative minima at x = –3.161 and x = 7.046

Answer: A

57) $f(x) = x^5 - 15x^4 - 3x^3 - 172x^2 + 135x + 0.058$

A) Relative maximum at x = 0.34; relative minimum at x = –12.64

B) Relative maximum at x= 0.379; relative minimum at x = 12.565

C) Relative maximum at x = 0.474; relative minima at x = –0.474and x = –12.593

D) Relative maximum at x = 0.379; relative minima at x = –0.472 and x = 12.565

Answer: B

58) $f(x) = 0.1x^5 + 5x^4 - 8x^3 - 15x^2 - 6x - 46$

A) Relative maxima at x = –41.212 and x = –0.219; relative minima at x = –0.593 and x = 2.006

B) Relative maxima at x = –41.132 and x = –0.273; relative minima at x = –0.547 and x = 1.952

C) Relative maxima at x = –41.036 and x = –0.193; relative minima at x = –0.61 and x= 2.015

D) Relative maxima at x = –41.159 and x = –0.186; relative minima at x = –0.548 and x = 1.979

Answer: B

59) $f(x) = 0.01x^5 - x^4 + x^3 + 8x^2 - 7x + 61$

A) Relative maxima at x = –1.927 and x = 2.267; relative minima at x = 0.514 and x = 79.212

B) Relative maxima at x = –1.841 and x = 2.304; relative minima at x = 0.363 and x = 79.172

C) Relative maxima at x = –1.861 and x = 2.247; relative minimum at x = 0.423

D) Relative maxima at x = –1.861 and x = 2.247; relative minima at x = 0.423 and x = 79.192

Answer: D

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

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

A) Relative minima: $(-\sqrt{5}, 0)$, $(\sqrt{5}, 0)$

B) Relative maximum: (0, 5)

C) Relative minimum: (0, 5)

D) Relative maximum: $(5, \sqrt{5})$

Answer: B

61) $f(x) = 4x^2 - 16x + 17$

A) Relative minimum: (1, 2)

B) Relative minimum: (2, 1)

C) Relative maximum: (–2, –1)

D) Relative minimum: (–1, –2)

Answer: B

62) $s(x) = -x^2 - 14x + 32$

A) Relative maximum: (–14, 32)

B) Relative maximum: (–7, 81)

C) Relative minimum: (14, 32)

D) Relative maximum: (7, 81)

Answer: B

63) $f(x) = x^2 + 7x - 6$

A) Relative maximum: $\left(-\frac{7}{2}, -\frac{73}{4}\right)$

B) Relative minimum: $\left(-\frac{7}{2}, -\frac{73}{4}\right)$

C) Relative maximum: $\left(\frac{7}{2}, \frac{73}{4}\right)$

D) Relative minimum: $\left(\frac{7}{2}, -\frac{25}{4}\right)$

Answer: B

64) $f(x) = -7x^2 - 2x - 2$

A) Relative maximum: $\left(-\frac{1}{7}, -\frac{13}{7}\right)$

B) Relative maximum: $\left(\frac{1}{7}, \frac{13}{7}\right)$

C) Relative maximum: $\left(-7, -\frac{13}{7}\right)$

D) Relative minimum: $\left(\frac{1}{7}, \frac{13}{7}\right)$

Answer: A

65) $y = x^3 - 3x^2 + 5x - 6$

A) Relative maximum: (2, 2)
B) Relative maximum: (–1, 2)
C) Relative minimum: (1, 2)
D) No relative extrema exist

Answer: D

66) $f(x) = x^3 - 12x - 4$

A) Relative minimum: (–2, 12); relative maximum: (2, –20)
B) Relative maximum: (5, 61); relative minimum: (2, –20)
C) Relative maximum: (5, 61); relative minimum: (–3, 5)
D) Relative maximum: (–2, 12); relative minimum: (2, –20)

Answer: D

67) $f(x) = x^3 - 6x^2 + 5$

A) Relative maximum: (0, 5)
B) Relative maximum: (–2, 37); relative minimum (2, –11)
C) Relative minimum: (0, 5); relative maximum: (4, –11)
D) Relative maximum: (0, 5); relative minimum (4, –27)

Answer: D

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

A) Relative minimum: (0, −2)

B) Relative maximum: (−1, 6); relative minimum: (1, 0)

C) Relative minimum: (0, −2); relative maximum: (2, 2)

D) Relative maximum: (0, −2); relative minimum: (2, 2)

Answer: C

69) $f(x) = 2x^3 - 6x^2 - 48x - 3$

A) Relative minimum: $\left(1, -59\right)$

B) Relative minimum: $\left(-2, \frac{53}{6}\right)$, relative maximum: $\left(4, -\frac{163}{6}\right)$

C) Relative maximum: $\left(-1, 41\right)$

D) Relative maximum: $\left(-2, \frac{53}{6}\right)$, relative minimum: $\left(4, -\frac{163}{6}\right)$

Answer: D

70) $f(x) = x^4 - 32x^2 - 3$

A) Relative maximum: (0, −3); relative minimum: (4, −259)

B) Relative minimum: (0, −3); relative maxima: (4, −259), (−4, −253)

C) Relative maximum: (4, −259); relative minimum: (−4, −259)

D) Relative maximum: (0, −3); relative minima: (4, −259), (−4, −259)

Answer: D

71) $f(x) = x^3 - 4x^4$

A) Relative minimum: $\left(-\frac{3}{16}, -\frac{135}{16384}\right)$; relative maximum: (0, 0)

B) Relative maximum: $\left(\frac{3}{16}, \frac{27}{16384}\right)$; relative minimum: (0, 0)

C) Relative maximum: $\left(\frac{3}{16}, \frac{27}{16384}\right)$

D) Relative maximum: (0,0); relative minima: $\left(-\frac{3}{16}, -\frac{135}{16384}\right)$ and $\left(\frac{3}{16}, \frac{27}{16384}\right)$

Answer: C

72) $f(x) = (x - 5)^{2/3}$

A) Relative minimum: (−5, 0)

B) Relative minimum: (5, 0)

C) Relative maximum: (−5, 0)

D) There are no relative extrema.

Answer: B

73) $f(x) = (x - 6)^{1/3}$

A) Relative maximum at (6, 0)

B) Relative minimum at (6, 0)

C) Relative minimum at (−6, 0)

D) No relative extrema exist

Answer: D

74) $f(x) = (x + 4)^4$

A) Relative maximum: (–4, 0)
B) Relative minimum: (–4, 0)
C) Relative maximum: (4, 0)
D) No relative extrema exist

Answer: B

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

A) Relative maximum: (0,0), relative minimum: $\left(2, 16\right)$
B) Relative maximum: (0,0), relative minimum: $\left(2, 16\right)$, relative maximum: (4, 0)
C) Relative minimum: (0,0), relative maximum: $\left(2, 16\right)$, relative minimum: (4, 0)
D) Relative minimum: (0,0), relative minimum: (4, 0)

Answer: C

76) $f(x) = 45x^3 - 3x^5$

A) Relative minimum: (–3, –486), relative maximum: (3, 486)
B) Relative minimum: (–3, –486), relative maximum at (0,0)
C) Relative maximum at (0,0), relative minimum: (3, 486)
D) Relative minimum: (–3, –486), relative minimum at (0,0), relative maximum: (3, 486)

Answer: A

77) $f(x) = \dfrac{5}{x^2 + 1}$

A) No relative extrema
B) Relative maximum: (–1, 5)
C) Relative maximum: (0, 5)
D) Relative maximum: (0, –5)

Answer: C

78) $f(x) = \dfrac{3x}{x^2 + 1}$

A) Relative minimum: $\left(-1, -\dfrac{3}{2}\right)$, relative maximum: $\left(1, \dfrac{3}{2}\right)$
B) Relative minimum: (0, 0)
C) Relative minimum: (1, 0), relative maximum: (–1, 0)
D) Relative maximum: (0, 0)

Answer: A

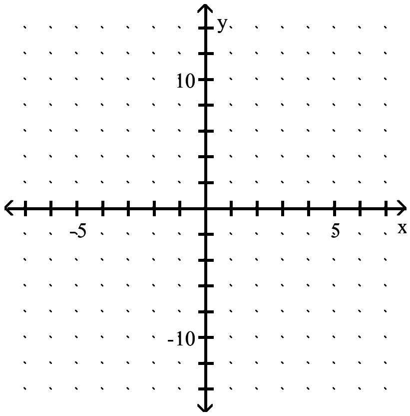
79) $f(x) = x\sqrt{16 - x^2}$

A) Relative maximum: $\left(-\sqrt{8}, -8\right)$, relative minimum: $\left(\sqrt{8}, 8\right)$
B) Relative maximum: $\left(\sqrt{8}, 8\right)$
C) Relative minimum: $\left(-\sqrt{8}, -8\right)$, relative maximum: $\left(\sqrt{8}, 8\right)$
D) Relative minimum: (0,0)

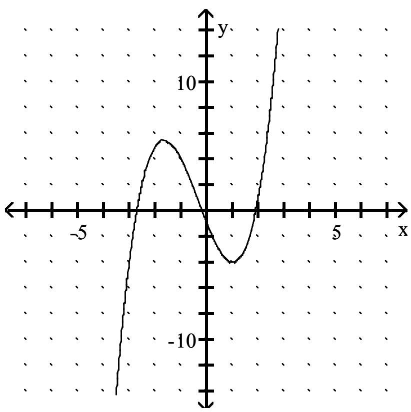
Answer: C

Graph the function.

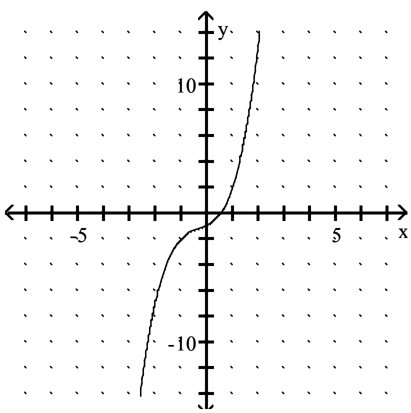
80) $f(x) = x^3 + x^2 - 5x - 1$



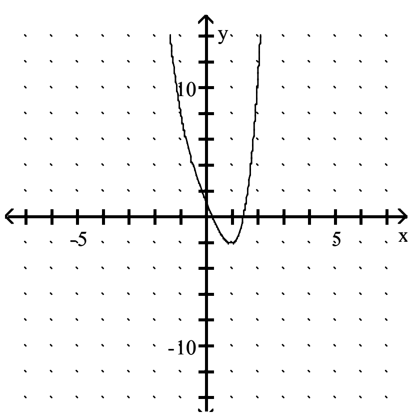
A)



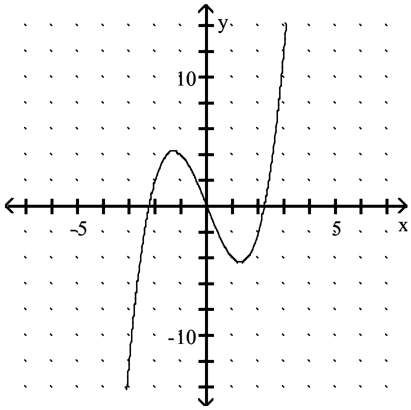
B)



C)

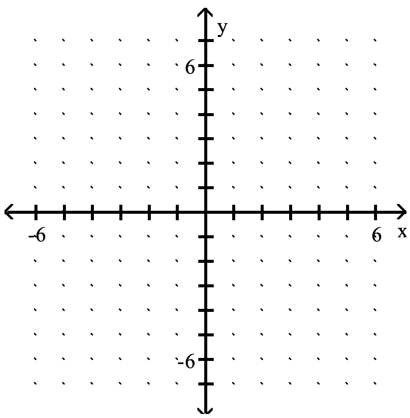


D)

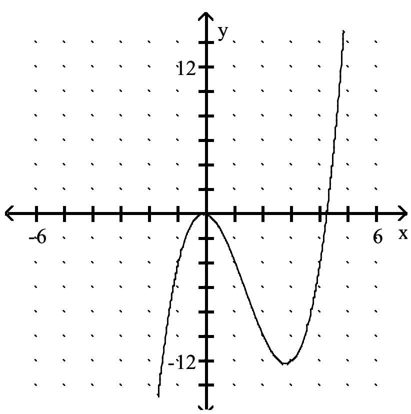


Answer: A

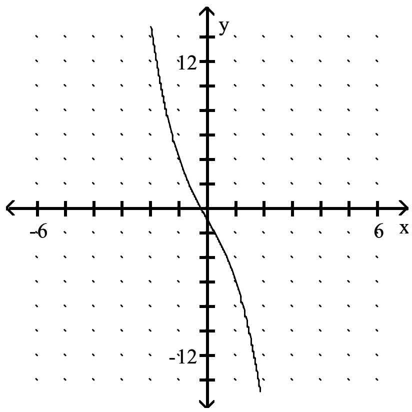
81) $f(x) = -x^3 - 4x - 1$



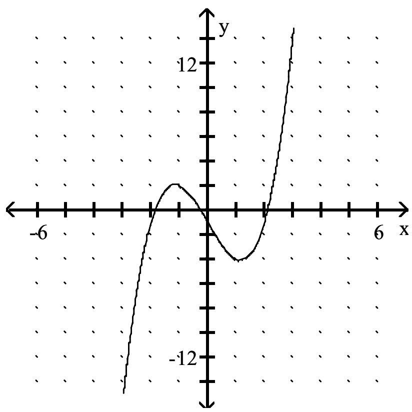
A)



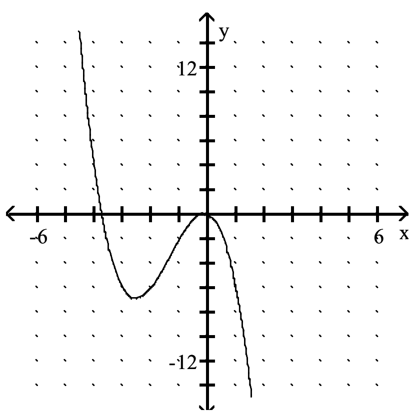
B)



C)

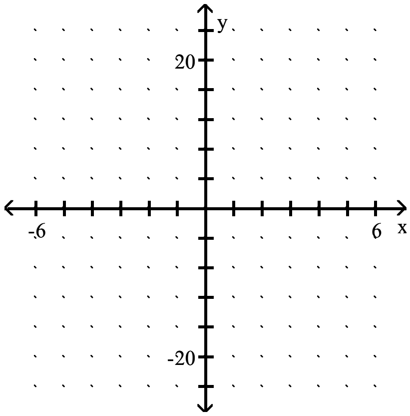


D)

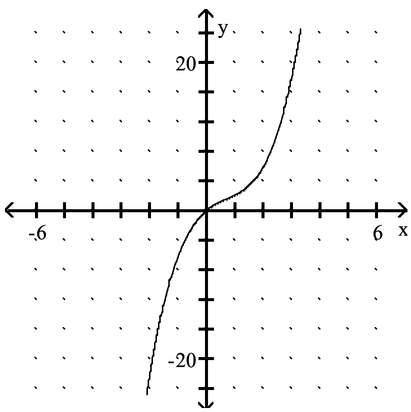


Answer: B

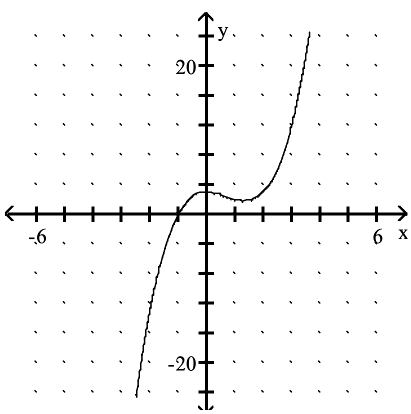
82) $f(x) = -x^3 - 2x^2 + 3$



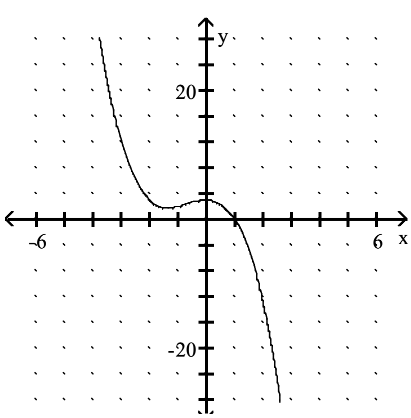
A)



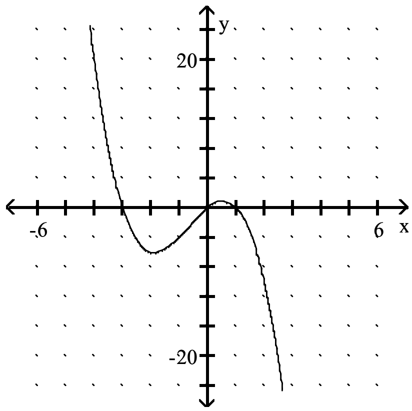
B)



C)

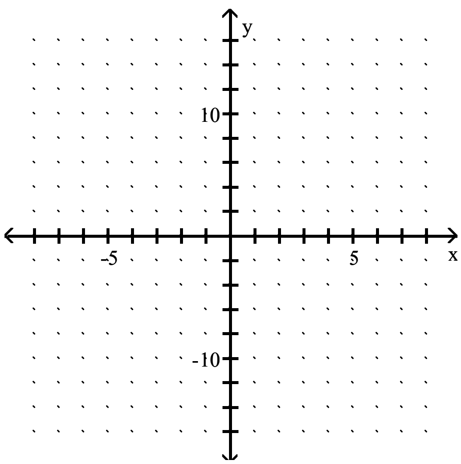


D)

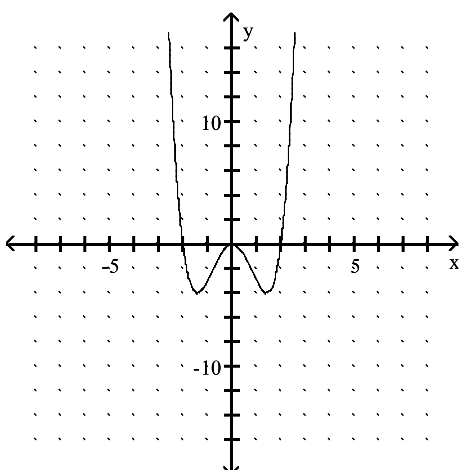


Answer: C

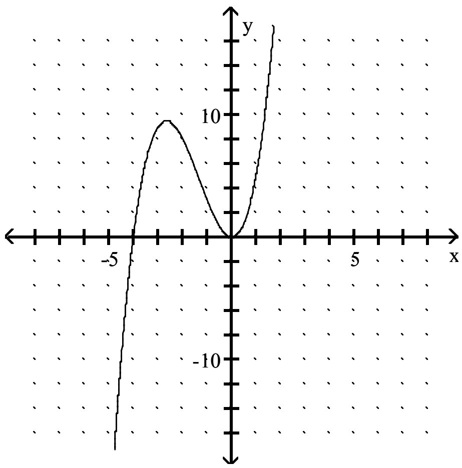
83) $f(x) = x^3 - 4x^2$



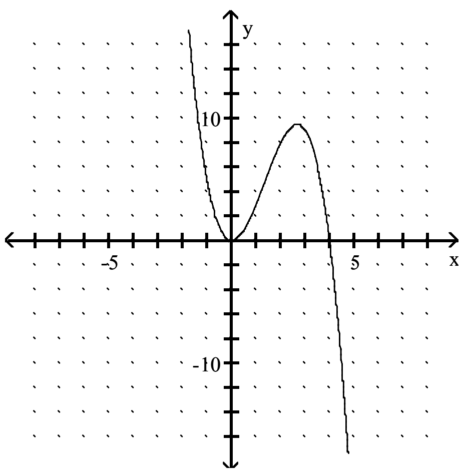
A)



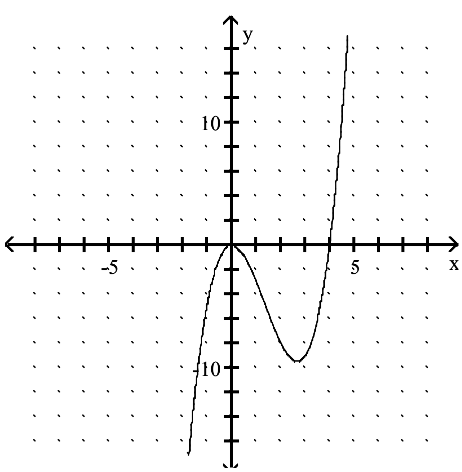
B)



C)

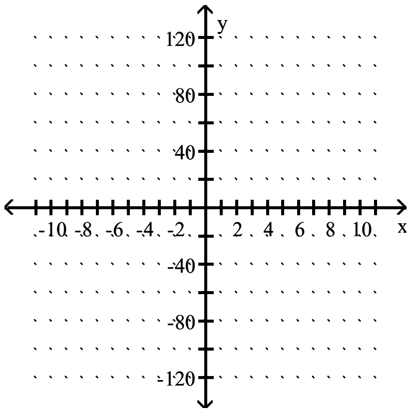


D)

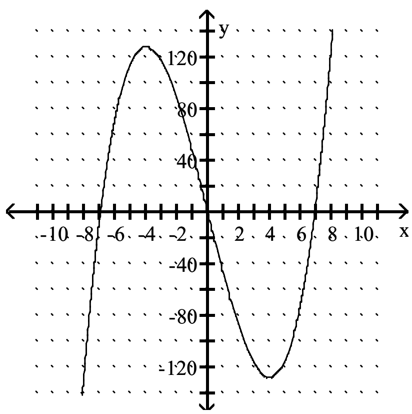


Answer: D

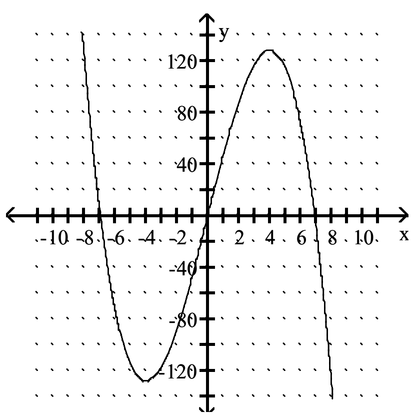
84) $f(x) = x^3 - 48x$



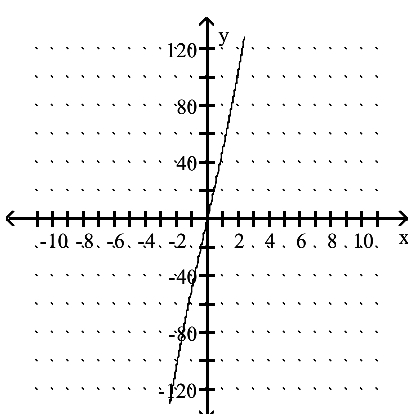
A)



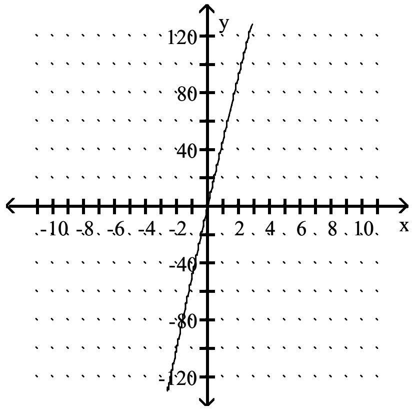
B)



C)

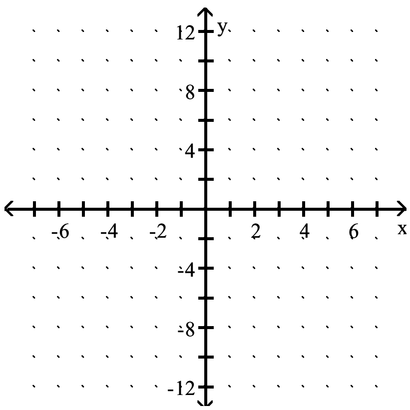


D)

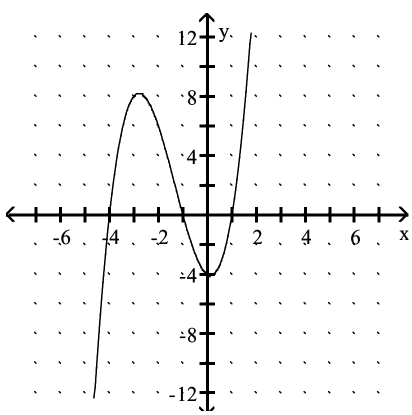


Answer: A

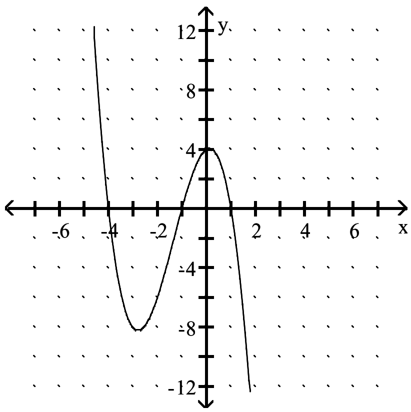
85) $f(x) = x^3 + 4x^2 - x - 4$



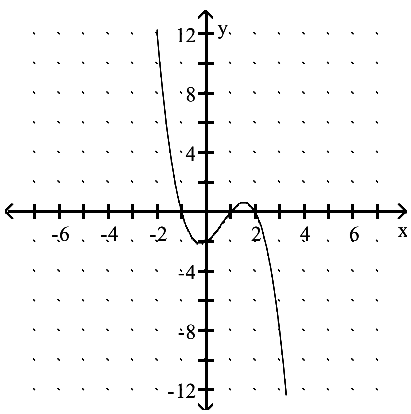
A)



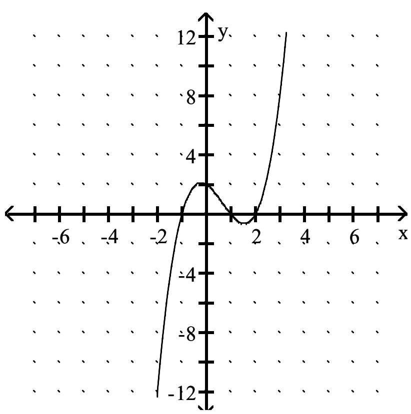
B)



C)

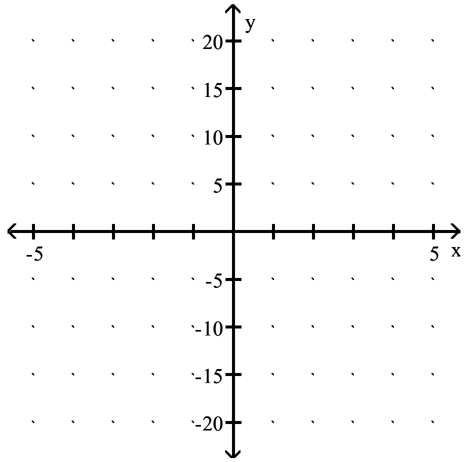


D)

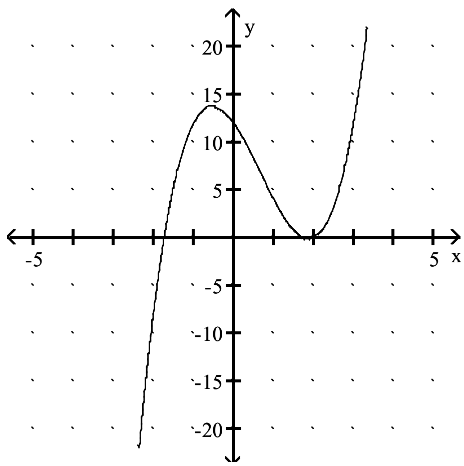


Answer: A

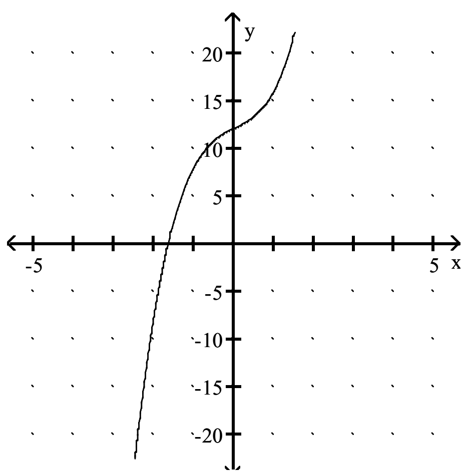
86) $f(x) = 2x^3 - 4x^2 - 6x + 12$



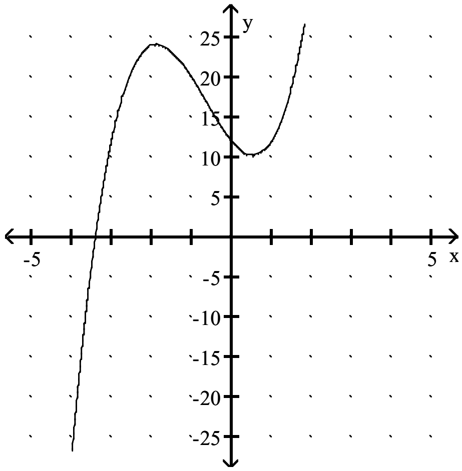
A)



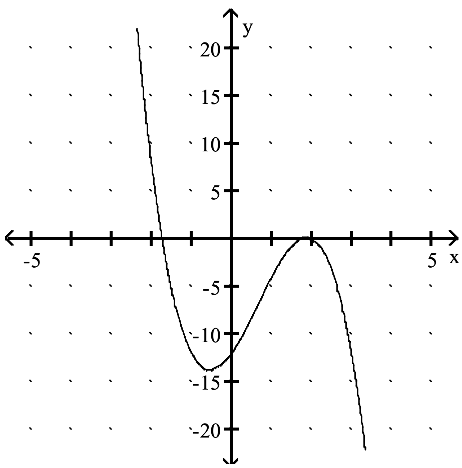
B)



C)

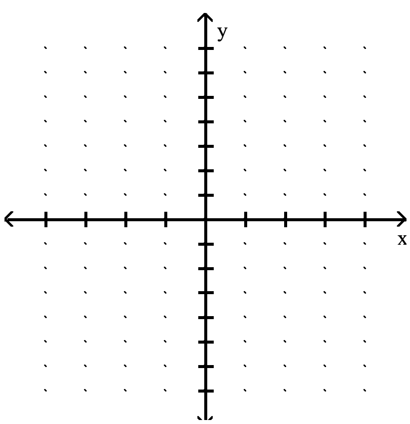


D)

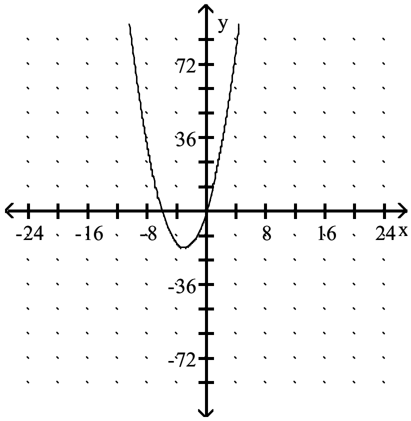


Answer: A

87) $h(x) = 2x^3 + 3x^2 - 12x$

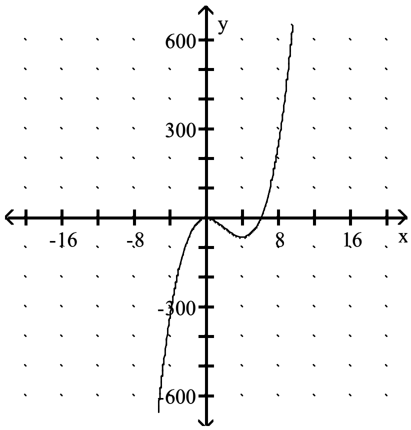


A)



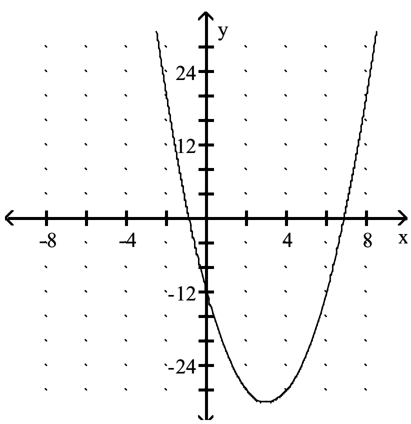
y
72
36
-24
-16
-8
8
16
24
x
-36
-72

B)



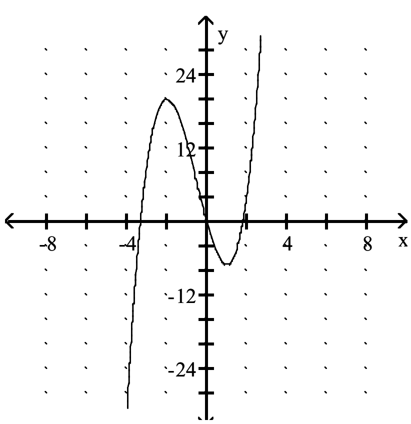
y
600
300
-16
-8
8
16
x
-300
-600

C)



y
24
12
-8
-4
4
8
x
-12
-24

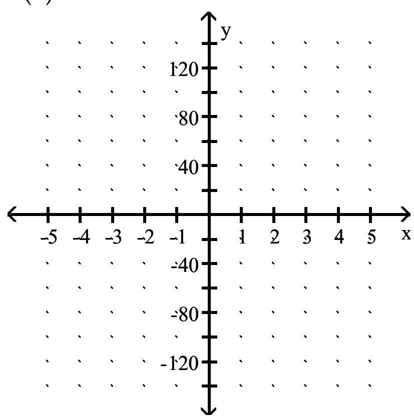
D)



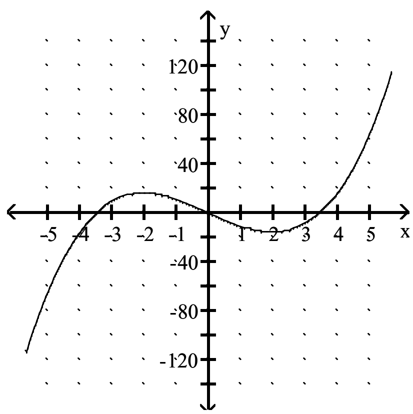
y
24
12
-8
-4
4
8
x
-12
-24

Answer: D

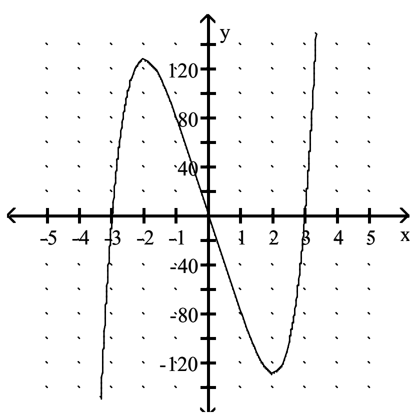
88) $h(x) = x^5 - 80x$



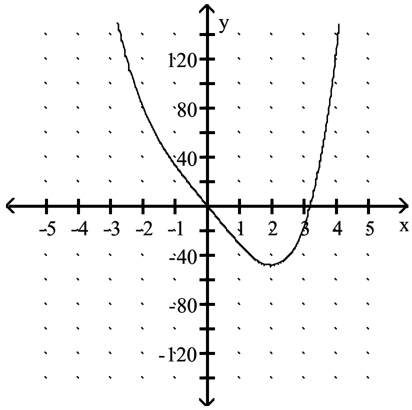
A)



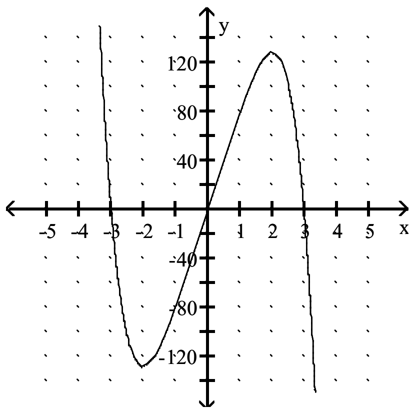
B)



C)

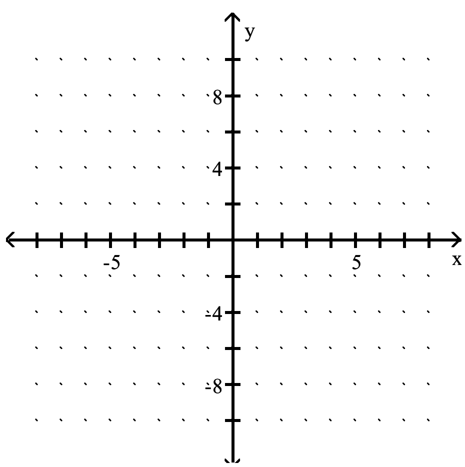


D)

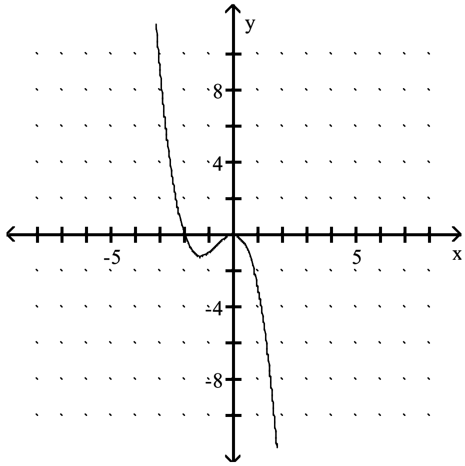


Answer: B

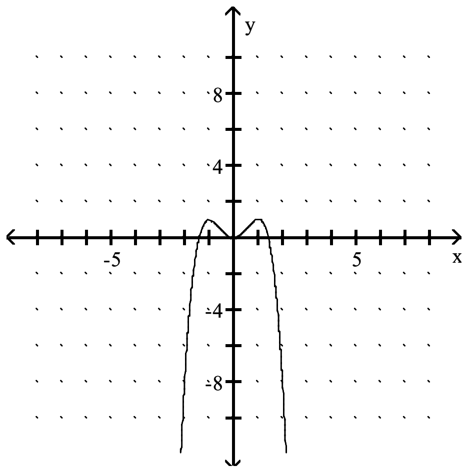
89) $f(x) = -x^4 - 2x^2$



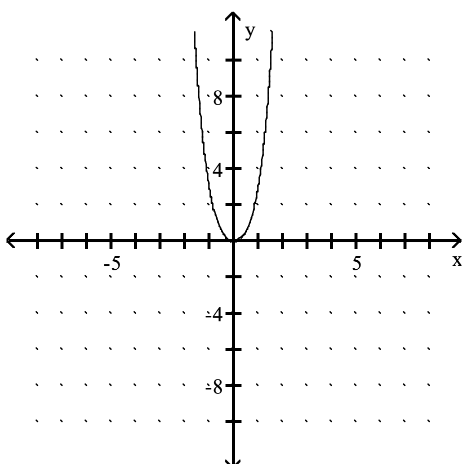
A)



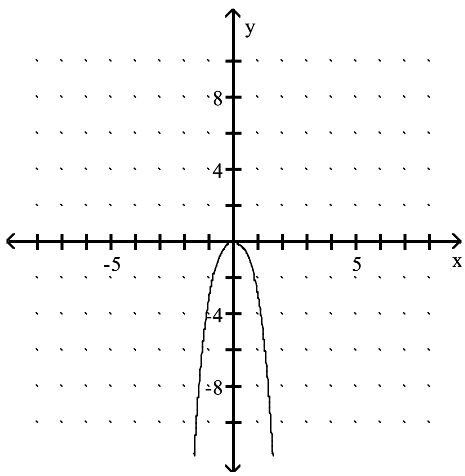
B)



C)

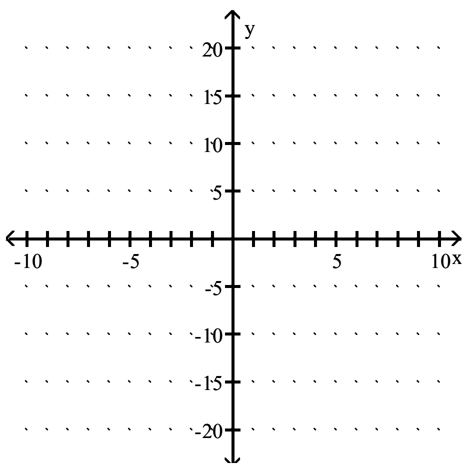


D)

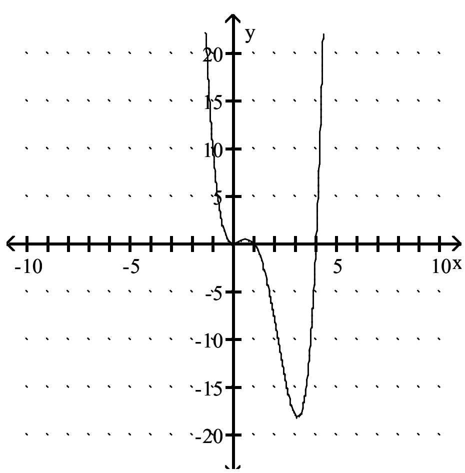


Answer: D

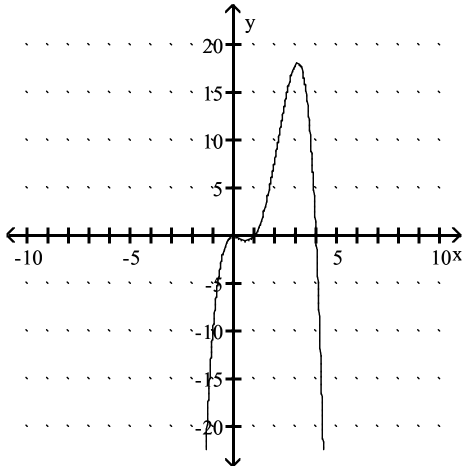
90) $f(x) = x^4 - 5x^3 + 4x^2$



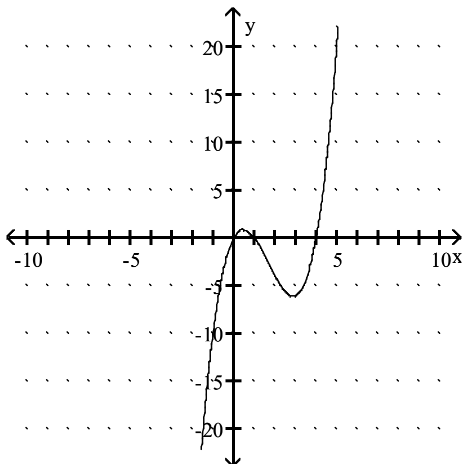
A)



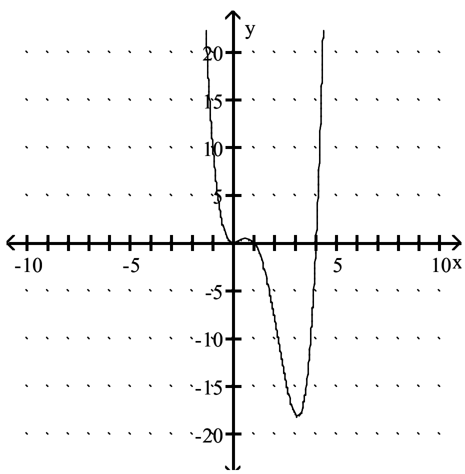
B)


y
20
15
10
5
-10
-5
5
10
x
-5
-10
-15
-20

C)

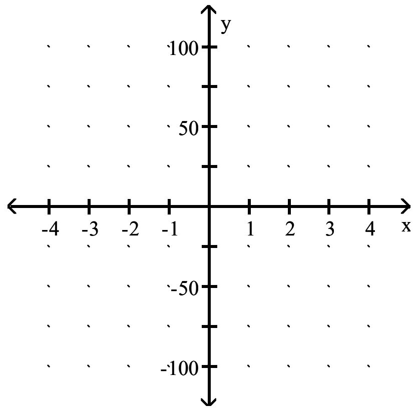

y
20
15
10
5
-10
-5
5
10
x
-5
-10
-15
-20

D)

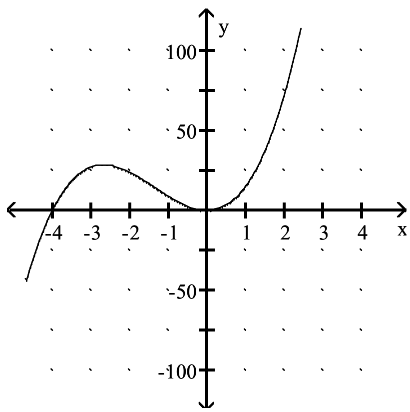

y
20
15
10
5
-10
-5
5
10
x
-5
-10
-15
-20

Answer: D

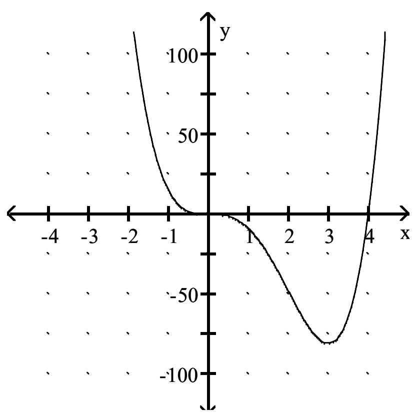
91) $g(x) = 3x^4 - 12x^3$



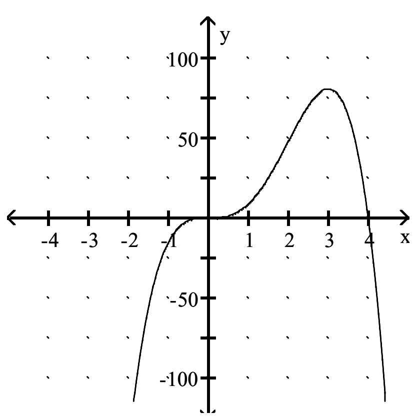
A)



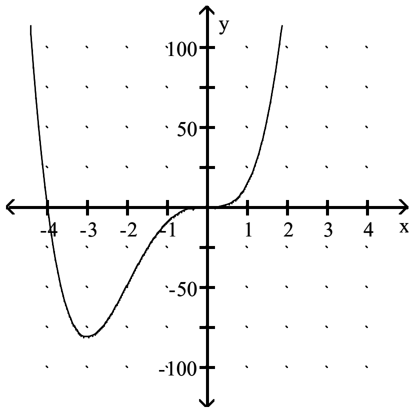
B)



C)

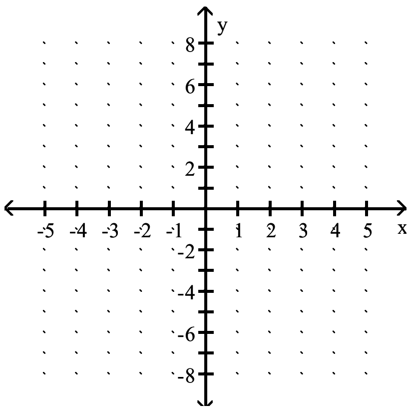


D)

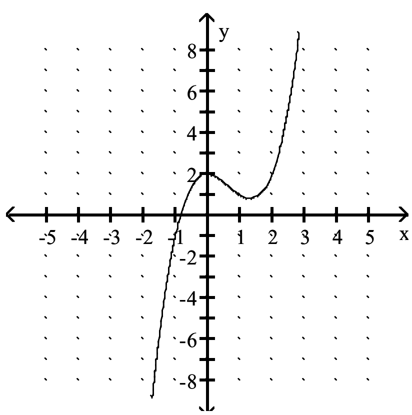


Answer: B

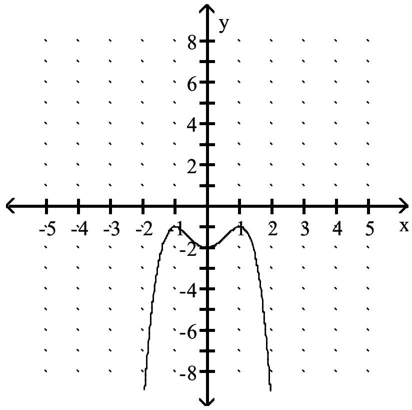
92) $h(x) = x^4 - 2x^2 + 2$



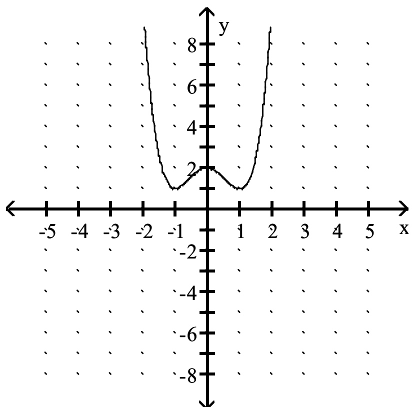
A)



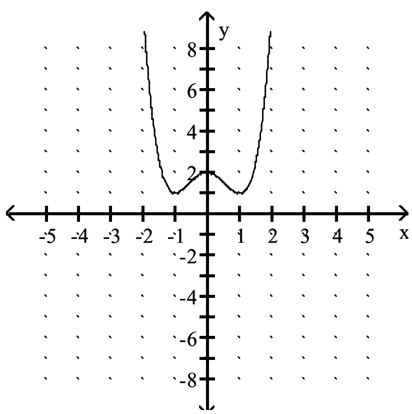
B)


y
8
6
4
2
-5 -4 -3 -2 -1 1 2 3 4 5 x
-2
-4
-6
-8

C)

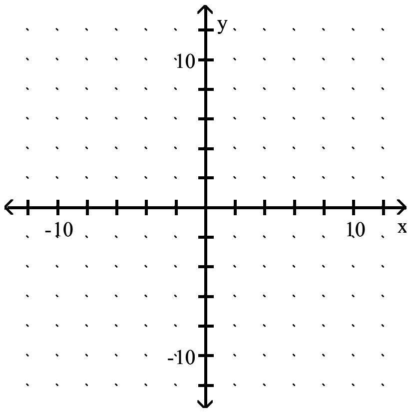

y
8
6
4
2
-5 -4 -3 -2 -1 1 2 3 4 5 x
-2
-4
-6
-8

D)

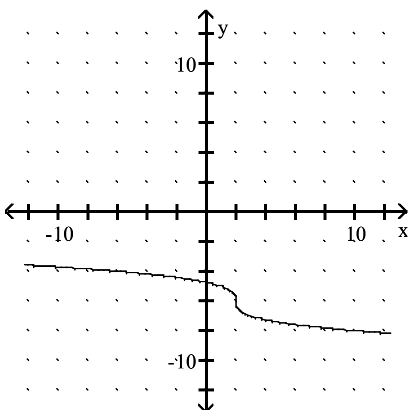

y
8
6
4
2
-5 -4 -3 -2 -1 1 2 3 4 5 x
-2
-4
-6
-8

Answer: C

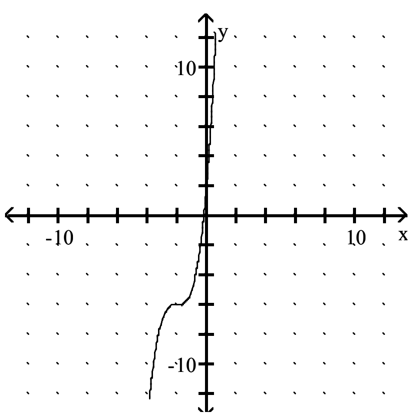
93) $f(x) = (x + 2)^{1/3} - 6$



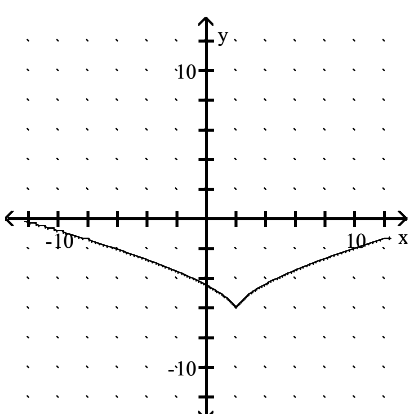
A)



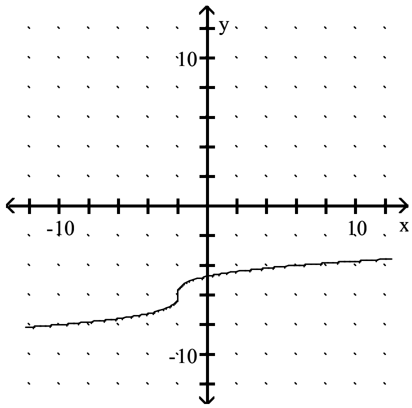
B)



C)

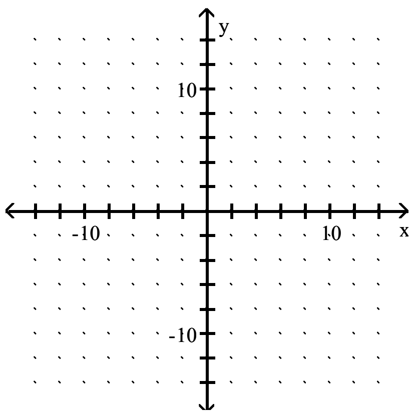


D)

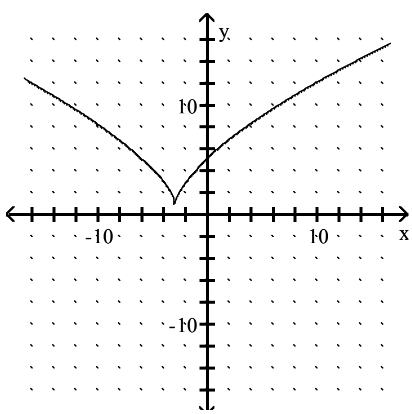


Answer: D

94) $f(x) = -2(x + 3)^{2/3} + 1$



A)



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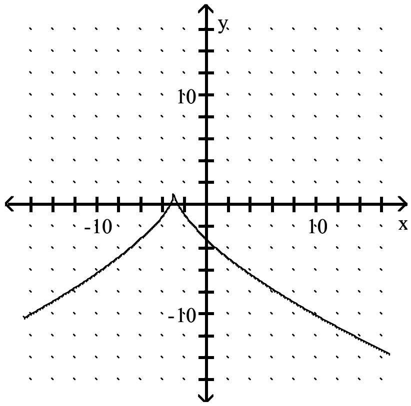
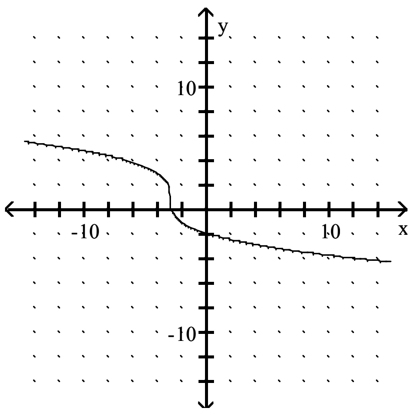
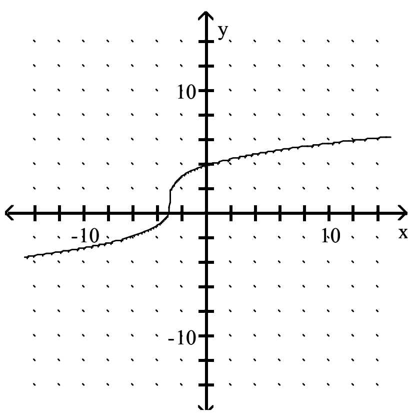


C)

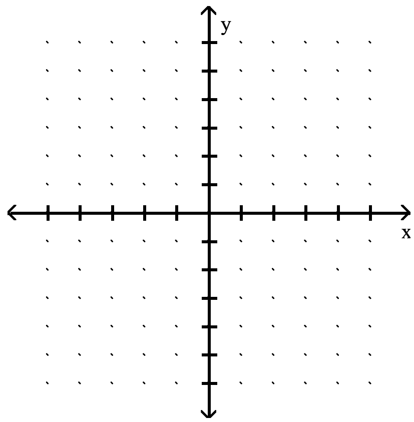


D)

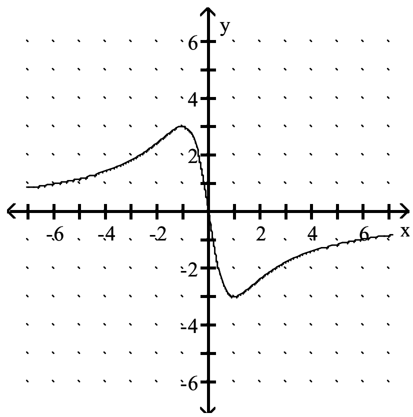


Answer: B

95) $g(x) = \dfrac{6x}{x^2 + 1}$



A)



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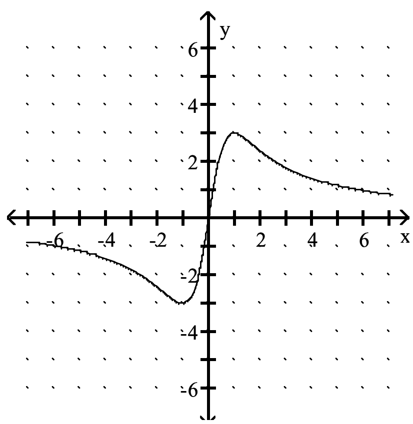
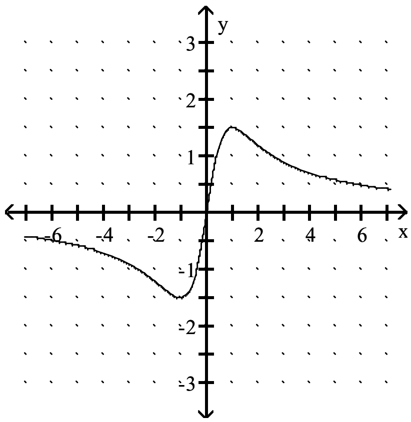
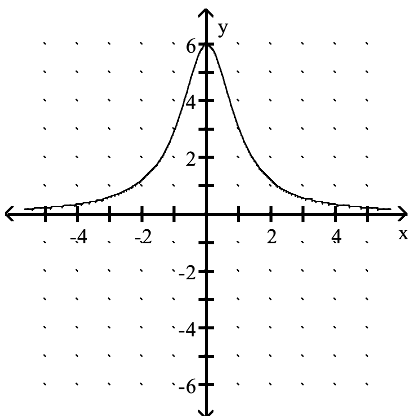


C)

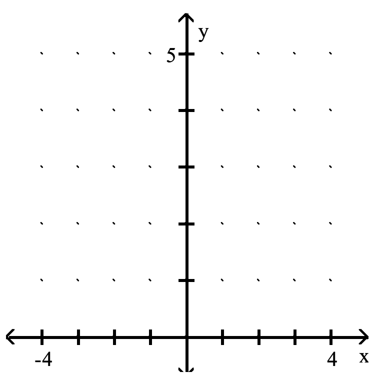


D)

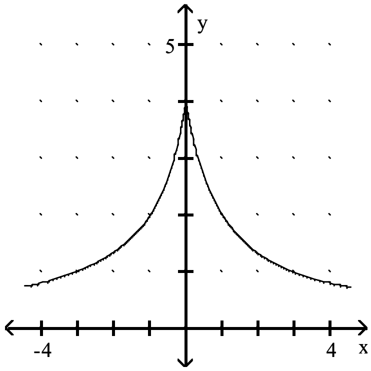


Answer: B

96) $f(x) = \dfrac{4}{x^2 + 1}$



A)



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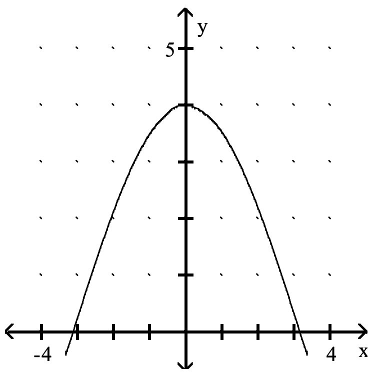

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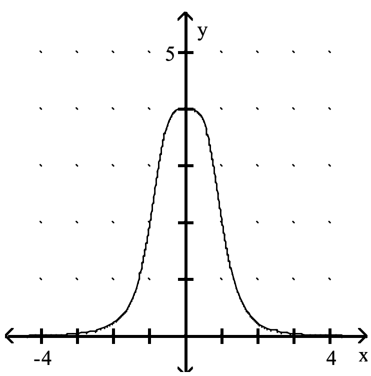
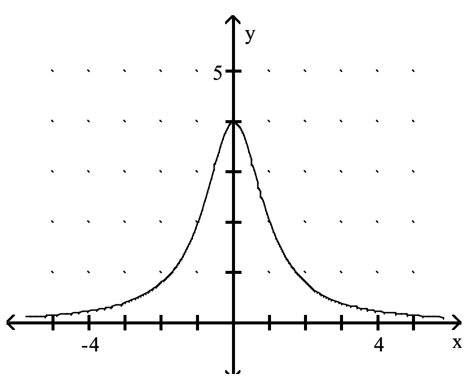
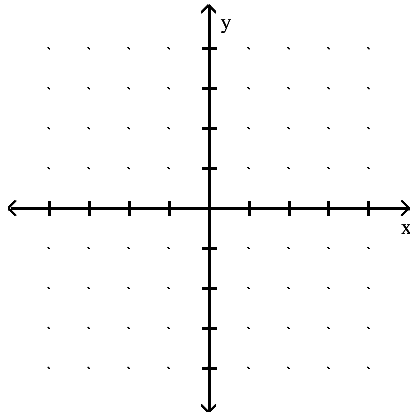


D)

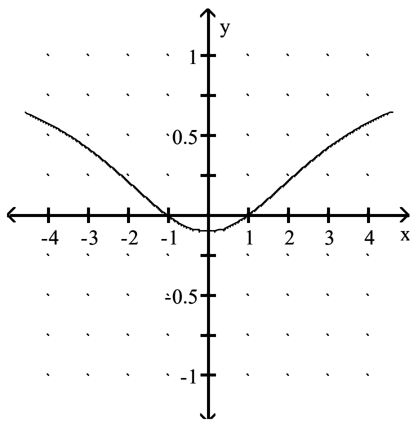


Answer: D

97) $F(x) = \frac{x^2}{x^2 + 10}$



A)



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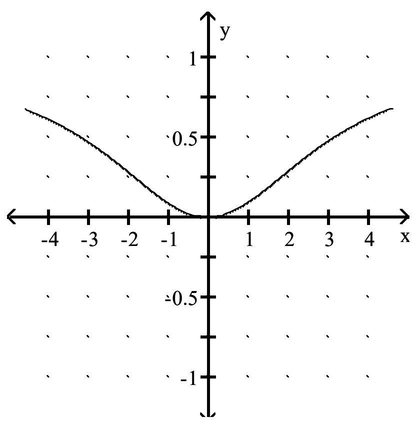
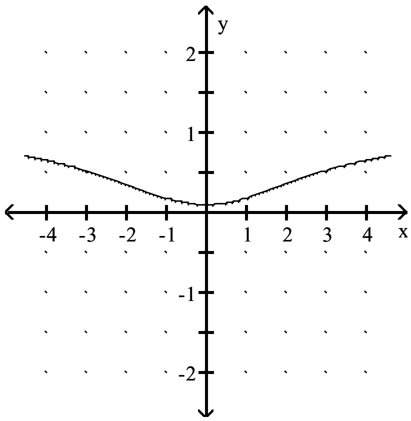
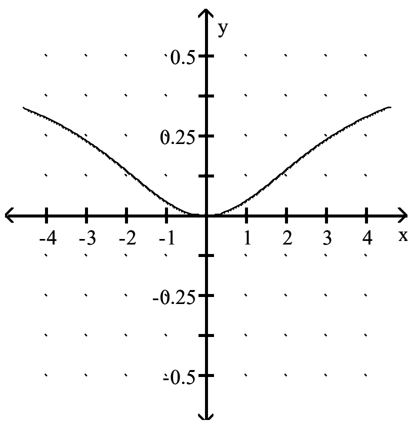


C)



D)



Answer: B

Find the points of inflection.

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

A) (0, 2)

B) (7, 0)

C) (0, 7)

D) (2, 0)

Answer: C

99) $f(x) = x^3 + 7x + 1$

A) (1, 7)

B) (0, 7)

C) (0, 1)

D) (1, 0)

Answer: C

100) $f(x) = -x^3 + 9x + 3$

A) (3, −3)

B) (−3, 9)

C) (0, 9)

D) (0, 3)

Answer: D

101) $f(x) = 7x - x^3$

A) (0, 0)
B) (1, 7)
C) (0, 0), (1, 7)
D) No points of inflection exist

Answer: A

102) $f(x) = x^3 - 12x^2 + 2x + 15$

A) (4, −252)
B) (4, −105)
C) (4, −46)
D) (−4, −48)

Answer: B

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

A) (1, 8)
B) (−1, −21)
C) (−1, 0)
D) (−1, 3)

Answer: B

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

A) (3, 0)
B) (3, 33)
C) (3, −17)
D) (−3, 75)

Answer: B

105) $f(x) = 2x^3 - 9x^2 + 12x$

A) $\left(0,0\right)$
B) $\left(0, 0\right)$
C) $\left(\frac{3}{2}, \frac{9}{2}\right)$
D) No points of inflection exist

Answer: C

106) $f(x) = \frac{4}{3}x^3 - 12x^2 + 10x + 45$

A) (3, −26)
B) (3, 0)
C) (3, 3)
D) (0, 3)

Answer: C

107) $f(x) = x^4 - 24x^2$

A) (−2, −80), (2, −80)
B) $(-2\sqrt{3}, 144), (2\sqrt{3}, 144)$
C) (0, 0), (−2, −80), (2, −80)
D) (0, 0)

Answer: A

108) $f(x) = 10x^3 - 3x^5$

A) (0, 0), (−1, −7), (1, 7)
B) (0, 0)
C) $(0, 0), (-\sqrt{2}, -8\sqrt{2}), (\sqrt{2}, 8\sqrt{2})$
D) (−1, −7), (1, 7)

Answer: A

109) $f(x) = \frac{1}{2}x^4 - 2x^3 + 12$

A) (0, 12), (2, 4)
B) (0, 12), (2, −8)
C) (2, 4)
D) (2, 0)

Answer: A

110) $f(x) = \frac{1}{4}x^4 - x^3 + 9$

A) (0, 0), (2, 5)
B) (0, 0), (2, −4)
C) (0, 9), (2, 5)
D) (0, 0)

Answer: C

111) $f(x) = \frac{3x}{x^2 + 25}$

A) $\left(\pm\frac{1}{\sqrt{3}}, \frac{21}{4}\right)$
B) $(0, 0), \left(\sqrt{75}, \frac{3}{100}\sqrt{75}\right), \left(-\sqrt{75}, -\frac{3}{100}\sqrt{75}\right)$
C) $\left(\pm\frac{5}{\sqrt{3}}, \frac{9}{100}\right)$
D) $(0, 0), \left(\sqrt{75}, -\frac{3}{100}\sqrt{75}\right), \left(-\sqrt{75}, \frac{3}{100}\sqrt{75}\right)$

Answer: B

112) $f(x) = (x + 2)^{2/3} - 8$

A) $(0, 2^{2/3} - 8)$
B) $(-2, -8), (0, 2^{2/3} - 8)$
C) (−2, −8)
D) No points of inflection exist

Answer: D

113) $f(x) = (x - 3)^{1/3} + 8$

A) $(0, 3^{1/3} + 8)$

B) (3, 8)

C) (−3, 8)

D) No points of inflection exist

Answer: B

114) $f(x) = x\sqrt{81 - x^2}$

A) (9, 0)

B) (0, 0)

C) (0, 0), (81, 0)

D) (−9, 0), (9, 0)

Answer: B

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

115) $s(x) = -x^2 - 20x - 84$

A) Decreasing on $(-\infty, -10)$, increasing on $(-10, \infty)$

B) Decreasing on $(-\infty, -10)$ and $(0, \infty)$, increasing on $(-10, 0)$

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

D) Increasing on $(-\infty, -10)$, decreasing on $(-10, \infty)$

Answer: D

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

A) Decreasing on $\left(-\infty, \dfrac{7}{2}\right)$, increasing on $\left(\dfrac{7}{2}, \infty\right)$

B) Decreasing on $\left(-\infty, -\dfrac{7}{2}\right)$, increasing on $\left(-\dfrac{7}{2}, \infty\right)$

C) Increasing on $\left(-\infty, -\dfrac{7}{2}\right)$, decreasing on $\left(-\dfrac{7}{2}, \infty\right)$

D) Increasing on $\left(-\infty, -\dfrac{7}{2}\right)$ and $(0, \infty)$, decreasing on $\left(-\dfrac{7}{2}, 0\right)$

Answer: B

117) $f(x) = -3x^2 - 2x - 4$

A) Increasing on $\left(-\infty, -\dfrac{1}{3}\right)$, decreasing on $\left(-\dfrac{1}{3}, \infty\right)$

B) Decreasing on $\left(-\infty, -\dfrac{1}{3}\right)$, increasing on $\left(-\dfrac{1}{3}, \infty\right)$

C) Increasing on $\left(-\infty, \dfrac{1}{3}\right)$, decreasing on $\left(\dfrac{1}{3}, \infty\right)$

D) Increasing on $\left(-\infty, -\dfrac{1}{3}\right)$ and $(0, \infty)$, decreasing on $\left(-\dfrac{1}{3}, 0\right)$

Answer: A

118) $y = x^3 - 3x^2 + 4x - 4$

A) Increasing on $(-\infty, -1)$ and $(1, \infty)$, decreasing on $(-1, 1)$
B) Increasing on $(-\infty, \infty)$
C) Decreasing on $(-\infty, -1)$ and $(1, \infty)$, increasing on $(-1, 1)$
D) Increasing on $(-\infty, 1)$, decreasing on $(1, \infty)$

Answer: B

119) $f(x) = x^3 - 12x - 2$

A) Decreasing on $(-\infty, -2)$, increasing on $(-2, \infty)$
B) Increasing on $(-\infty, -4)$ and $(4, \infty)$, decreasing on $(-4, 4)$
C) Increasing on $(-\infty, -2)$ and $(2, \infty)$, decreasing on $(-2, 2)$
D) Decreasing on $(-\infty, -2)$ and $(2, \infty)$, increasing on $(-2, 2)$

Answer: C

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

A) Increasing on $(-\infty, 0)$ and $(2, \infty)$, decreasing on $(0, 2)$
B) Decreasing on $(-\infty, 0)$ and $(2, \infty)$, increasing on $(0, 2)$
C) Decreasing on $(-\infty, 2)$, increasing on $(2, \infty)$
D) Decreasing on $(-\infty, -1)$ and $(1, \infty)$, increasing on $(-1, 1)$

Answer: B

121) $f(x) = 2x^3 - 15x^2 + 24x$

A) Decreasing on $(-\infty, 1)$ and $(4, \infty)$, increasing on $(1, 4)$
B) Decreasing on $(-\infty, 0)$ and $(4, \infty)$, increasing on $(0, 4)$
C) Increasing on $(-\infty, 1)$, decreasing on $(1, \infty)$
D) Increasing on $(-\infty, 1)$ and $(4, \infty)$, decreasing on $(1, 4)$

Answer: D

122) $f(x) = x^4 - 2x^2 - 9$

A) Increasing on $(-\infty, -1)$ and $(0, 1)$, decreasing on $(-1, 0)$ and $(1, \infty)$
B) Decreasing on $(-\infty, -1)$ and $(1, \infty)$, increasing on $(-1, 1)$
C) Increasing on $(-\infty, -1)$ and $(1, \infty)$, decreasing on $(-1, 1)$
D) Decreasing on $(-\infty, -1)$ and $(0, 1)$, increasing on $(-1, 0)$ and $(1, \infty)$

Answer: D

123) $f(x) = x^3 - 5x^4$

A) Decreasing on $\left(-\infty, \frac{3}{20}\right)$, increasing on $\left(\frac{3}{20}, \infty\right)$
B) Decreasing on $\left(-\infty, -\frac{3}{20}\right)$ and $\left(0, \frac{3}{20}\right)$, increasing on $\left(-\frac{3}{20}, 0\right)$ and $\left(\frac{3}{20}, \infty\right)$
C) Increasing on $\left(-\infty, -\frac{3}{20}\right)$ and $\left(0, \frac{3}{20}\right)$, decreasing on $\left(-\frac{3}{20}, 0\right)$ and $\left(\frac{3}{20}, \infty\right)$
D) Increasing on $\left(-\infty, \frac{3}{20}\right)$, decreasing on $\left(\frac{3}{20}, \infty\right)$

Answer: D

124) $f(x) = (x + 3)^{2/3} - 7$

A) Decreasing on $(-\infty, -3)$, increasing on $(-3, \infty)$
B) Decreasing on $(-\infty, \infty)$
C) Decreasing on $(-\infty, -3)$ and $(0, \infty)$, increasing on $(-3, 0)$
D) Increasing on $(-\infty, -3)$, decreasing on $(-3, \infty)$

Answer: A

125) $f(x) = (x - 2)^{1/3} + 6$

A) Increasing on $(-\infty, 2)$, decreasing on $(2, \infty)$
B) Decreasing on $(-\infty, 2)$, increasing on $(2, \infty)$
C) Decreasing on $(-\infty, \infty)$
D) Increasing on $(-\infty, \infty)$

Answer: D

126) $f(x) = x^2(6 - x)^2$

A) Increasing on $(-\infty, 0)$ and $\left(3, 6\right)$, decreasing on $\left(0, 3\right)$ and $(6, \infty)$
B) Decreasing on $(-\infty, 0)$ and $\left(3, 6\right)$, increasing on $\left(0, 3\right)$ and $(6, \infty)$
C) Decreasing on $(-\infty, 0)$ and $\left(3, \infty\right)$, increasing on $\left(0, 3\right)$
D) Decreasing on $(-\infty, 0)$ and $(6, \infty)$, increasing on $(0, 6)$

Answer: B

127) $f(x) = 45x^3 - 3x^5$

A) Decreasing on $(-\infty, -3)$ and $(0, 3)$, increasing on $(-3, 0)$ and $(3, \infty)$
B) Increasing on $(-\infty, -3)$ and $(0, 3)$, decreasing on $(-3, 0)$ and $(3, \infty)$
C) Decreasing on $(-\infty, -3)$ and $(3, \infty)$, increasing on $(-3, 3)$
D) Increasing on $(-\infty, -3)$ and $(3, \infty)$, decreasing on $(-3, 3)$

Answer: C

128) $f(x) = \dfrac{3}{x^2 + 1}$

A) Increasing on $(-\infty, \infty)$
B) Increasing on $(-\infty, 0)$, decreasing on $(0, \infty)$
C) Decreasing on $(-\infty, \infty)$
D) Decreasing on $(-\infty, 0)$, increasing on $(0, \infty)$

Answer: B

129) $f(x) = \dfrac{9x}{x^2 + 1}$

A) Decreasing on $(-\infty, -1)$ and $(1, \infty)$, increasing on $(-1, 1)$
B) Increasing on $(-\infty, \infty)$
C) Increasing on $(-\infty, -1)$ and $(1, \infty)$, decreasing on $(-1, 1)$
D) Decreasing on $(-\infty, -1)$, increasing on $(-1, \infty)$

Answer: A

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

130) $f(x) = x^2 - 12x + 40$

A) Concave up for all x
B) Concave down for all x
C) Concave up on $(-\infty, 6)$, concave down on $(6, \infty)$
D) Concave up on $(6, \infty)$, concave down on $(-\infty, 6)$

Answer: A

131) $q(x) = 6x^3 + 2x + 8$

A) Concave up on $(-\infty, 0)$, concave down on $(0, \infty)$
B) Concave down for all x
C) Concave up for all x
D) Concave up on $(0, \infty)$, concave down on $(-\infty, 0)$

Answer: D

132) $f(x) = 9x - x^3$

A) Concave up on $(-\infty, 0)$ and $(1, \infty)$, concave down on $(0, 1)$
B) Concave down for all t
C) Concave up on $(0, \infty)$, concave down on $(-\infty, 0)$
D) Concave up on $(-\infty, 0)$, concave down on $(0, \infty)$

Answer: D

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

A) Concave down on $(-\infty, -4)$ and $(4, \infty)$, concave up on $(-4, 4)$
B) Concave down for all x
C) Concave up on $(-4, \infty)$, concave down on $(-\infty, -4)$
D) Concave up on $(-\infty, -4)$, concave down on $(-4, \infty)$

Answer: C

134) $h(x) = \frac{4}{3}x^3 - 12x^2 + 10x + 45$

A) Concave up on $(-\infty, 0)$ and $(3, \infty)$, concave down on $(0, 3)$
B) Concave up on $(-\infty, 3)$, concave down on $(3, \infty)$
C) Concave down for all x
D) Concave up on $(3, \infty)$, concave down on $(-\infty, 3)$

Answer: D

135) $G(x) = \frac{1}{4}x^4 - x^3 + 6$

A) Concave up for $(-\infty, 0)$, concave down for $(0, \infty)$
B) Concave up on $(-\infty, 0)$ and $(2, \infty)$, concave down on $(0, 2)$
C) Concave up on $(0, 2)$, concave down on $(-\infty, 0)$ and $(2, \infty)$
D) Concave up for $(2, \infty)$, concave down on $(-\infty, 2)$

Answer: B

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

A) Concave down on $(-\infty, 0)$, concave up on $(0, \infty)$
B) Concave up on $(-\infty, 2)$, concave down on $(2, \infty)$
C) Concave down on $(-\infty, 2)$, concave up on $(2, \infty)$
D) Concave up on $(-\infty, 0)$, concave down on $(0, \infty)$

Answer: D

137) $f(x) = x^3 - 12x^2 + 2x + 15$

A) Concave down on $(-\infty, -4)$, concave up on $(-4, \infty)$
B) Concave up on $(-\infty, -4)$, concave down on $(-4, \infty)$
C) Concave down on $(-\infty, 4)$, concave up on $(4, \infty)$
D) Concave up on $(-\infty, 4)$, concave down on $(4, \infty)$

Answer: C

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

A) Concave down on $(-\infty, -3.5)$, concave up on $(-3.5, \infty)$
B) Concave up on $(-\infty, -3.5)$, concave down on $(-3.5, \infty)$
C) Concave up on $\left(-\infty, -2\right)$, concave down on $\left(-2, \infty\right)$

D) Concave down on $\left(-\infty, -2\right)$, concave up on $\left(-2, \infty\right)$

Answer: D

139) $f(x) = x^4 - 24x^2$

A) Concave down on $(-\infty, -2)$ and $(2, \infty)$, concave up on $(-2, 2)$
B) Concave up on $(-\infty, -2)$ and $(2, \infty)$, concave down on $(-2, 2)$
C) Concave up on $(-\infty, -2\sqrt{3})$ and $(2\sqrt{3}, \infty)$, concave down on $(-2\sqrt{3}, 2\sqrt{3})$
D) Concave up on $(-\infty, -2)$ and $(0, 2)$, concave down on $(-2, 0)$ and $(2, \infty)$

Answer: B

140) $f(x) = 10x^3 - 3x^5$

A) Concave down on $(-\infty, -1)$ and $(0, 1)$, concave up on $(-1, 0)$ and $(1, \infty)$
B) Concave up on $(-\infty, -\sqrt{2})$ and $(0, \sqrt{2})$, concave down on $(-\sqrt{2}, 0)$ and $(\sqrt{2}, \infty)$
C) Concave up on $(-\infty, -1)$ and $(0, 1)$, concave down on $(-1, 0)$ and $(1, \infty)$
D) Concave up on $(-\infty, -1)$ and $(1, \infty)$, concave down on $(-1, 1)$

Answer: C

141) $f(x) = \dfrac{4x}{x^2 + 49}$

A) Concave down on $\left(-\infty, -\sqrt{147}\right)$ and $\left(0, \sqrt{147}\right)$, concave up on $\left(-\sqrt{147}, 0\right)$ and $\left(\sqrt{147}, \infty\right)$.
B) Concave down on $(-\infty, 0)$, concave up on $(0, \infty)$
C) Concave up on $\left(-\infty, -\sqrt{147}\right)$ and $\left(0, \sqrt{147}\right)$, concave down on $\left(-\sqrt{147}, 0\right)$ and $\left(\sqrt{147}, \infty\right)$.
D) Concave down on $\left(-\infty, -\sqrt{147}\right)$ and $\left(\sqrt{147}, \infty\right)$, concave up on $\left(-\sqrt{147}, \sqrt{147}\right)$.

Answer: A

142) $f(x) = (x + 2)^{2/3} - 5$
A) Concave down on $(-\infty, \infty)$
B) Concave up on $(-\infty, -2)$ and $(-2, \infty)$
C) Concave down on $(-\infty, -2)$, concave up on $(-2, \infty)$
D) Concave down on $(-\infty, -2)$ and $(-2, \infty)$

Answer: D

143) $f(x) = (x - 2)^{1/3} - 6$
A) Concave up on $(-\infty, \infty)$
B) Concave up on $(-\infty, 2)$, concave down on $(2, \infty)$
C) Concave down on $(-\infty, 2)$, concave up on $(2, \infty)$
D) Concave down on $(-\infty, 2)$ and $(2, \infty)$

Answer: B

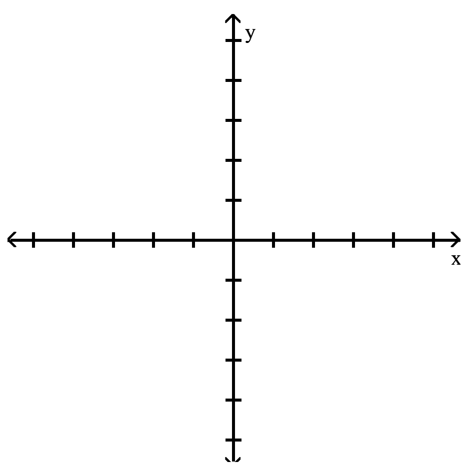
144) $f(x) = x\sqrt{25 - x^2}$
A) Concave up on $(-5, 0)$, concave down on $(0, 5)$
B) Concave up on $(-\infty, 0)$, concave down on $(0, \infty)$
C) Concave down on $(-5, 0)$, concave up on $(0, 5)$
D) Concave up on $(-\infty, \infty)$

Answer: A

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

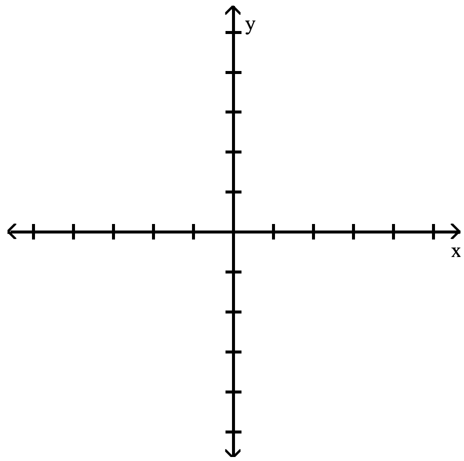
Draw a graph to match the description. Answers will vary.

145) $f(x)$ is decreasing and concave up on $(-\infty, -7)$; $f(x)$ is decreasing and concave down on $(-7, \infty)$.



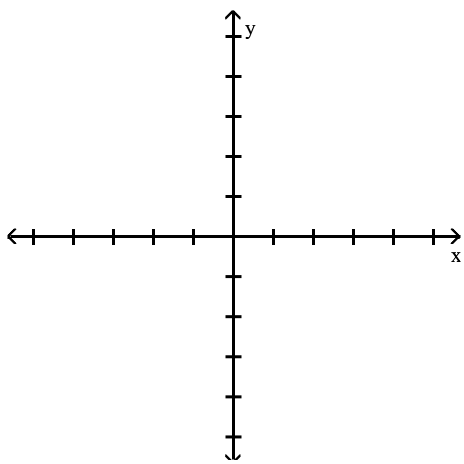
Answer: Answers will vary.

146) f(x) is increasing and concave up on $(-\infty, -4)$; f(x) is increasing and concave down on $(-4, \infty)$.



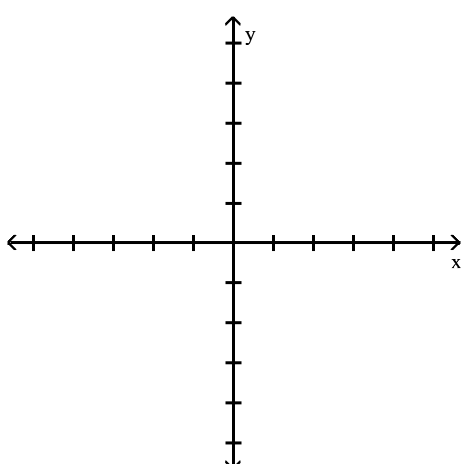
Answer: Answers will vary.

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



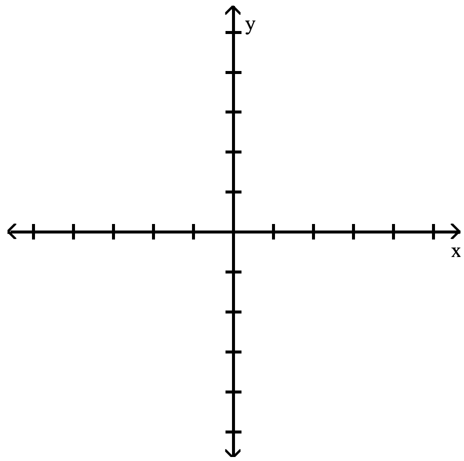
Answer: Answers will vary.

148) f(x) is increasing and concave down on $(-\infty, 3)$; f(x) is increasing and concave up on $(3, \infty)$.



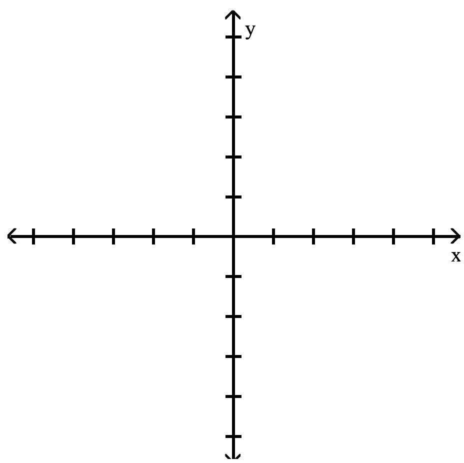
Answer: Answers will vary.

149) g(x) is concave down at (–5, –3), concave up at (5, 10), and has an inflection point at (3, 4).



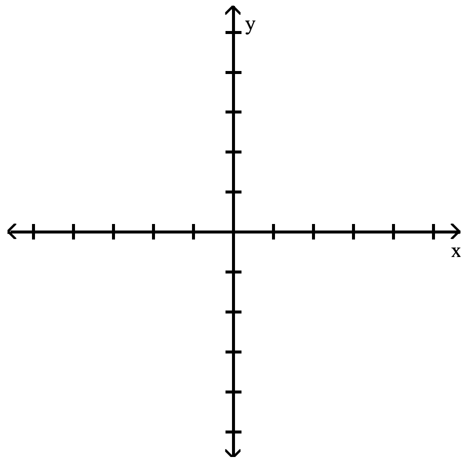
Answer: Answers will vary.

150) g(x) is concave up at (–6, 12), concave down at (6, –15), and has an inflection point at (2, –3).



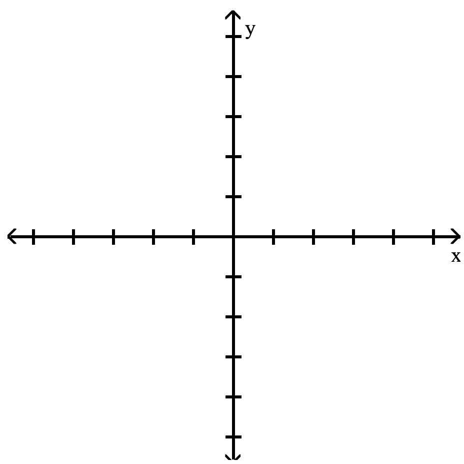
Answer: Answers will vary.

151) $f'(-7) = 0$, $f''(-7) < 0$, $f(-7) = 17$, $f'(7) = 0$, $f''(7) > 0$, $f(7) = -3$, $f''(3) = 0$ and $f(3) = 3$.



Answer: Answers will vary.

152) $f'(-5) = 0$, $f''(-5) > 0$, $f(-5) = -13$, $f'(5) = 0$, $f''(5) < 0$, $f(5) = 25$, $f''(-3) = 0$ and $f(3) = 13$.



Answer: Answers will vary.

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

Solve the problem.

153) The annual revenue and cost functions for a manufacturer of grandfather clocks are approximately $R(x) = 480x - 0.02x^2$ and $C(x) = 120x + 100{,}000$, where x denotes the number of clocks made. What is the maximum annual profit?

A) \$1,520,000
B) \$1,820,000
C) \$1,720,000
D) \$1,620,000

Answer: A

154) The annual revenue and cost functions for a manufacturer of precision gauges are approximately $R(x) = 500x - 0.03x^2$ and $C(x) = 120x + 100{,}000$, where x denotes the number of gauges made. What is the maximum annual profit?

A) $1,303,333
B) $1,403,333
C) $1,203,333
D) $1,103,333

Answer: D

155) The percent of concentration of a certain drug in the bloodstream x hr after the drug is administered is given by $K(x) = \dfrac{3x}{x^2 + 25}$. How long after the drug has been administered is the concentration a maximum? Round answer to the nearest tenth, if necessary.

A) 1.3 hr
B) 2.5 hr
C) 3 hr
D) 5 hr

Answer: D

156) A person coughs when a foreign object is in the windpipe. The velocity of the cough depends on the size of the object. Suppose a person has a windpipe with a 18–mm radius. If a foreign object has a radius r, in mm, assume that the velocity V, in mm/second, needed to remove the object by a cough is given by
$V(r) = k(18r^2 - r^3), \quad 0 \le r \le 18,$
where k is some positive constant. For what size object is the maximum velocity needed to remove the object? Round answer to the nearest tenth, if necessary.

A) 6
B) 12
C) 9
D) 13

Answer: B

157) Suppose that the temperature T, in degrees Fahrenheit, during a 24–hr period in winter is given by
$T(x) = 0.0023(x^3 - 39x + 240), \quad 0 \le x \le 24,$
where x = the number of hours since midnight. Estimate the relative minimum temperature and when it occurs. Round answers to the nearest hundredth, if necessary.

A) 0.34° F at 3.61 hours after midnight
B) 0.37° F at 0.37 hours after midnight
C) 0.33° F at 0.33 hours after midnight
D) 0.35° F at 3.61 hours after midnight

Answer: A

158) 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 $P(x) = -x^3 + 11x^2 + 15x - 39$, where $0 \le x \le 20$. Find the inflection point of this function to determine the point of diminishing returns.

A) (3.67, 63.26)
B) (3.67, 24.96)
C) (2.75, 114.59)
D) (3.67, 114.59)

Answer: D

159) The function $R(x) = 12{,}000 - x^3 + 24x^2 + 400x$, $0 \le x \le 20$, 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.

A) (38.05, 6878.37)
B) (8, 16,224)
C) (14, 19,560)
D) (9.6, 17,167.1)

Answer: B

Determine the vertical asymptote(s) of the given function. If none exists, state that fact.

160) $f(x) = \dfrac{7x}{x - 6}$

A) $x = 6$
B) $x = 7$
C) $x = -6$
D) none

Answer: A

161) $f(x) = \dfrac{x + 6}{x^2 - 64}$

A) $x = 0$, $x = 64$
B) $x = -8$, $x = 8$
C) $x = -8$, $x = 8$, $x = -6$
D) $x = 64$, $x = -6$

Answer: B

162) $h(x) = \dfrac{x + 9}{x^2 + 64}$

A) $x = -8$, $x = -9$
B) $x = -8$, $x = 8$, $x = -9$
C) $x = -8$, $x = 8$
D) none

Answer: D

163) $g(x) = \dfrac{x + 11}{x^2 + 9x}$

A) $x = -3$, $x = 3$
B) $x = 0$, $x = -3$, $x = 3$
C) $x = -9$, $x = -11$
D) $x = 0$, $x = -9$

Answer: D

164) $f(x) = \dfrac{x(x - 1)}{x^3 + 9x}$

A) $x = 0$
B) $x = -3$, $x = 3$
C) $x = 0$, $x = -9$
D) $x = 0$, $x = -3$, $x = 3$

Answer: A

165) $R(x) = \frac{-3x^2}{x^2 + 5x - 66}$

A) $x = -11, x = 6$
B) $x = -66$
C) $x = -11, x = 6, x = -3$
D) $x = 11, x = -6$

Answer: A

166) $R(x) = \frac{x - 1}{x^3 + 8x^2 - 48x}$

A) $x = -4, x = 0, x = 12$
B) $x = -4, x = -30, x = 12$
C) $x = -12, x = 0, x = 4$
D) $x = -12, x = 4$

Answer: C

167) $f(x) = \frac{-2x(x + 2)}{4x^2 - 3x - 7}$

A) $x = \frac{7}{4}, x = -1$

B) $x = -\frac{4}{7}, x = 1$

C) $x = -\frac{7}{4}, x = 1$

D) $x = \frac{4}{7}, x = -1$

Answer: A

168) $f(x) = \frac{x - 2}{4x - x^3}$

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

Answer: A

169) $f(x) = \frac{-x^2 + 16}{x^2 + 5x + 4}$

A) $x = -1, x = 4$
B) $x = 1, x = -4$
C) $x = -1$
D) $x = -1, x = -4$

Answer: C

Determine the horizontal asymptote of the given function. If none exists, state that fact.

170) $h(x) = \frac{9x - 4}{x - 8}$

A) $y = 9$
B) $y = 8$
C) $y = 0$
D) no horizontal asymptotes

Answer: A

171) $h(x) = 6 - \frac{5}{x}$

A) $x = 0$
B) $y = 6$
C) $y = 5$
D) no horizontal asymptotes

Answer: B

172) $g(x) = \frac{x^2 + 6x - 5}{x - 5}$

A) $y = 1$
B) $y = 0$
C) $y = 5$
D) no horizontal asymptotes

Answer: D

173) $h(x) = \frac{8x^2 - 2x - 8}{6x^2 - 8x + 5}$

A) $y = \frac{4}{3}$
B) $y = \frac{1}{4}$
C) $y = 0$
D) no horizontal asymptotes

Answer: A

174) $h(x) = \frac{5x^4 - 7x^2 - 6}{3x^5 - 5x + 2}$

A) $y = \frac{7}{5}$
B) $y = 0$
C) $y = \frac{5}{3}$
D) no horizontal asymptotes

Answer: B

175) $h(x) = \frac{5x^3 - 2x}{3x^3 - 8x + 6}$

A) $y = \frac{1}{4}$

B) $y = \frac{5}{3}$

C) $y = 0$

D) no horizontal asymptotes

Answer: B

176) $h(x) = \frac{8x^3 - 3x - 2}{6x^2 + 9}$

A) $y = \frac{4}{3}$

B) $y = 8$

C) $y = 0$

D) no horizontal asymptotes

Answer: D

177) $f(x) = \frac{2x + 1}{x^2 - 49}$

A) $y = 0$

B) $y = -7, y = 7$

C) no horizontal asymptotes

D) $y = 2$

Answer: A

178) $R(x) = \frac{-3x^2 + 1}{x^2 + 3x - 54}$

A) $y = 0$

B) $y = -9, y = 6$

C) $y = -3$

D) no horizontal asymptotes

Answer: C

179) $f(x) = \frac{x^2 - 7}{49x - x^4}$

A) $y = -7, y = 7$

B) $y = -1$

C) $y = 0$

D) no horizontal asymptotes

Answer: C

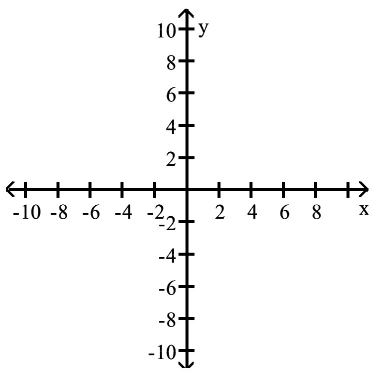
180) $f(x) = \dfrac{25x^4 + x^2 - 5}{x - x^3}$

A) no horizontal asymptotes
B) $y = -1$, $y = 1$
C) $y = -25$
D) $y = 0$

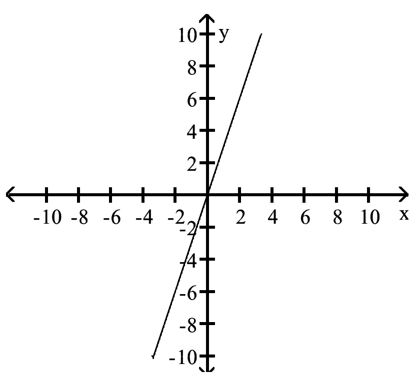
Answer: A

Graph the rational function.

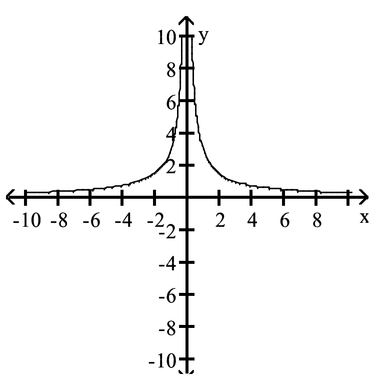
181) $f(x) = \dfrac{3}{x}$



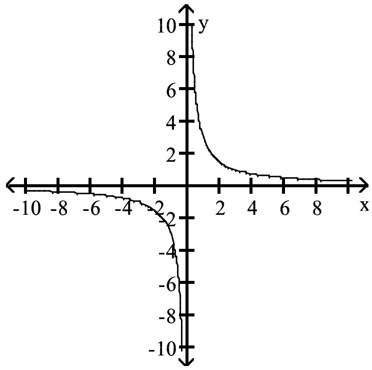
A)



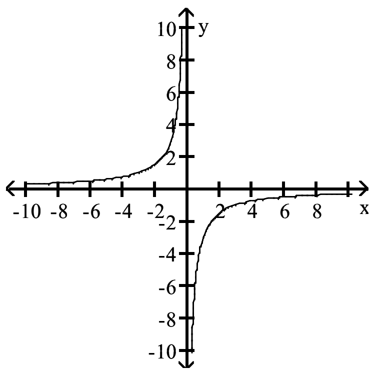
B)



C)

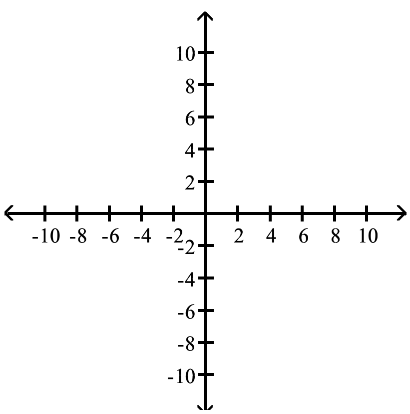


D)

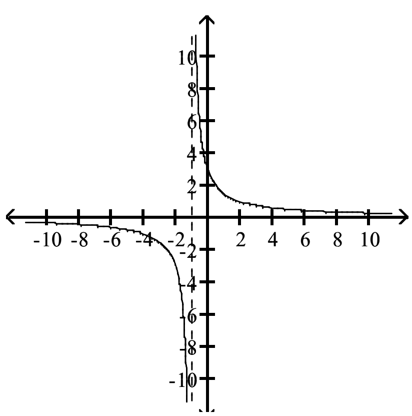


Answer: C

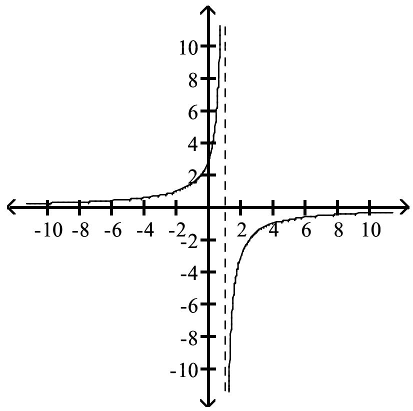
182) $f(x) = \dfrac{3}{x - 1}$



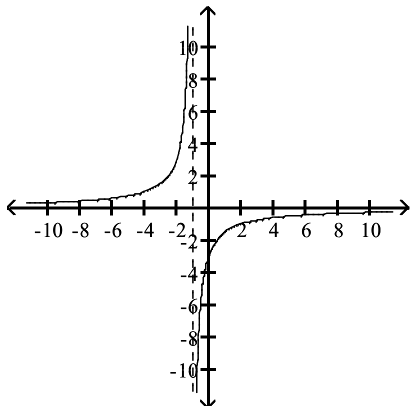
A)



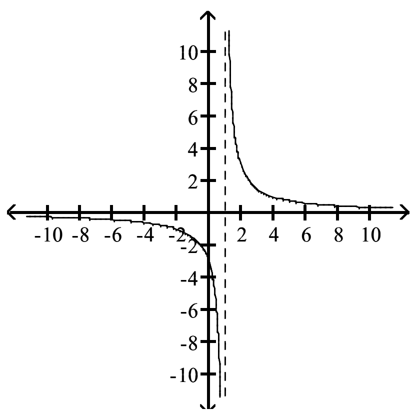
B)


10 8 6 4 2 -2 -4 -6 -8 -10
-10 -8 -6 -4 -2 2 4 6 8 10

C)

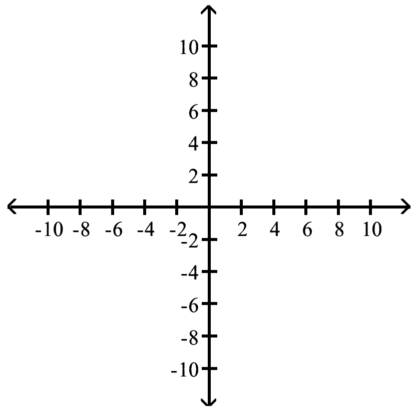

10 8 6 4 2 -2 -4 -6 -8 -10
-10 -8 -6 -4 -2 2 4 6 8 10

D)

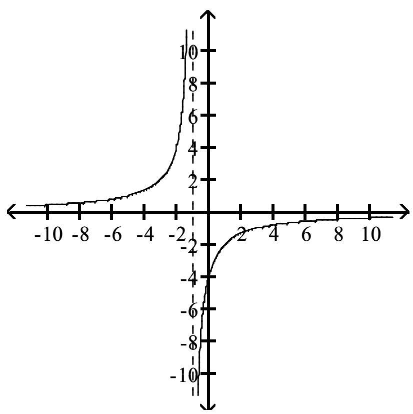

10 8 6 4 2 -2 -4 -6 -8 -10
-10 -8 -6 -4 -2 2 4 6 8 10

Answer: D

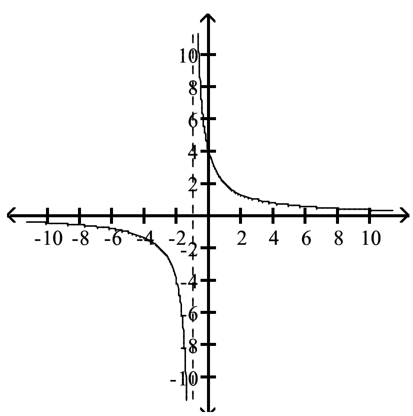
183) $f(x) = \frac{-4}{x + 1}$



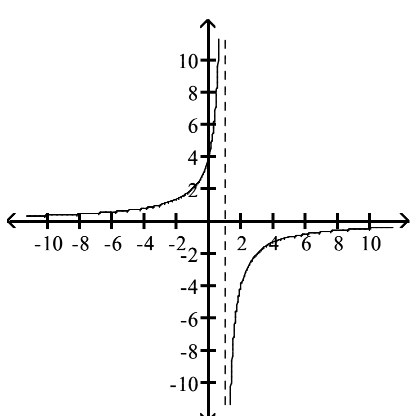
A)



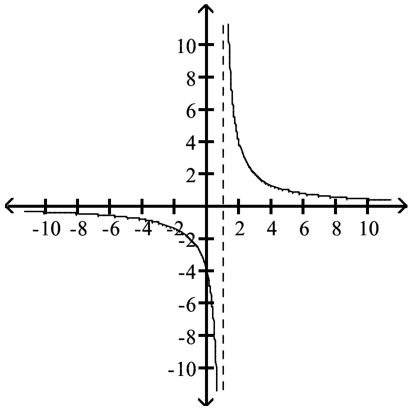
B)



C)

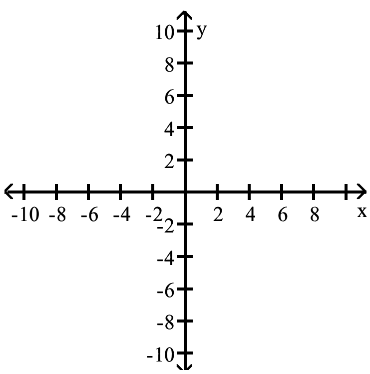


D)

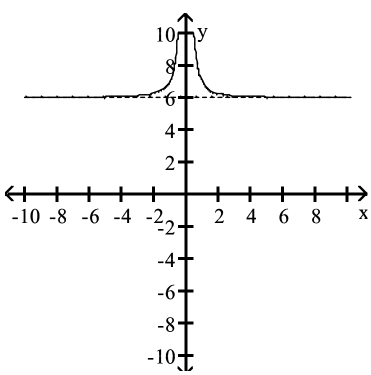


Answer: A

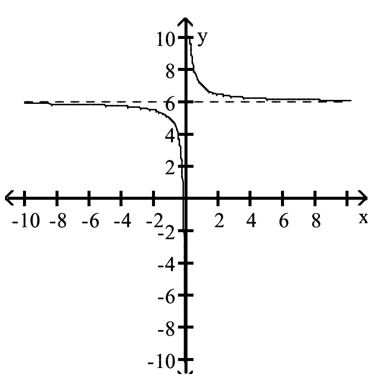
184) $f(x) = \dfrac{6x + 1}{x}$



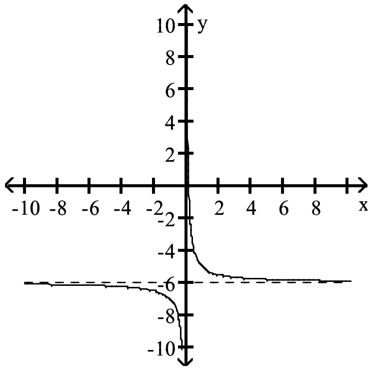
A)



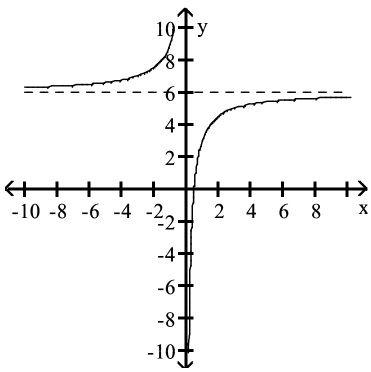
B)



C)

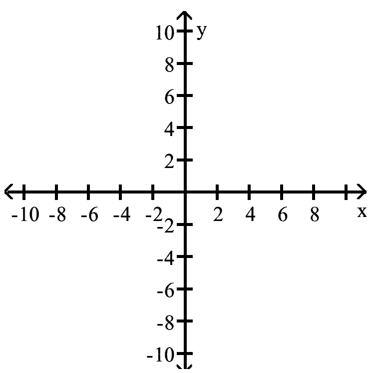


D)

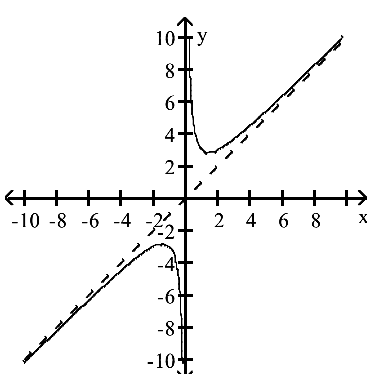


Answer: B

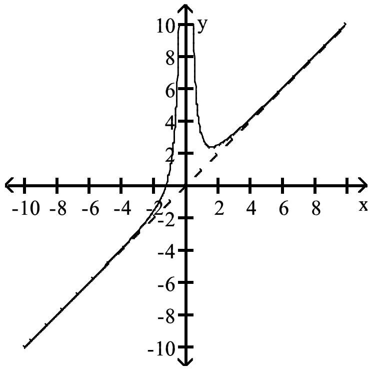
185) $f(x) = x + \frac{2}{x}$



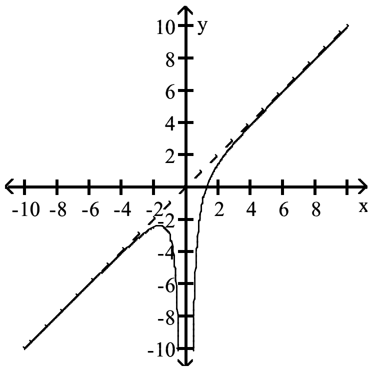
A)



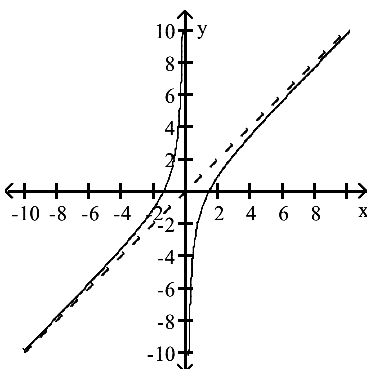
B)



C)

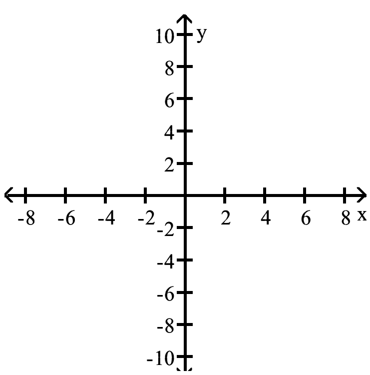


D)

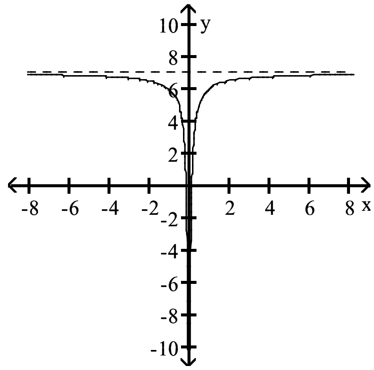


Answer: A

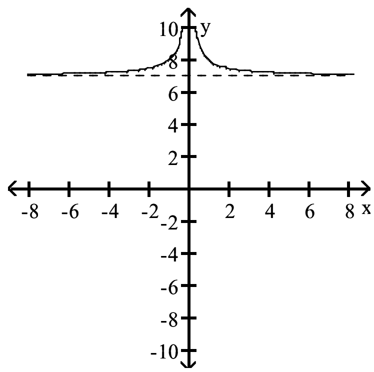
186) $f(x) = \dfrac{7}{x^2}$



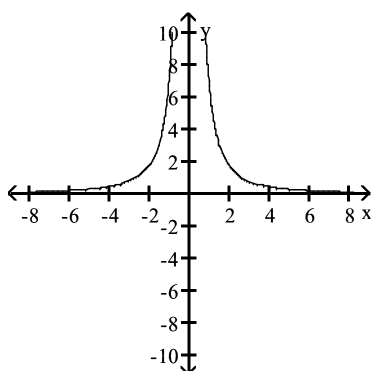
A)



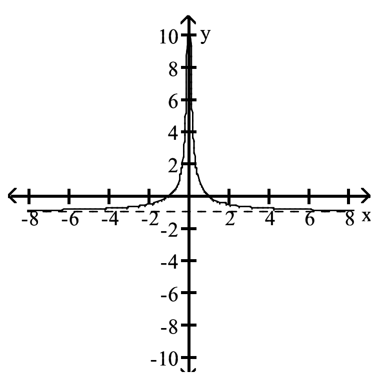
B)



C)

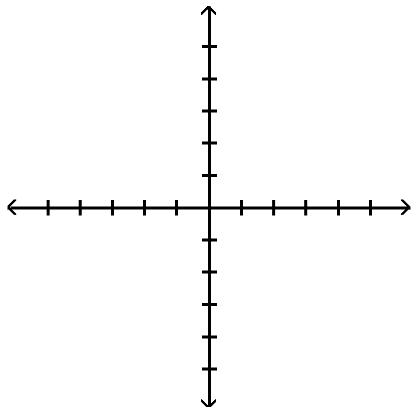


D)

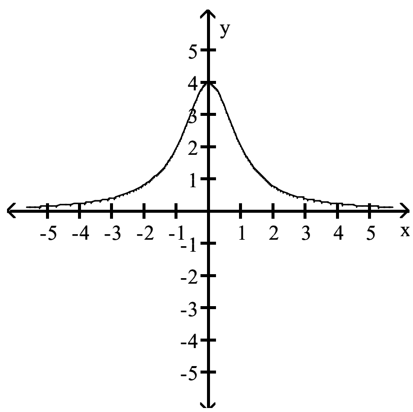


Answer: C

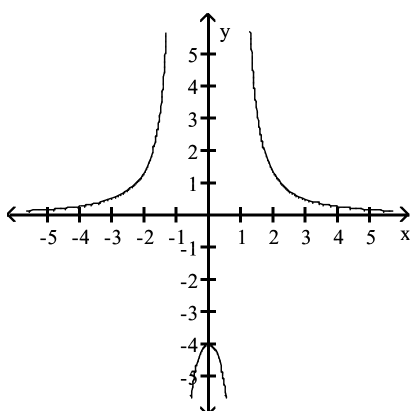
187) $f(x) = \frac{-4}{x^2 + 1}$



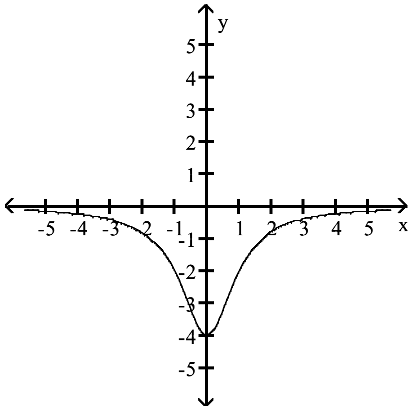
A)



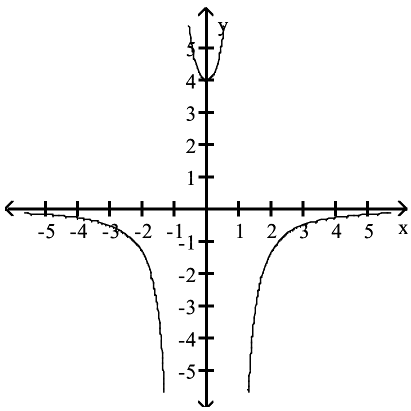
B)



C)

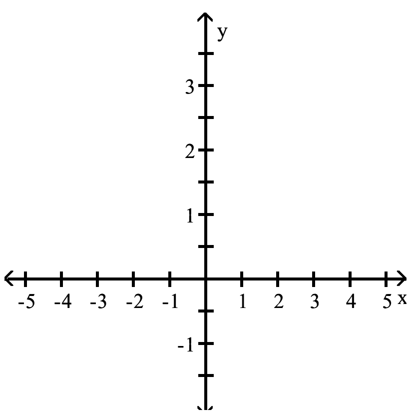


D)

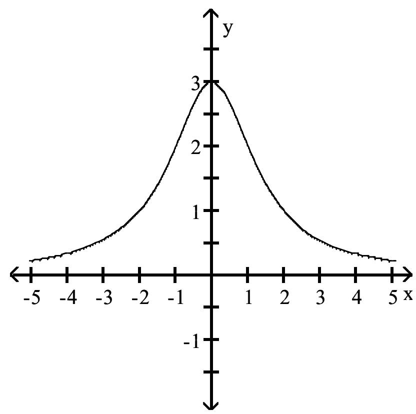


Answer: C

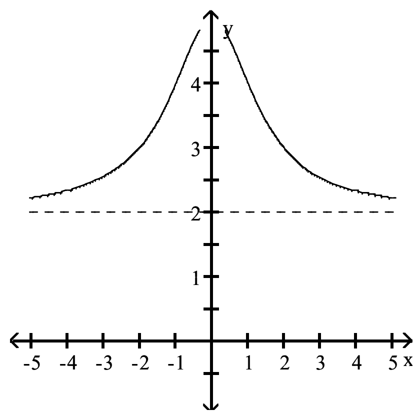
188) $f(x) = \dfrac{6}{x^2 + 2}$



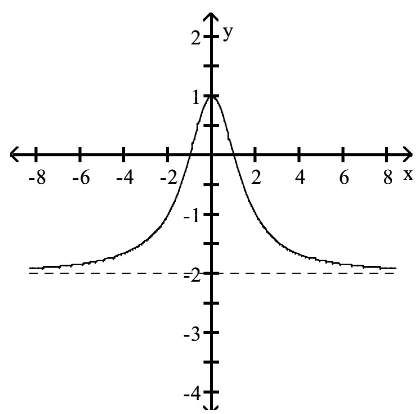
A)



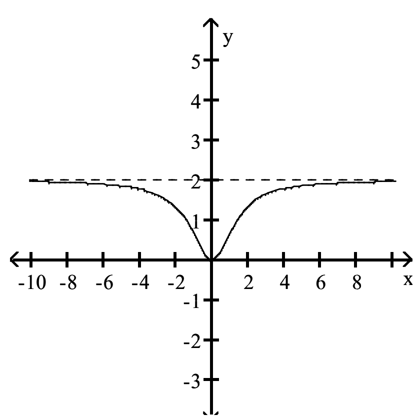
B)



C)

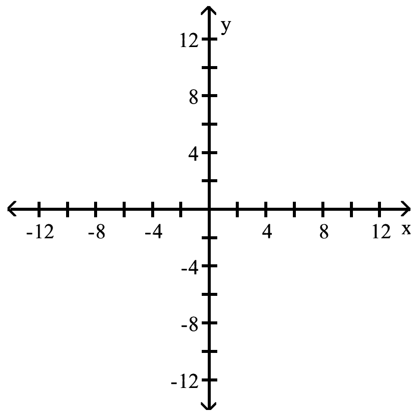


D)

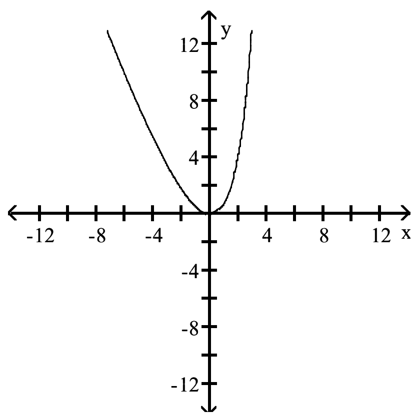


Answer: A

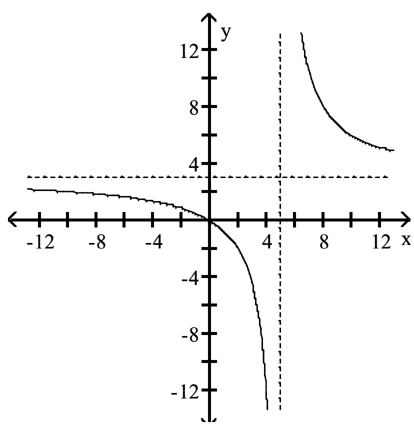
189) $f(x) = \frac{3x}{x - 5}$



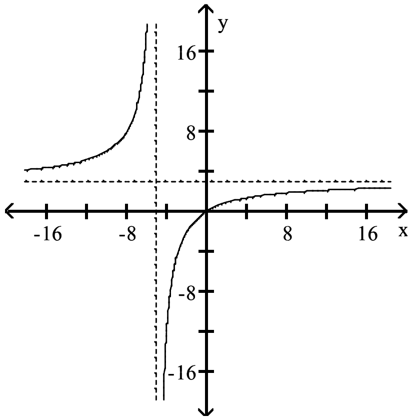
A)



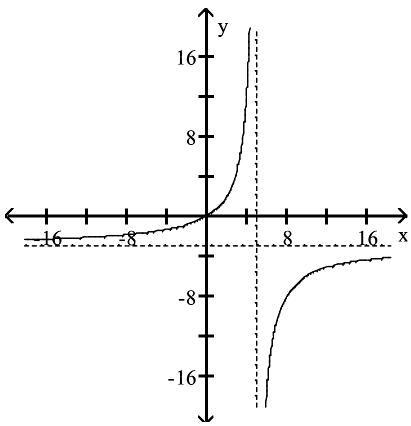
B)



C)

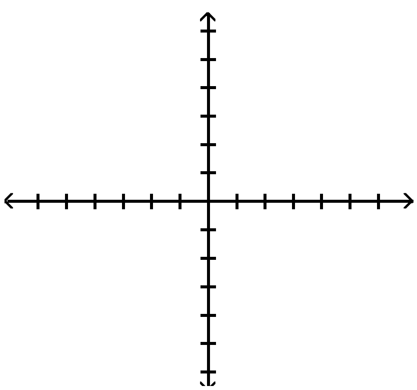


D)

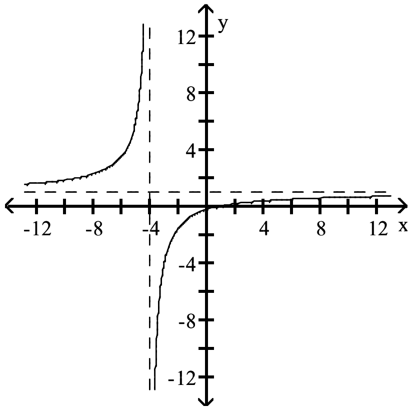


Answer: B

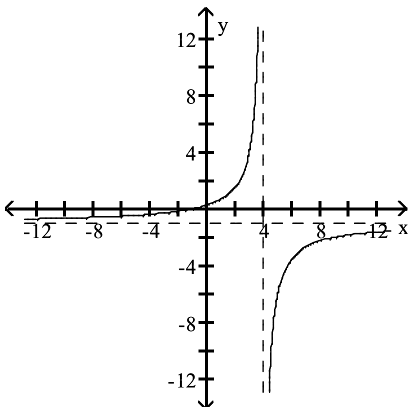
190) $f(x) = \dfrac{x - 1}{x + 4}$



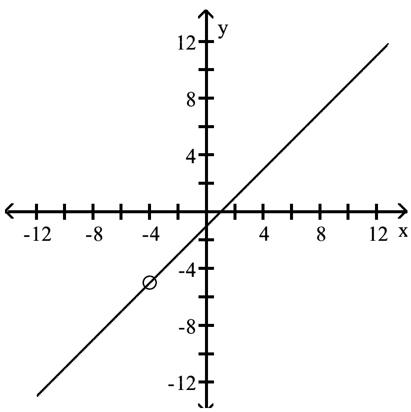
A)



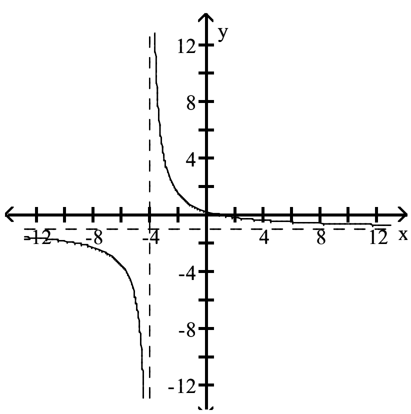
B)



C)

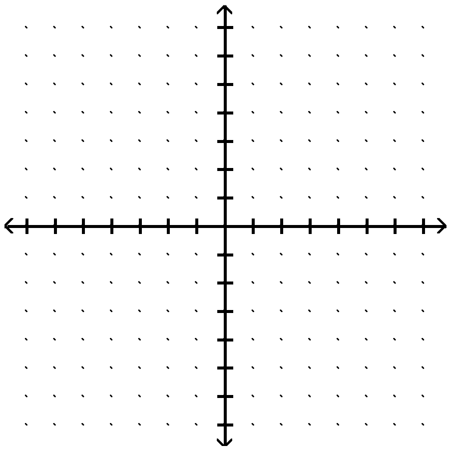


D)

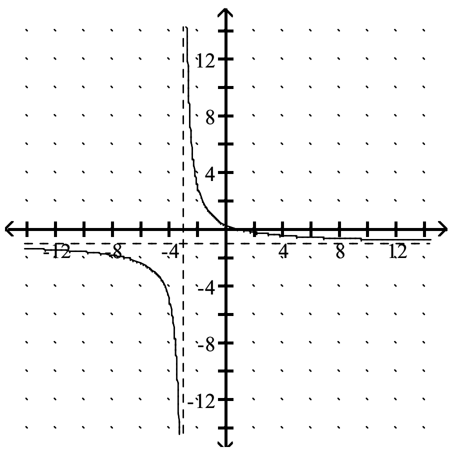


Answer: A

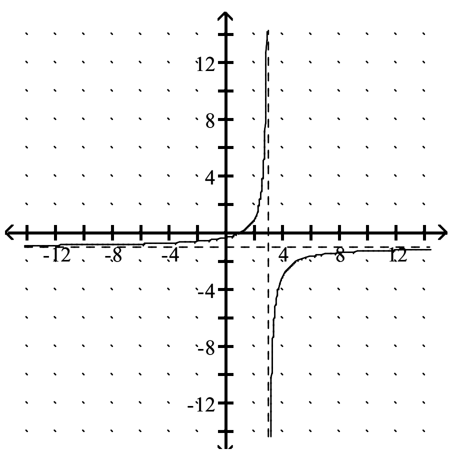
191) $f(x) = \dfrac{3x + 1}{x - 1}$



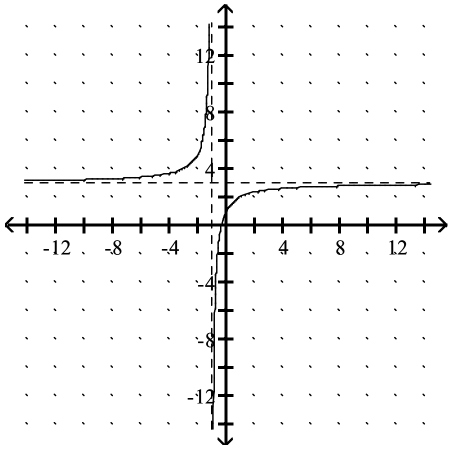
A)



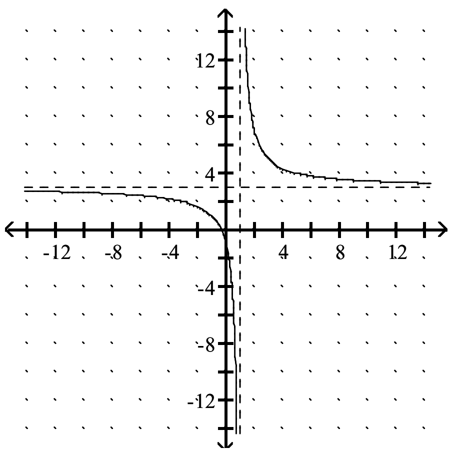
B)



C)

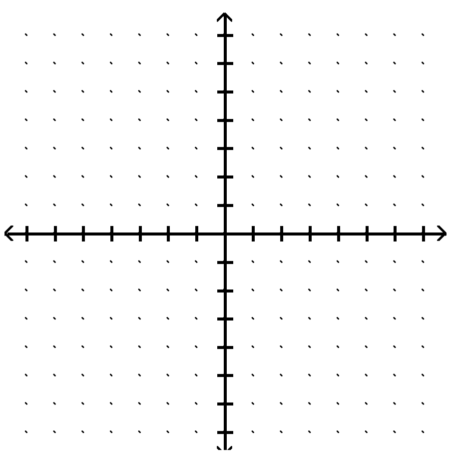


D)

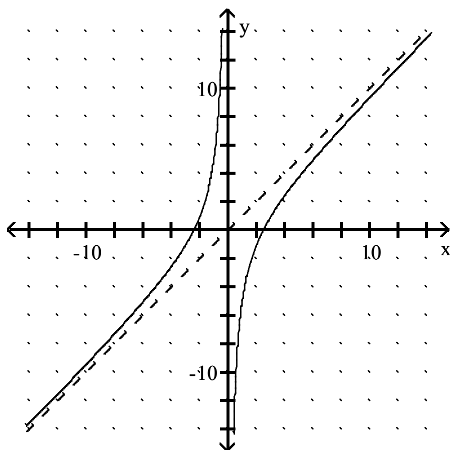


Answer: D

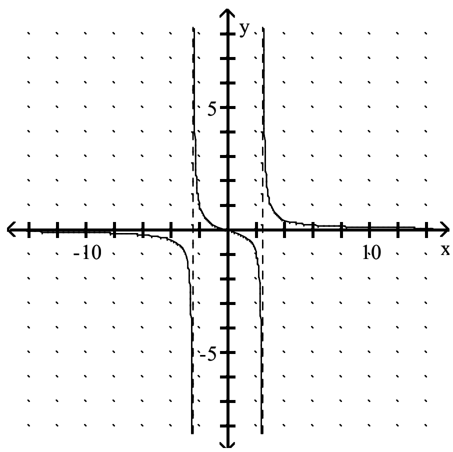
192) $f(x) = \dfrac{x}{x^2 - 36}$



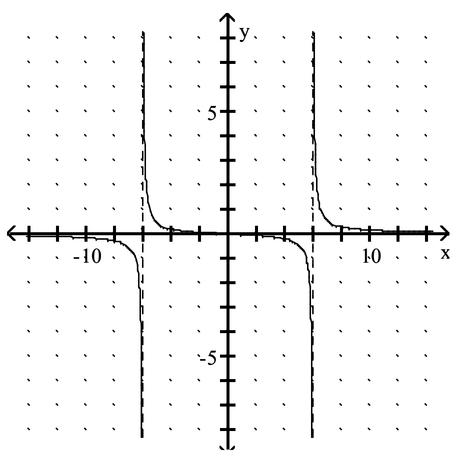
A)



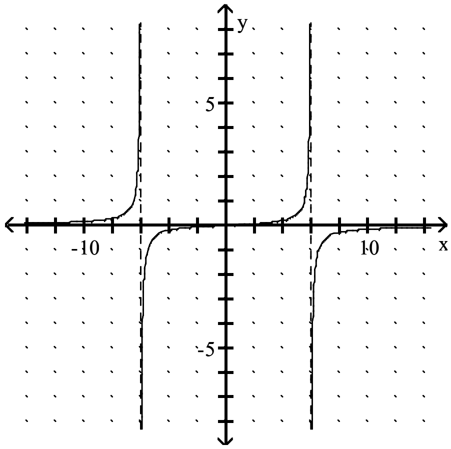
B)



C)

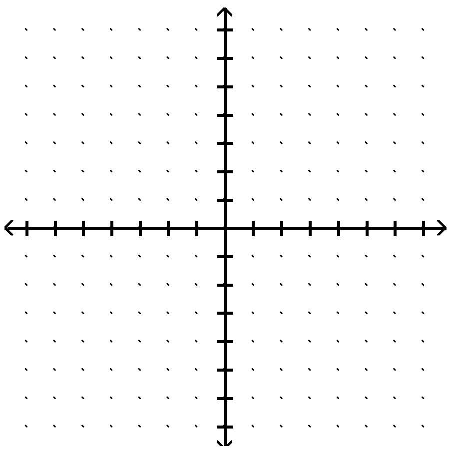


D)

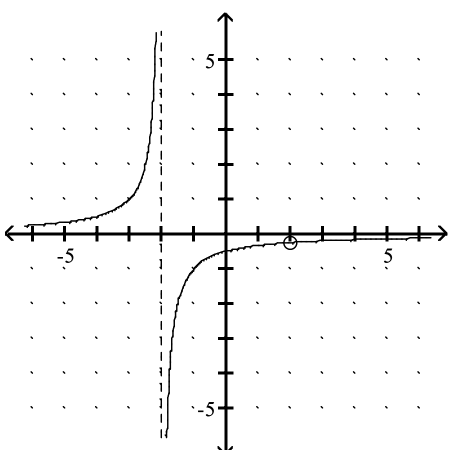


Answer: C

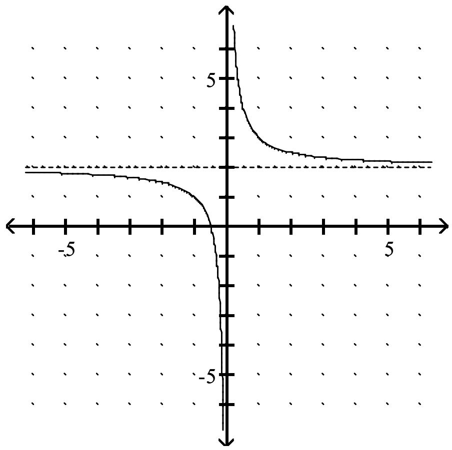
193) $f(x) = \dfrac{x - 2}{x^2 - 4}$



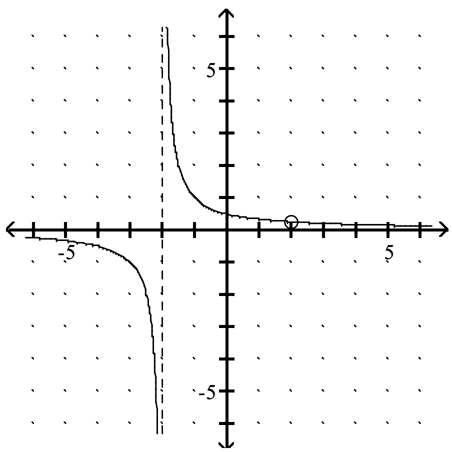
A)



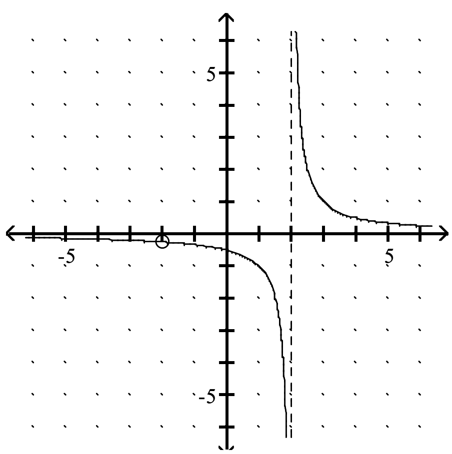
B)



C)

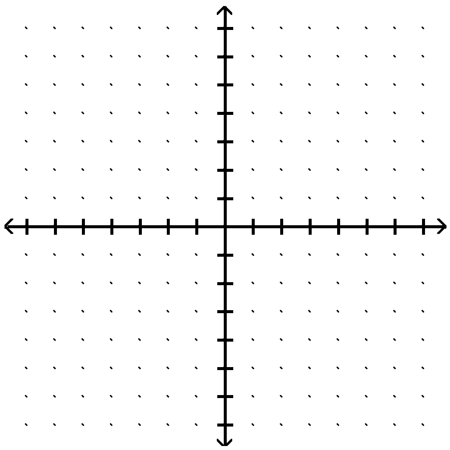


D)

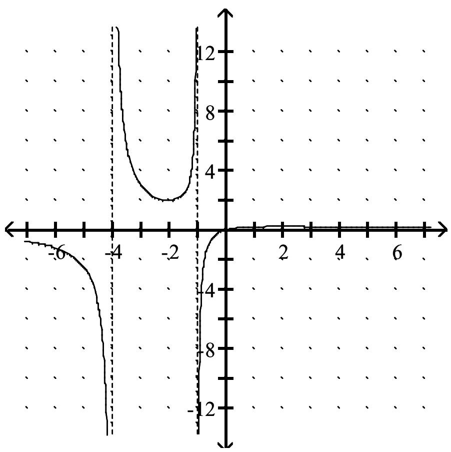


Answer: C

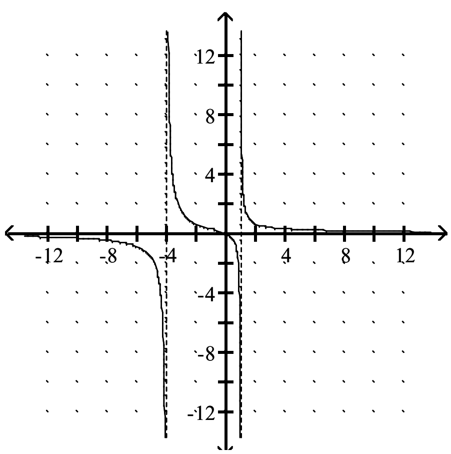
194) $f(x) = \dfrac{x^2 - 16}{x + 2}$



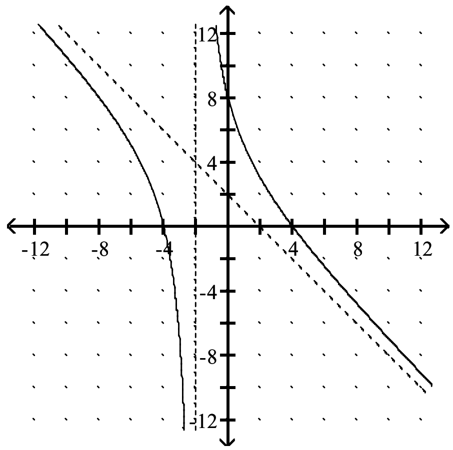
A)



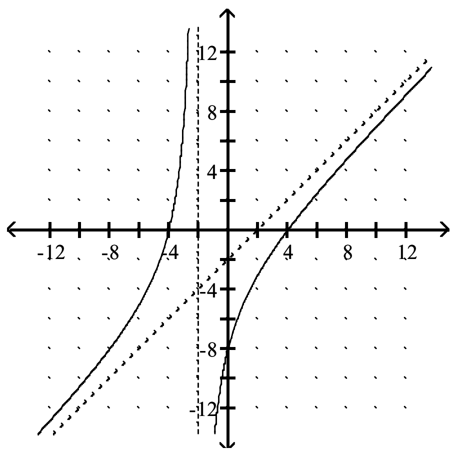
B)



C)

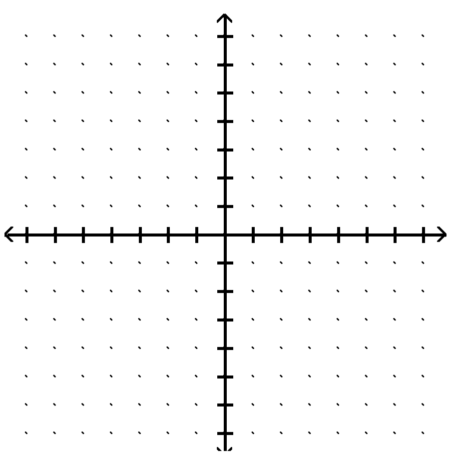


D)

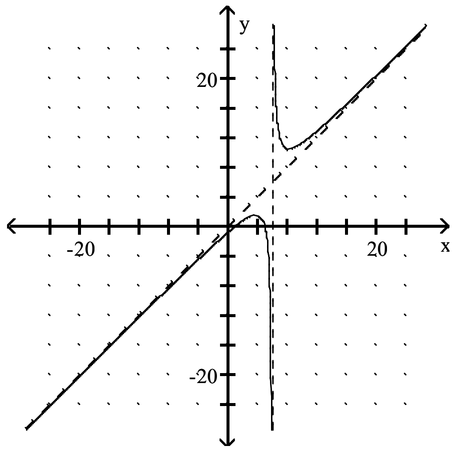


Answer: D

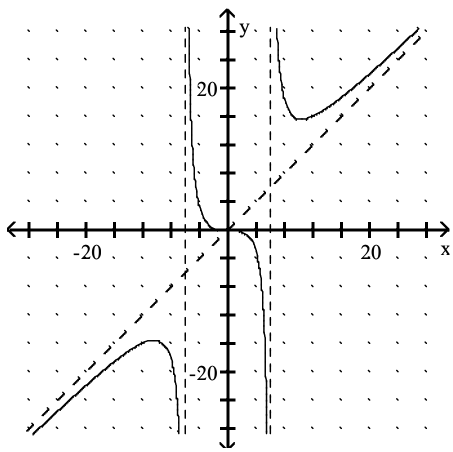
195) $f(x) = \dfrac{x^3}{x^2 - 36}$



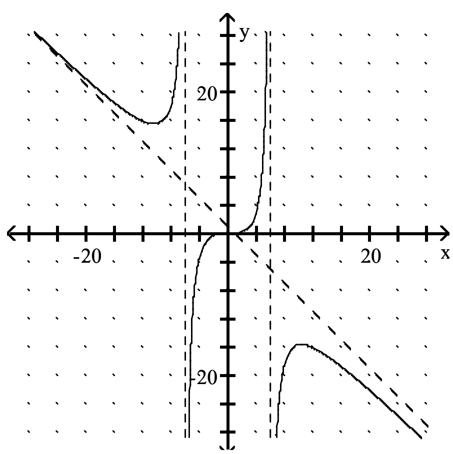
A)



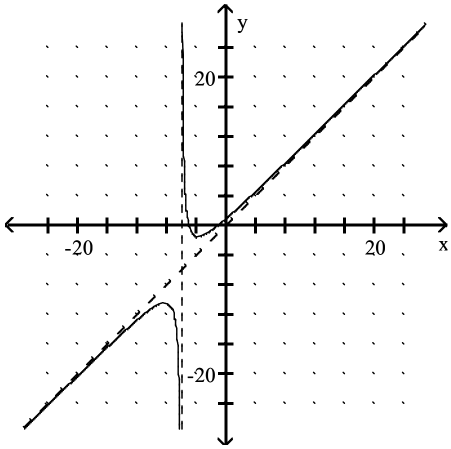
B)



C)

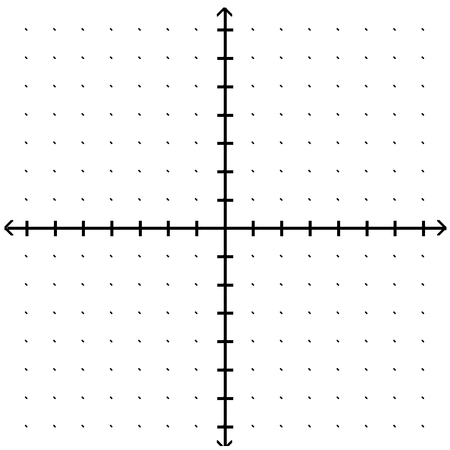


D)

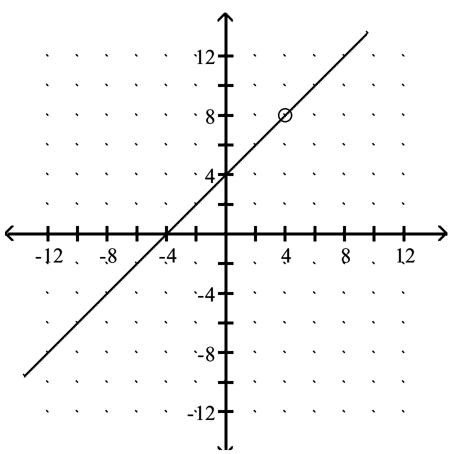


Answer: B

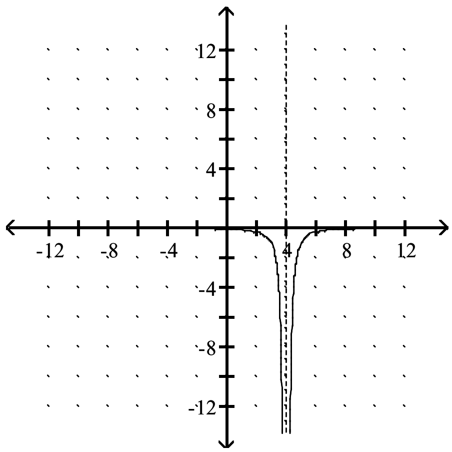
196) $f(x) = \dfrac{x^2 - 16}{x - 4}$



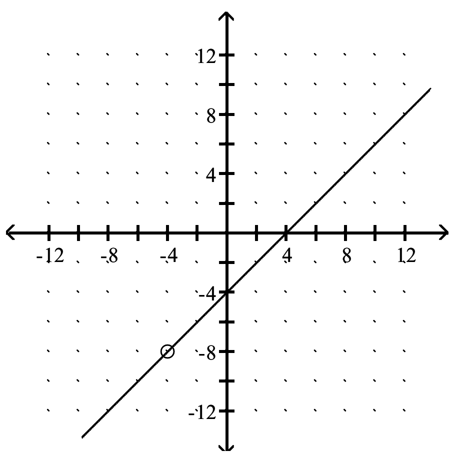
A)



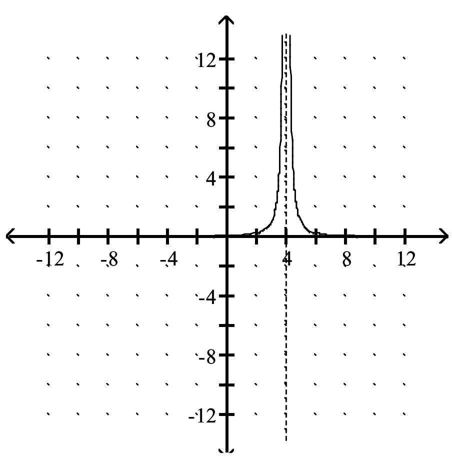
B)



C)

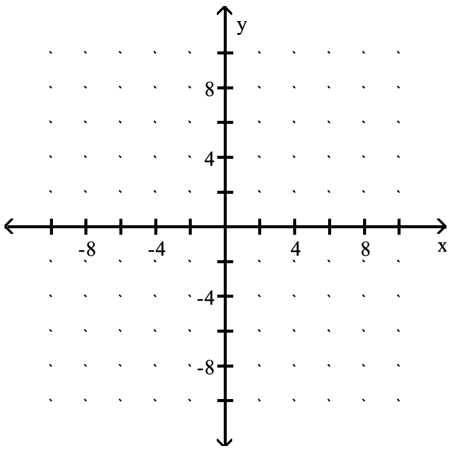


D)

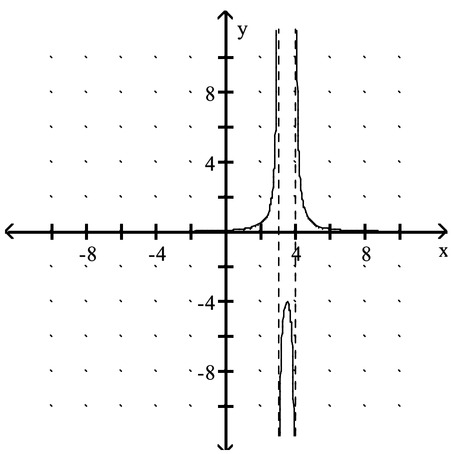


Answer: A

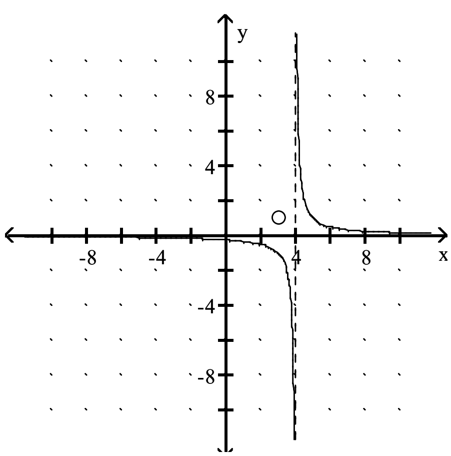
197) $f(x) = \dfrac{x + 3}{x^2 + 7x + 12}$



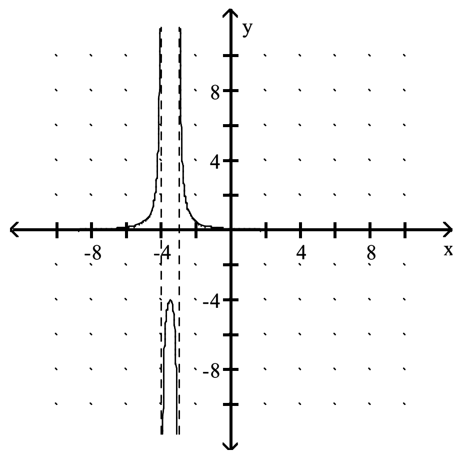
A)



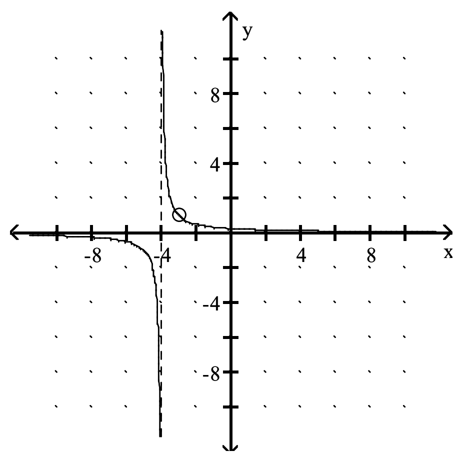
B)



C)

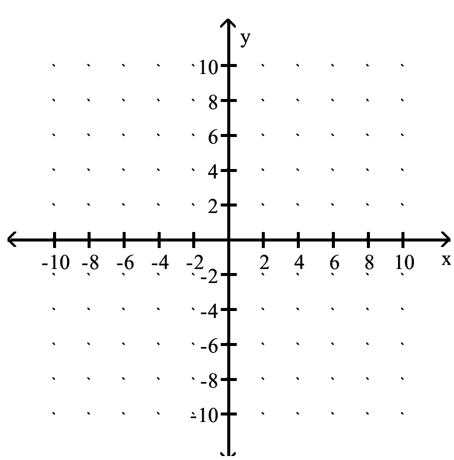


D)

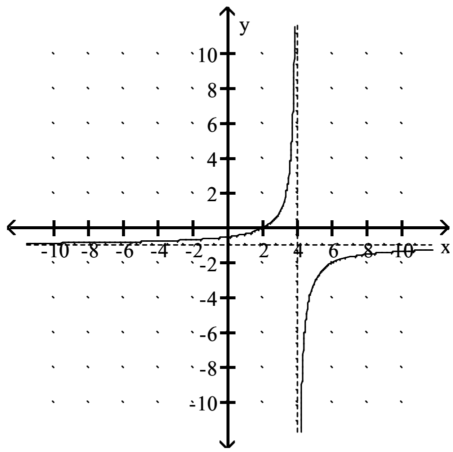


Answer: D

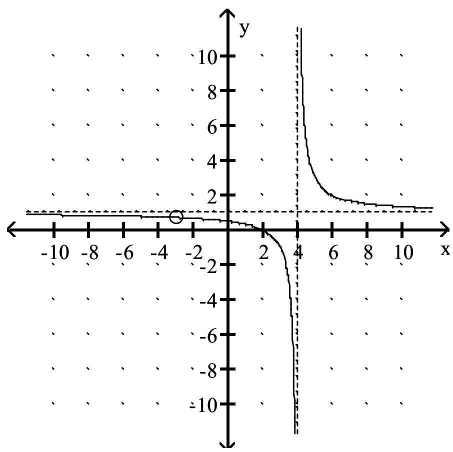
198) $f(x) = \dfrac{x^2 + x - 6}{x^2 - x - 12}$



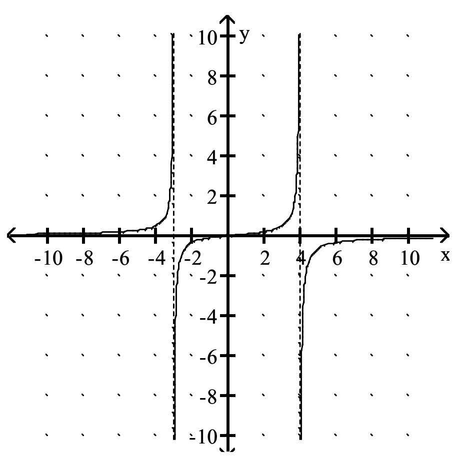
A)


y
10
8
6
4
2
-10 -8 -6 -4 -2 2 4 6 8 10 x
-2
-4
-6
-8
-10

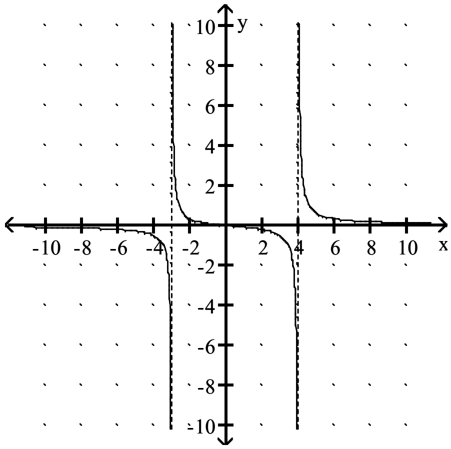
B)


y
10
8
6
4
2
-10 -8 -6 -4 -2 2 4 6 8 10 x
-2
-4
-6
-8
-10

C)

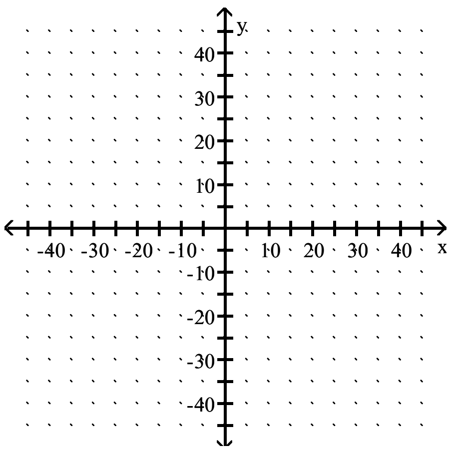

10 y
8
6
4
2
-10 -8 -6 -4 -2 2 4 6 8 10 x
-2
-4
-6
-8
-10

D)

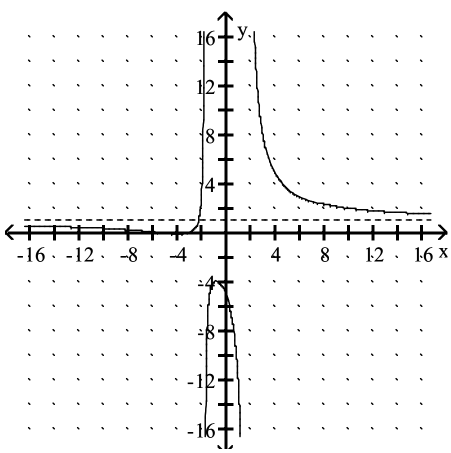


Answer: B

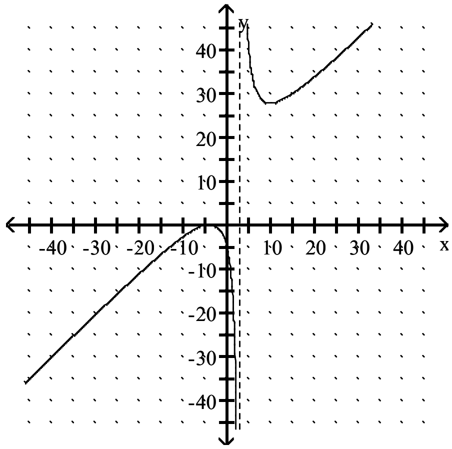
199) $f(x) = \frac{x^2 + 8x + 15}{x - 3}$



A)

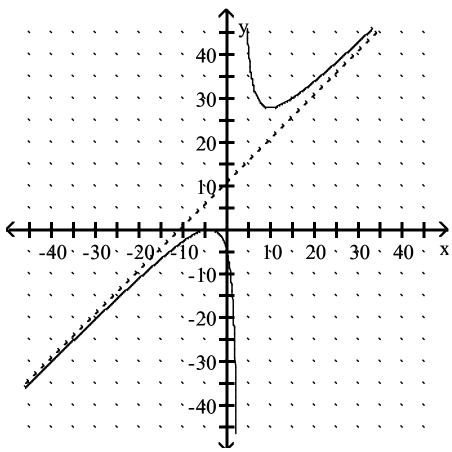


B)



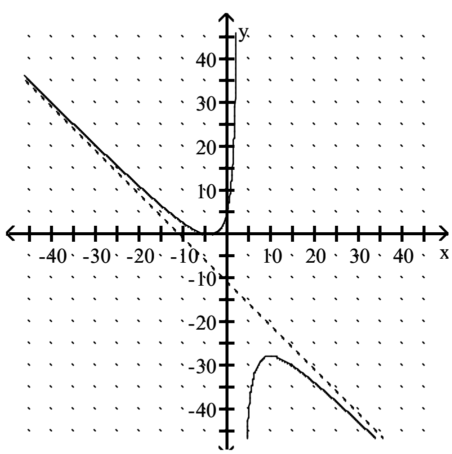
y
40
30
20
10
-40
-30
-20
-10
10
20
30
40
x
-10
-20
-30
-40

C)



y
40
30
20
10
-40
-30
-20
-10
10
20
30
40
x
-10
-20
-30
-40

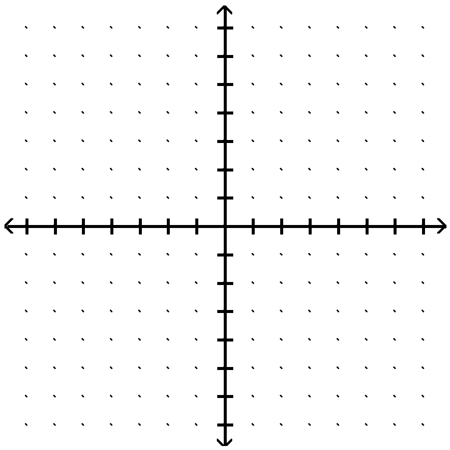
D)



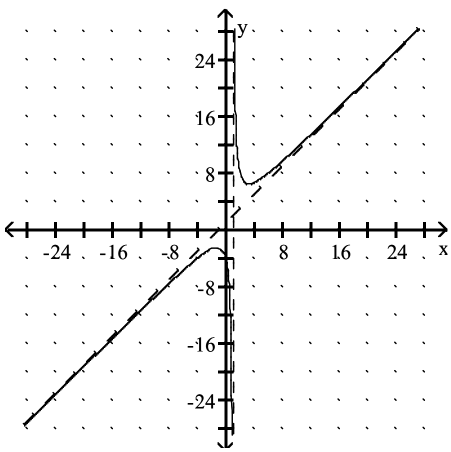
y
40
30
20
10
-40
-30
-20
-10
10
20
30
40
x
-10
-20
-30
-40

Answer: C

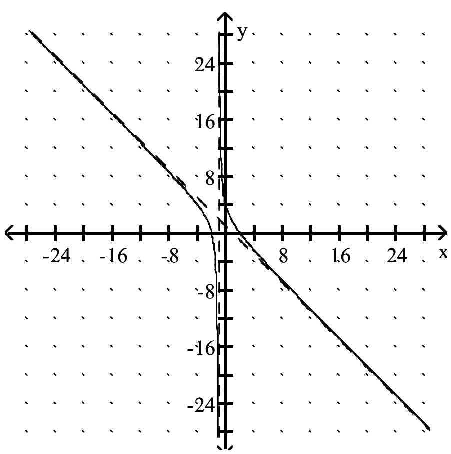
200) $f(x) = \frac{x^2 + 4}{x - 1}$



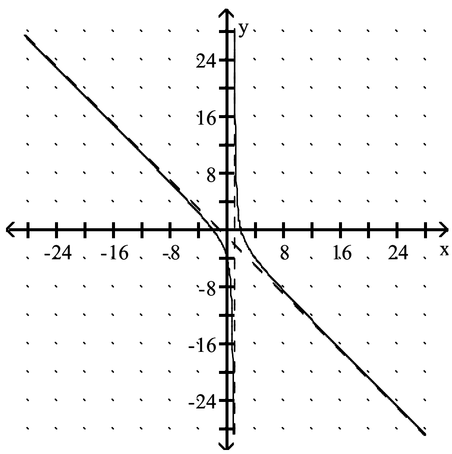
A)



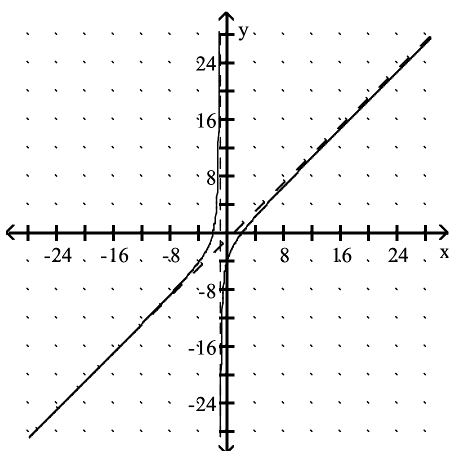
B)



C)



D)

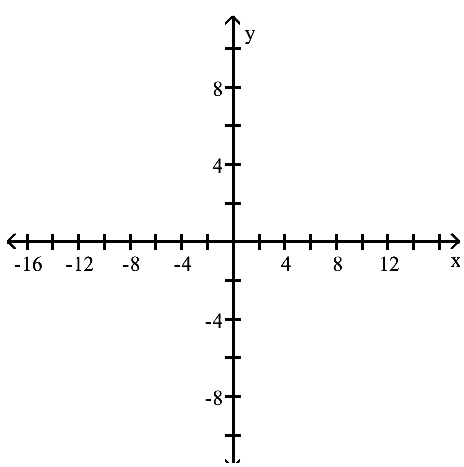


Answer: A

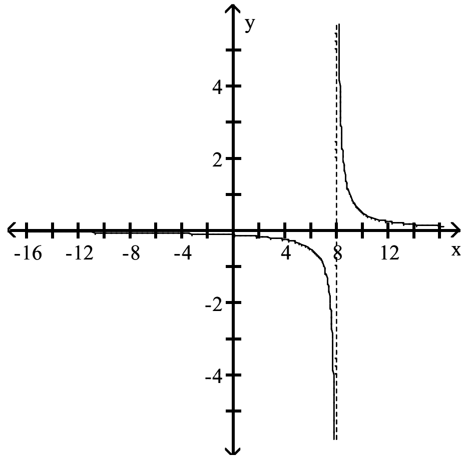
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Sketch the graph of the function. Indicate where it is increasing and where it is decreasing. Indicate where any relative extrema occur, where asymptotes occur, where the graph is concave up and where is it concave down, where any points of inflection occur, and where any intercepts occur.

201) $f(x) = \dfrac{1}{x - 8}$

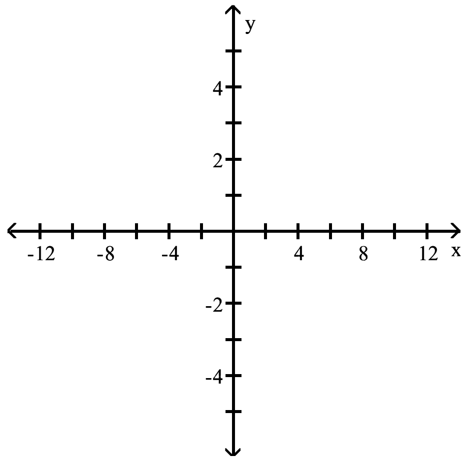


Answer:

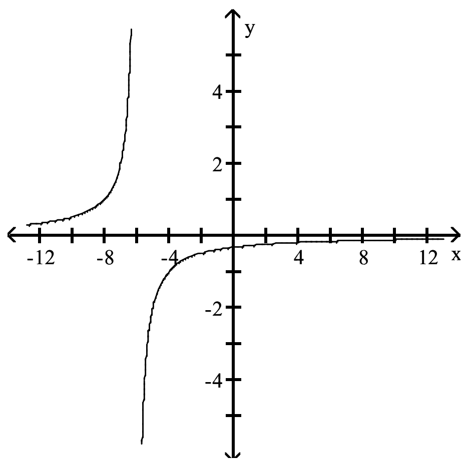


Decreasing on $(-\infty, 8)$ and $(8, \infty)$
No relative extrema
Asymptotes: $x = 8$ and $y = 0$
Concave down on $(-\infty, 8)$; concave up on $(8, \infty)$
No points of inflection
y–intercept: $\left(0, -\frac{1}{8}\right)$, no x–intercepts

202) $f(x) = \frac{-2}{x + 6}$

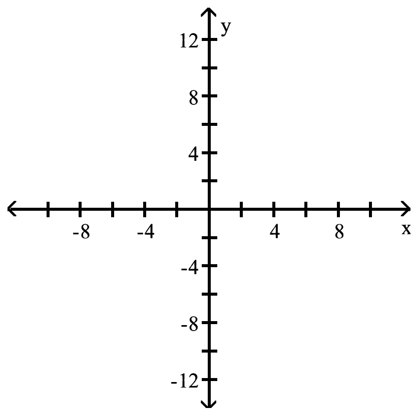


Answer:

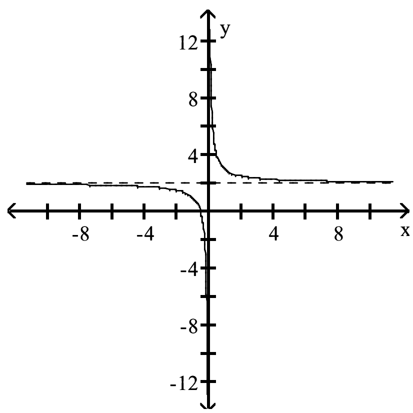


Increasing on $(-\infty, -6)$ and $(-6, \infty)$
No relative extrema
Asymptotes: $x = -6$ and $y = 0$
Concave up on $(-\infty, -6)$; concave down on $(-6, \infty)$
No points of inflection
y–intercept: $\left(0, -\frac{1}{3}\right)$, no x–intercepts

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

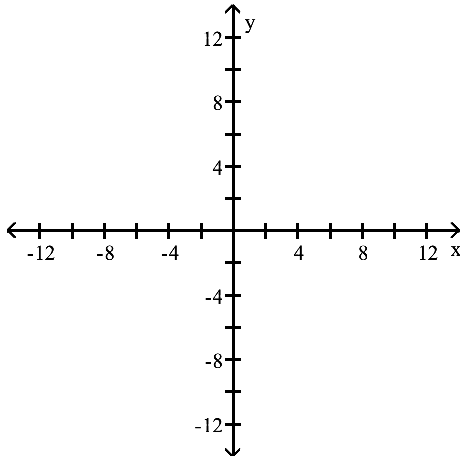


Answer:

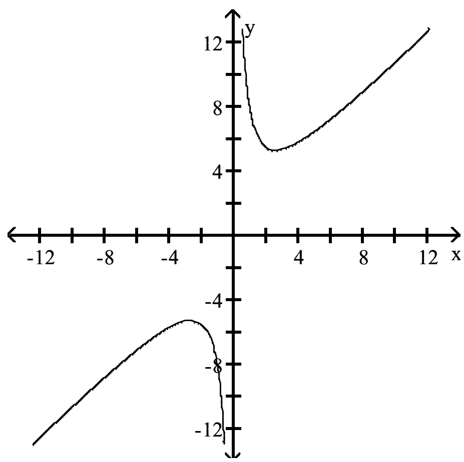


Decreasing on $(-\infty, 0)$ and $(0, \infty)$
No relative extrema
Asymptotes: $x = 0$ and $y = 2$
Concave down on $(-\infty, 0)$; concave up on $(0, \infty)$
No points of inflection
x-intercept: $\left(-\frac{1}{2}, 0\right)$, no y-intercepts

204) $f(x) = x + \frac{7}{x}$

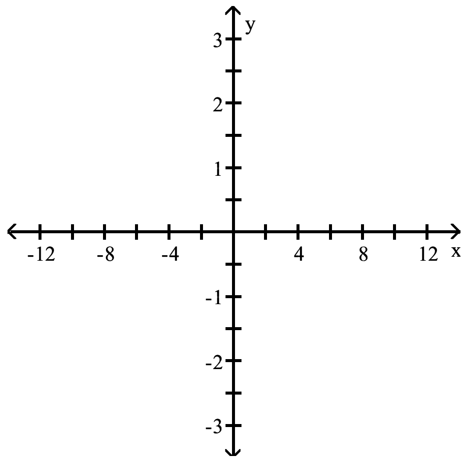


Answer:

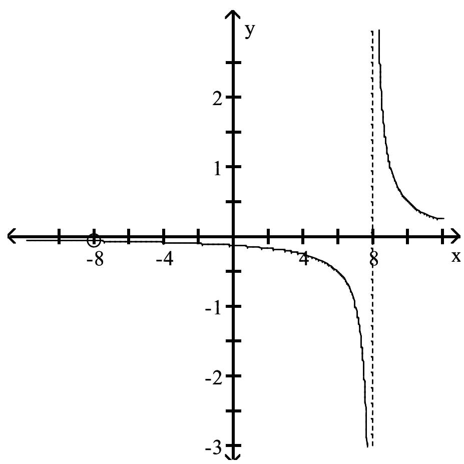


Increasing on $(-\infty, -\sqrt{7}]$ and $[\sqrt{7}, \infty)$; decreasing on $[-\sqrt{7}, 0)$ and $(0, \sqrt{7}]$
Relative minimum at $(\sqrt{7}, 2\sqrt{7})$, relative maximum at $(-\sqrt{7}, -2\sqrt{7})$
Vertical asymptote: $x = 0$; slant asymptote: $y = x$
Concave down on $(-\infty, 0)$; concave up on $(0, \infty)$
No points of inflection
No intercepts

205) $f(x) = \frac{x + 8}{x^2 - 64}$

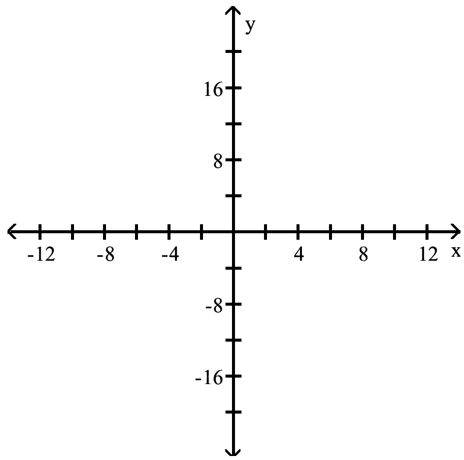


Answer:

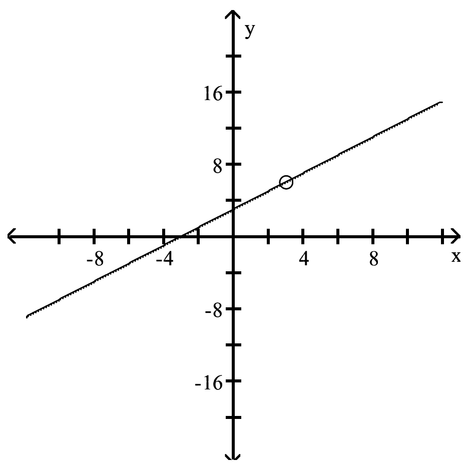


Decreasing on $(-\infty, -8)$, $(-8, 8)$, and $(8, \infty)$
No relative extrema
Asymptotes: $x = 8$ and $y = 0$
Concave down on $(-\infty, -8)$ and $(-8, 8)$; concave up on $(8, \infty)$
No points of inflection
y-intercept: $\left(0, -\frac{1}{8}\right)$, no x-intercept

206) $f(x) = \dfrac{x^2 - 9}{x - 3}$

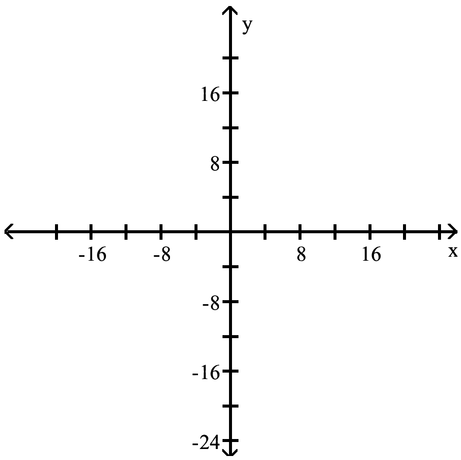


Answer:

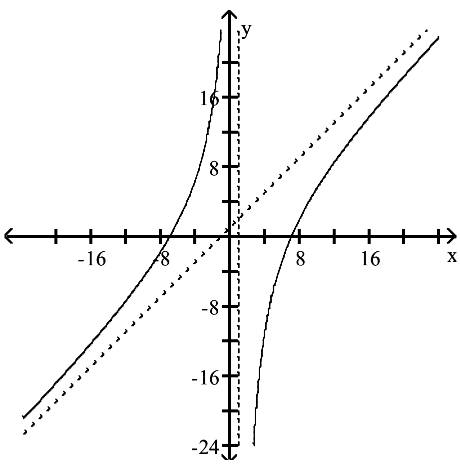


Increasing on $(-\infty, 3)$, and $(3, \infty)$
No relative extrema
No asymptotes
No concavity
No points of inflection
y-intercept: (0, 3), x-intercept: (-3, 0)

207) $f(x) = \dfrac{x^2 - 49}{x - 1}$

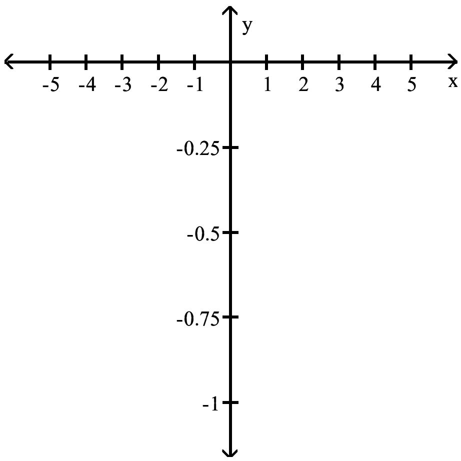


Answer:

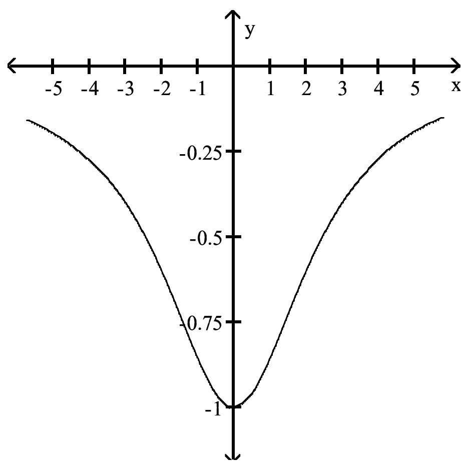


Increasing on $(-\infty, 1)$, and $(1, \infty)$
No relative extrema
Asymptotes: $x = 1$ and $y = x + 1$
Concave up on $(-\infty, 1)$; concave down on $(1, \infty)$
No points of inflection
y–intercept: $(0, 49)$, x–intercepts: $(-7, 0)$ and $(7, 0)$

208) $f(x) = \dfrac{-6}{x^2 + 6}$



Answer:

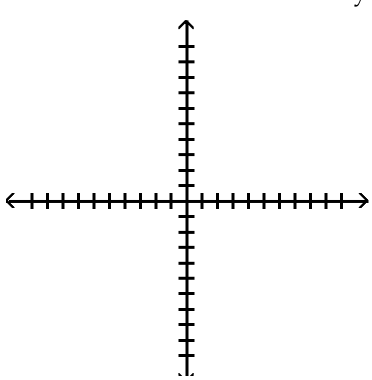


Decreasing on $(-\infty, 0]$; increasing on $[0, \infty)$
Relative minimum at $(0, -1)$
Asymptote: $y = 0$
Concave down on $(-\infty, -\sqrt{2})$ and $(\sqrt{2}, \infty)$; concave up on $(-\sqrt{2}, \sqrt{2})$
Points of inflection: $\left(-\sqrt{2}, -\dfrac{3}{4}\right), \left(\sqrt{2}, -\dfrac{3}{4}\right)$
y–intercept: $(0, -1)$; no x–intercept

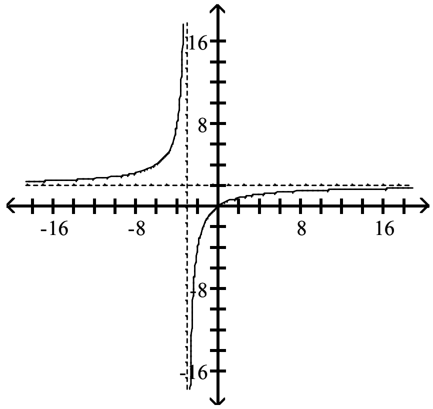
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine a rational function that meets the given conditions, and sketch its graph.

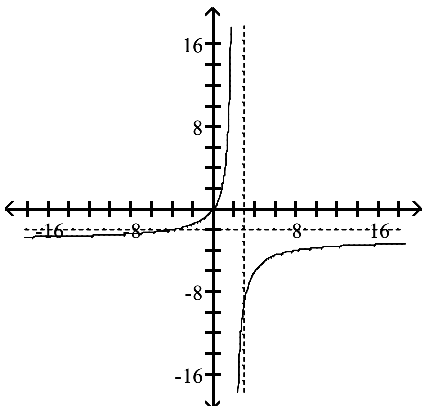
209) The function f has a vertical asymptote at $x = -3$, a horizontal asymptote at $y = 2$, and $f(0) = 0$.



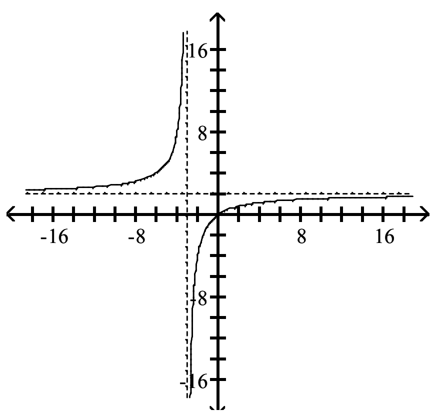
A) $f(x) = \frac{2x}{x - 3}$



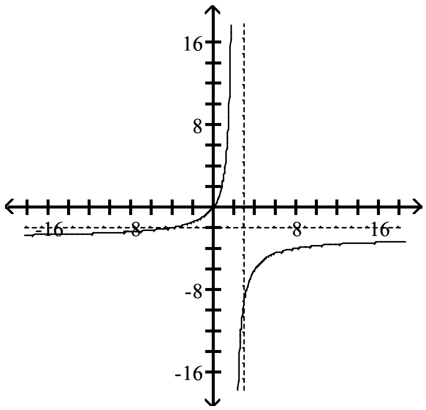
B) $f(x) = \frac{-3x}{x - 2}$



C) $f(x) = \frac{2x}{x + 3}$

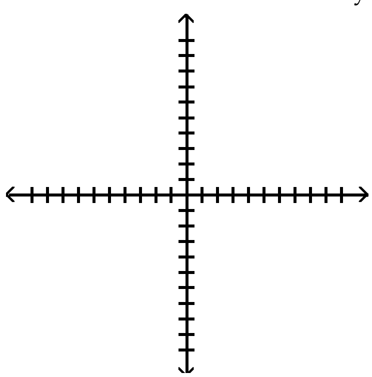


D) $f(x) = \frac{-3x}{x + 2}$

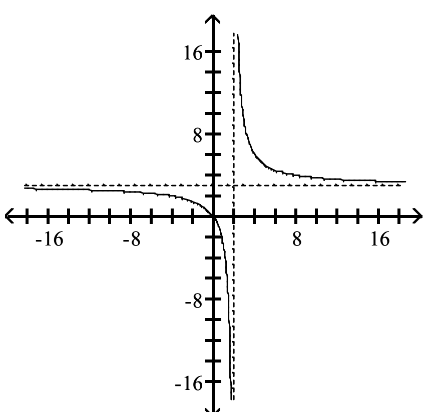


Answer: C

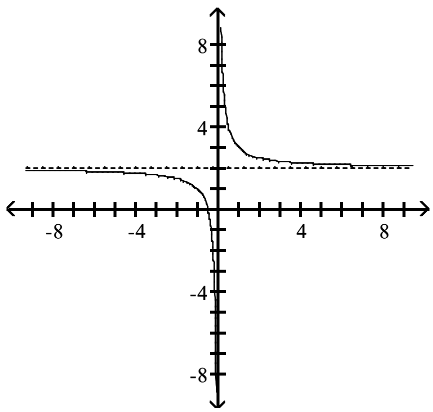
210) The function f has a vertical asymptote at x = 0, a horizontal asymptote at y = 2, and f(1) = 3.



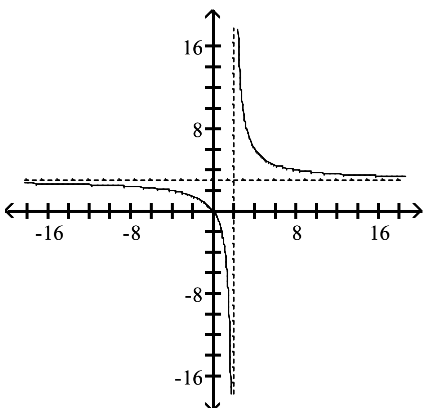
A) $f(x) = \frac{3x}{x + 2}$



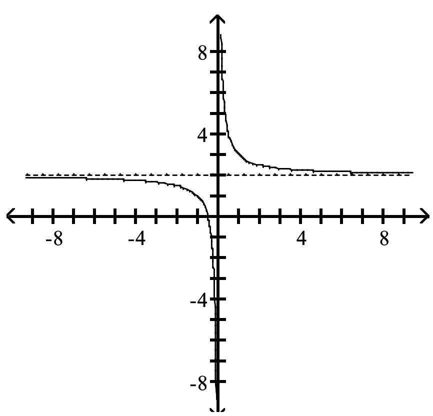
B) $f(x) = \frac{2x + 1}{x}$



C) $f(x) = \frac{3x}{x - 2}$

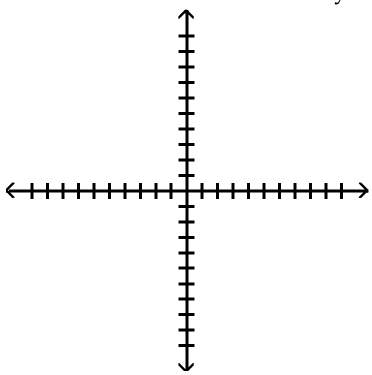


D) $f(x) = \frac{2x - 1}{x}$

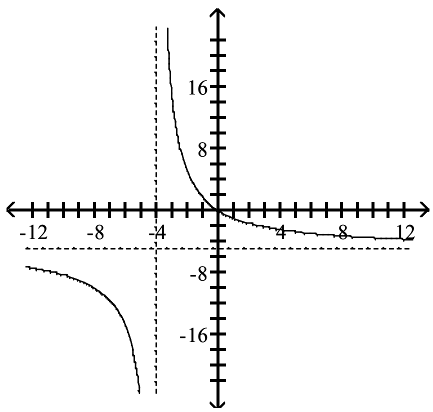


Answer: B

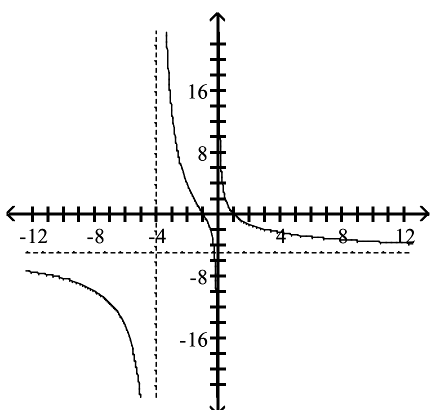
211) The function f has vertical asymptotes at x = – 4 and x = 0, a horizontal asymptote at y = –5, and f(1) = 0.



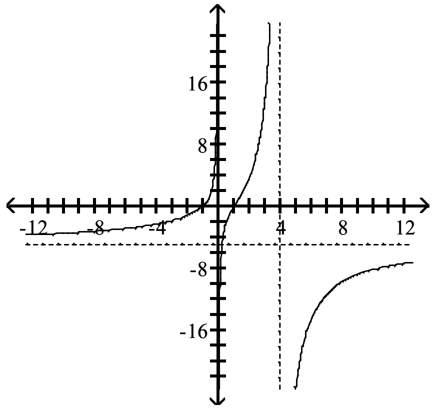
A) $f(x) = \dfrac{-5x^2}{x^2 + 4x}$



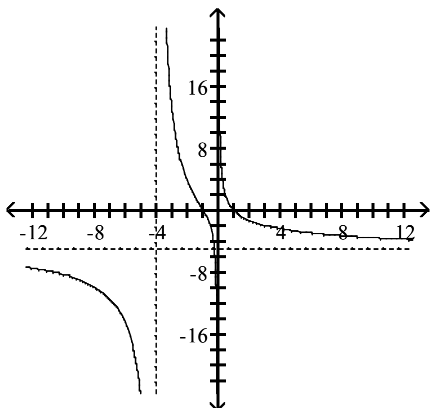
B) $f(x) = \dfrac{-5x^2 + 5}{x^2 + 4x}$



C) $f(x) = \dfrac{-5x^2 + 5}{x^2 + 4x}$

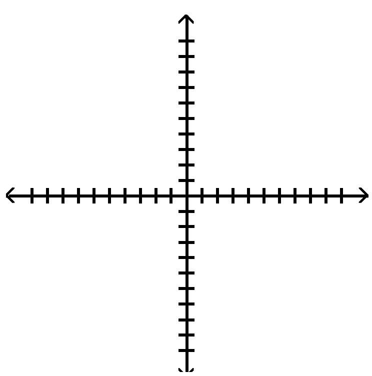


D) $f(x) = \dfrac{-5x^2 + 5}{x^2 - 4x}$

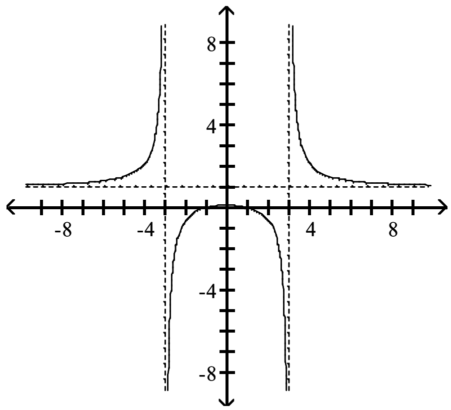


Answer: B

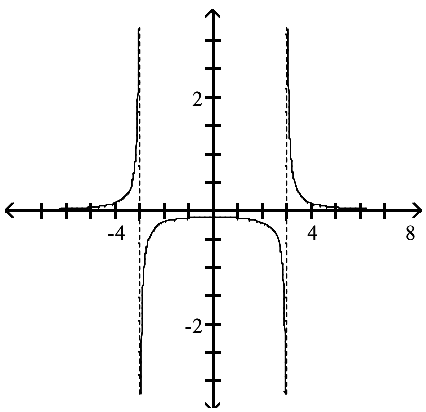
212) The function g has vertical asymptotes at $x = -3$ and $x = 3$, a horizontal asymptote at $y = 1$, x–intercepts at $x = -1$ and $x = 1$, and $g(0) = \dfrac{1}{9}$.



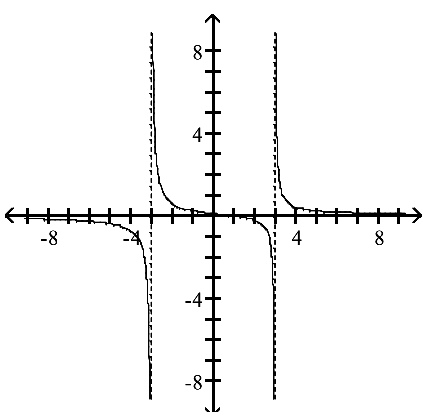
A) $g(x) = \dfrac{x - 1}{x^2 - 9}$



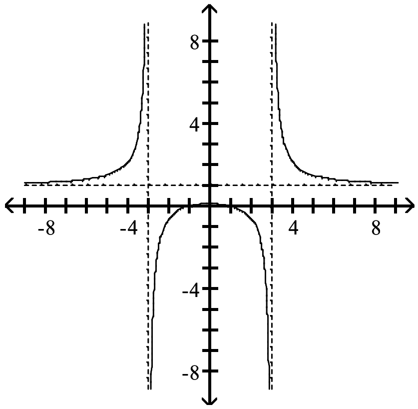
B) $g(x) = \dfrac{1}{x^2 - 9}$



C) $g(x) = \dfrac{x - 1}{x^2 - 9}$

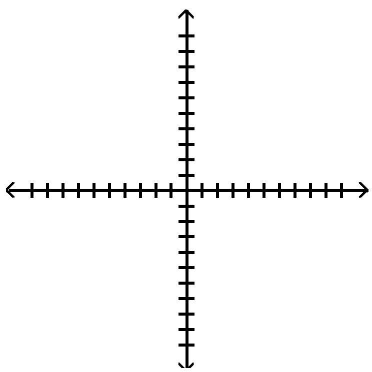


D) $g(x) = \frac{x^2 - 1}{x^2 - 9}$

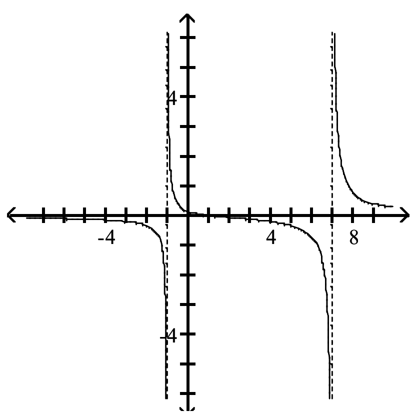


Answer: D

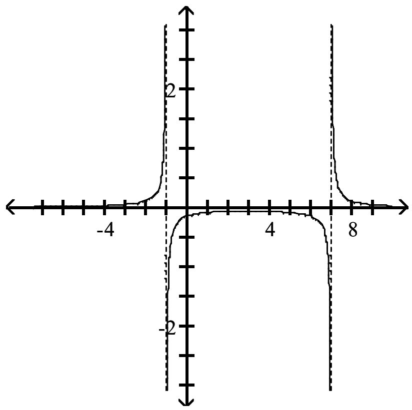
213) The function g has vertical asymptotes at x = –1 and x = 7, a horizontal asymptote at y = 0, x–intercept at x = 1, and $g(0) = \frac{1}{7}$.



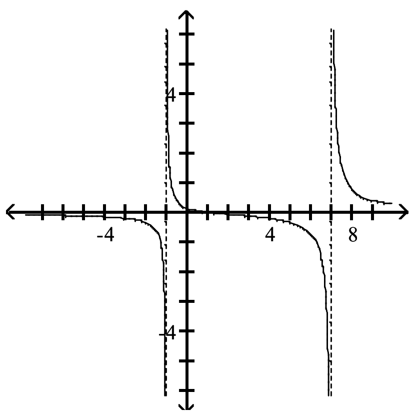
A) $g(x) = \frac{x - 1}{x^2 - 6x - 7}$



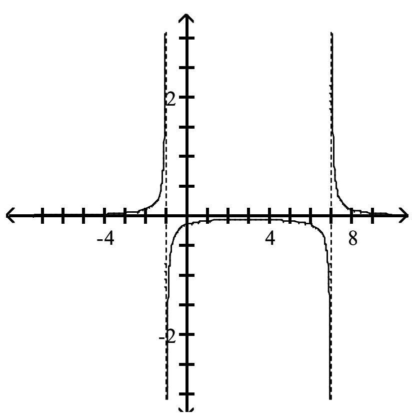
B) $g(x) = \frac{1}{x^2 - 6x - 7}$



C) $g(x) = \frac{1}{x^2 - 6x - 7}$



D) $g(x) = \frac{x - 1}{x^2 - 6x - 7}$



Answer: A

Solve the problem.

214) Suppose that the value V of a certain product decreases, or depreciates, with time t, in months, where

$$V(t) = 34 - \frac{16t^2}{(t + 2)^2}.$$

Find $\lim_{t \to \infty} V(t)$.

A) 30
B) 34
C) 16
D) 18

Answer: D

215) Suppose that the value V of a certain product decreases, or depreciates, with time t, in months, where

$$V(t) = 100 - \frac{20t^2}{(t + 2)^2}.$$

Find $\lim_{t \to \infty} V(t)$.

A) 80
B) 20
C) 100
D) 90

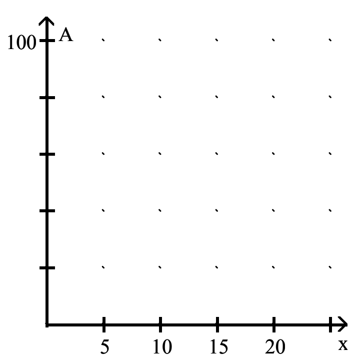
Answer: A

216) Suppose that the total-cost function for a certain company to produce x units of a product is given by $C(x) = 3x^2 + 50$.
Find the slant asymptote for the graph of the average cost function $A(x) = C(x)/x$.

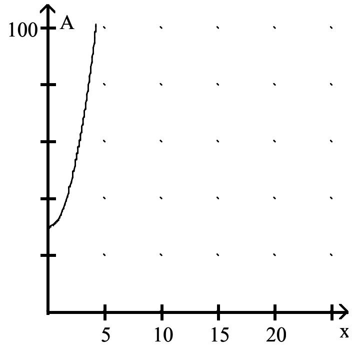
A) $y = 3x^2$
B) $y = 3x$
C) $y = 3x + 50$
D) $y = 6x$

Answer: B

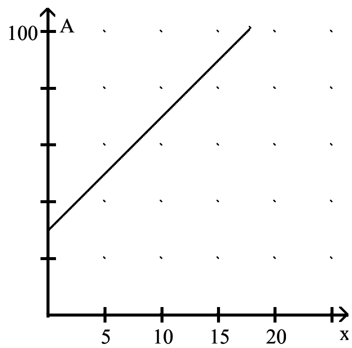
217) Suppose that the total-cost function for a certain company to produce x units of a product is given by $C(x) = 4x^2 + 30$. Graph the average cost function $A(x) = C(x)/x$.



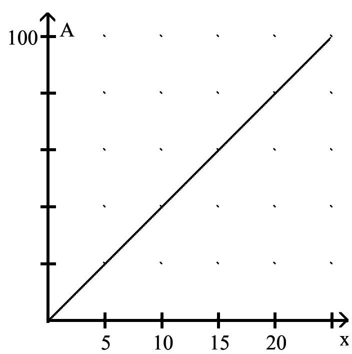
A)



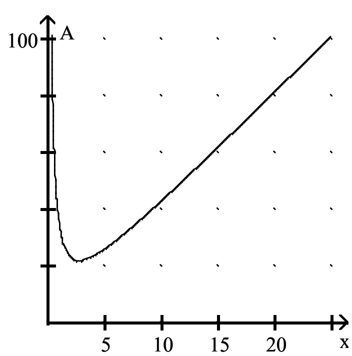
B)



C)



D)



Answer: D

218) Suppose that the cost C of removing p% of the pollutants from a chemical dumping site is given by

$C(p) = \dfrac{\$20,000}{100 - p}$.

Can a company afford to remove 100% of the pollutants? Explain.

A) No, the cost of removing p% of the pollutants increases without bound as p approaches 100.
B) Yes, the cost of removing p% of the pollutants is $200, which is certainly affordable.
C) No, the cost of removing p% of the pollutants is $200, which is a prohibitive amount of money.
D) Yes, the cost of removing p% of the pollutants is $20,000, which is certainly affordable.

Answer: A

219) Suppose that the cost C of removing p% of the contaminants from the site of a small chemical spill is given by

$C(p) = \dfrac{\$2000}{100 - p}$.

Find $\lim\limits_{p \to 100^-} C(p)$.

A) $400
B) $20
C) $2000
D) As p approaches 100, C(p) increases without bound.

Answer: D

220) After an injection, the amount of a medication A in the bloodstream decreases with time t, in hours. Suppose that under certain conditions A is given by

$A(t) = \dfrac{A_o}{t^2 + 1}$,

where A_o is the initial amount of the medication given. Assume that an initial amount of 20.0 cc is injected. According to this function, does the medication ever completely leave the bloodstream?

A) No
B) Yes

Answer: A

221) After an injection, the amount of a medication A in the bloodstream decreases with time t, in hours. Suppose that under certain conditions A is given by

$A(t) = \dfrac{A_0}{0.5t^2 + 1}$,

where A_0 is the initial amount of the medication given. Assume that an initial amount of 54.0 cc is injected.

Find $\lim\limits_{t \to \infty} A(t)$.

A) $2A_0$
B) A(t) increases without bound
C) A_0
D) 0

Answer: D

222) In baseball, a pitcher's earned–run average (the average number of runs given up every 9 innings, or 1 game) is given by

$E = 9 \cdot \frac{n}{i}$,

where n is the number of earned runs allowed and i is the number of innings pitched. Suppose we fix the number of earned runs allowed at 3 and let i vary.

Find $\lim_{i \to 0^+} E(i)$.

A) 0
B) 9
C) 3
D) ∞

Answer: D

223) In baseball, a pitcher's earned–run average (the average number of runs given up every 9 innings, or 1 game) is given by E = 9 (n/i) , where n is the number of earned runs allowed and i is the number of innings pitched. Suppose we fix the number of earned runs allowed at 6 and let i vary.

a) Complete the following table, rounding to two decimal places.

Innings pitched (i)	ERA (E)
18	
14	
10	
6	
2	
2/3	
1/3	

b) Find $\lim_{i \to 0^+} E(i)$.

c) On the basis of Parts (a) and (b), determine a pitcher's earned–run average if 6 runs were allowed and there were 0 outs.

A)

Innings pitched (i)	ERA (E)
18	3
14	3.86
10	5.4
6	9
2	27
2/3	81
1/3	162

$-\infty$; $-\infty$

B)

Innings pitched (i)	ERA (E)
18	3
14	3.86
10	5.4
6	9
2	27
2/3	81
1/3	162

162; 324

C)

Innings pitched (i)	ERA (E)
18	3
14	3.86
10	5.4
6	9
2	27
2/3	81
1/3	162

∞; ∞

D)

Innings pitched (i)	ERA (E)
18	3
14	3.86
10	5.4
6	9
2	27
2/3	81
1/3	162

∞ ; 0

Answer: C

Find the limit, if it exists.

224) $\lim\limits_{x \to \infty} \dfrac{3x - 5}{16x}$

A) -4

B) $\dfrac{1}{8}$

C) -5

D) $\dfrac{3}{16}$

Answer: D

225) $\lim\limits_{x \to \infty} \left(\dfrac{4}{x} - 5\right)$

A) -4

B) -5

C) -1

D) Does not exist

Answer: B

226) $\lim\limits_{x \to \infty} \dfrac{5 - 3x}{10 - 7x^2}$

A) $\dfrac{3}{7}$

B) 0

C) $\dfrac{1}{2}$

D) Does not exist

Answer: B

227) $\lim\limits_{x \to \infty} \dfrac{5x + 1}{12x - 7}$

A) $\dfrac{5}{12}$

B) 0

C) ∞

D) $-\dfrac{1}{7}$

Answer: A

228) $\lim\limits_{x \to \infty} \dfrac{5x^3 + 4x^2}{6x^2 - x}$

A) $\dfrac{2}{3}$

B) 5

C) 0

D) ∞

Answer: D

229) $\lim\limits_{x \to \infty} \dfrac{3x - 5x^2 + 7x^3}{5 - 2x - x^3}$

A) -7

B) ∞

C) 7

D) $\dfrac{3}{2}$

Answer: A

230) $\lim\limits_{x \to -\infty} \dfrac{5x^3 + 4x^2}{5x^2 - x}$

A) 0

B) -5

C) $\dfrac{4}{5}$

D) $-\infty$

Answer: D

231) $\lim_{x \to -\infty} \dfrac{3x^3 + 4x^2}{x - 6x^2}$

A) $-\dfrac{2}{3}$

B) $-\infty$

C) 3

D) ∞

Answer: D

232) $\lim_{x \to -\infty} \dfrac{5 - 3x^2}{12 - 5x}$

A) $\dfrac{3}{5}$

B) ∞

C) $\dfrac{5}{12}$

D) $-\infty$

Answer: D

233) $\lim_{x \to -\infty} \dfrac{7x^5 - 6x^2 + 10}{3 - 2x - x^4}$

A) $-\infty$

B) -7

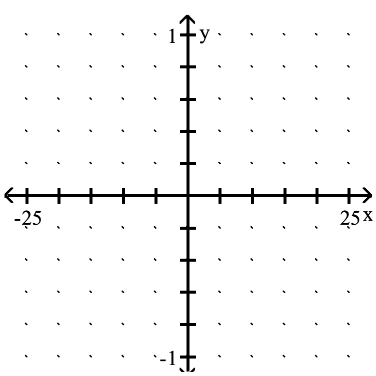
C) ∞

D) 7

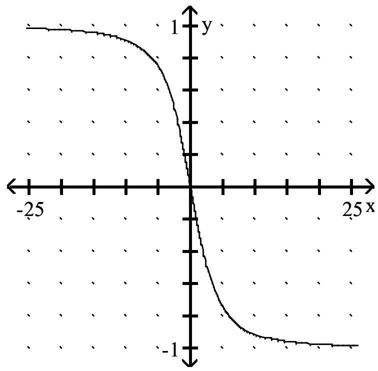
Answer: C

Use a graphing calculator to graph the function.

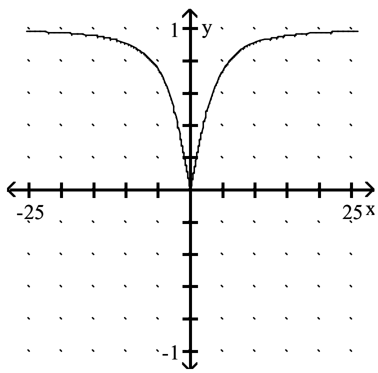
234) $f(x) = \dfrac{x}{\sqrt{x^2 + 20}}$



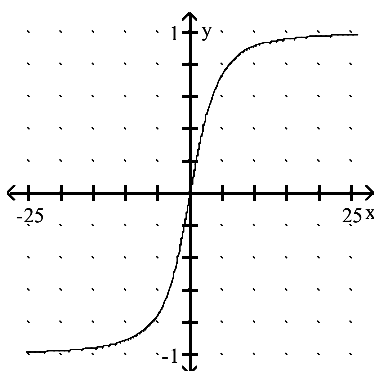
A)



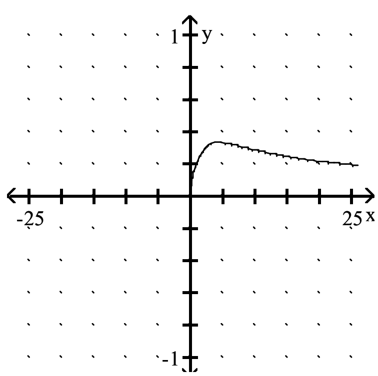
B)



C)

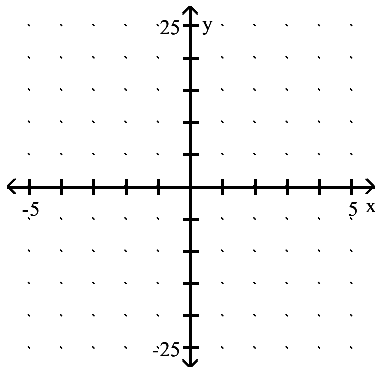


D)

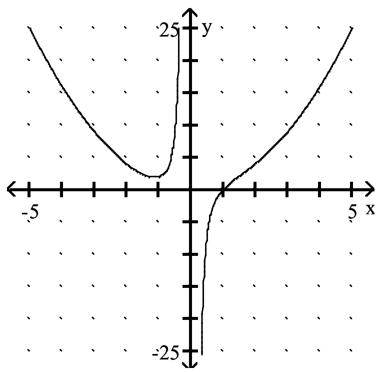


Answer: C

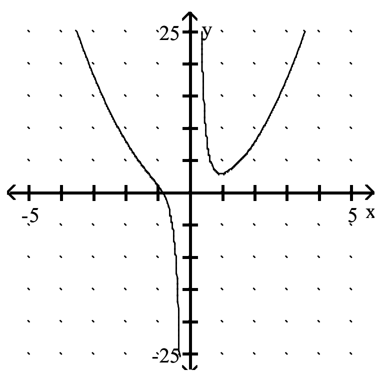
235) $f(x) = x^2 + \frac{1}{x^3}$



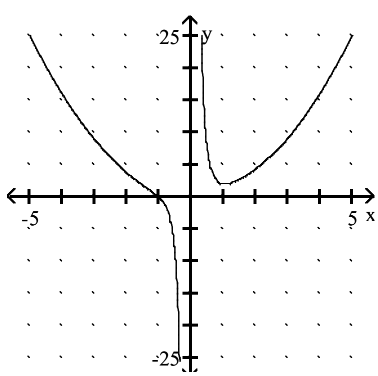
A)



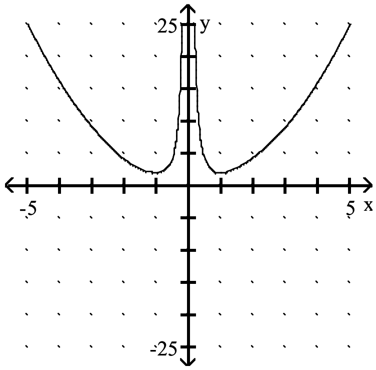
B)



C)

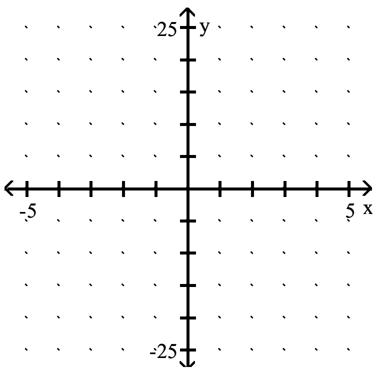


D)

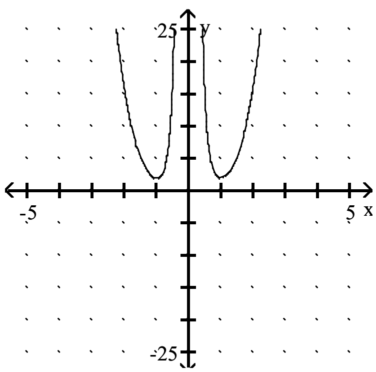


Answer: C

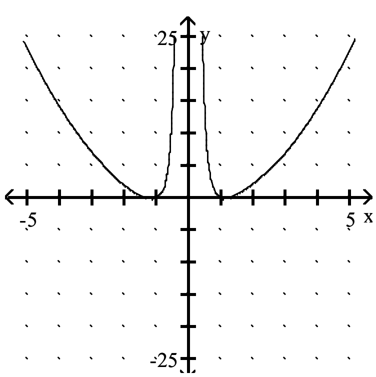
236) $f(x) = x^2 + \frac{1}{x^4}$



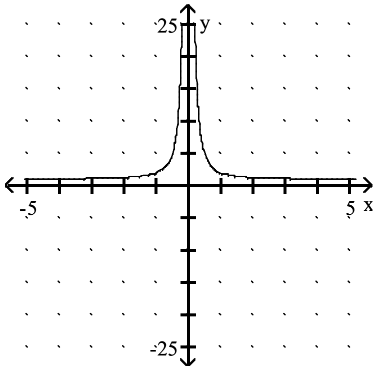
A)



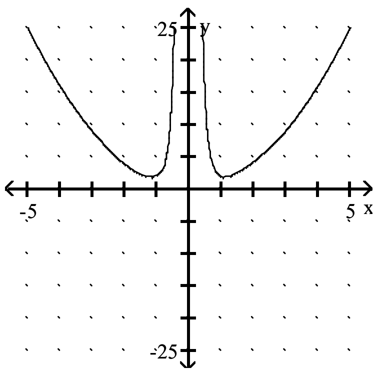
B)



C)

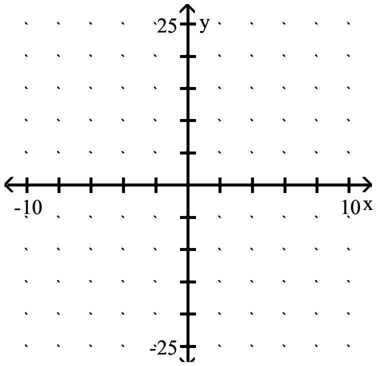


D)

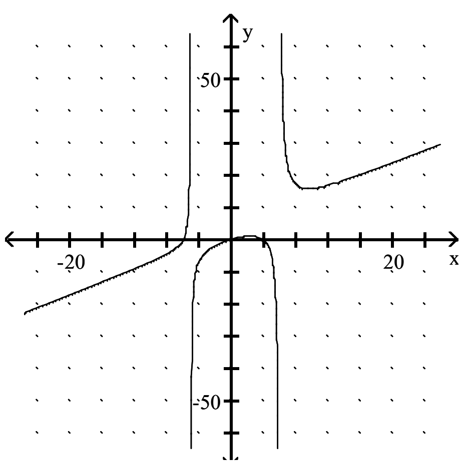


Answer: D

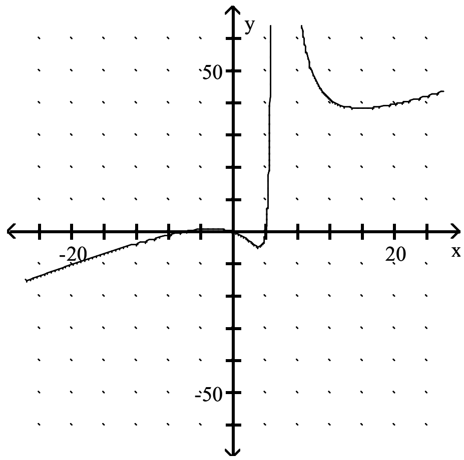
237) $f(x) = \dfrac{x\,(x + 6)\,(x - 4)}{(x - 6)\,(x + 5)}$



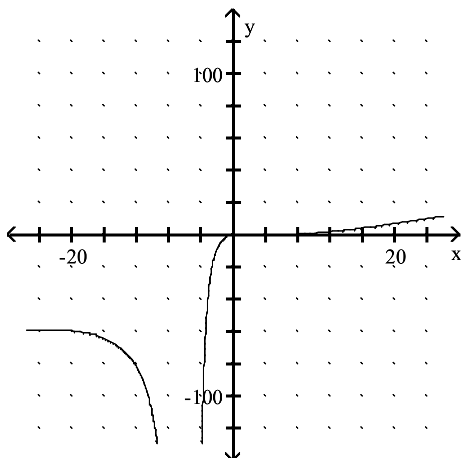
A)



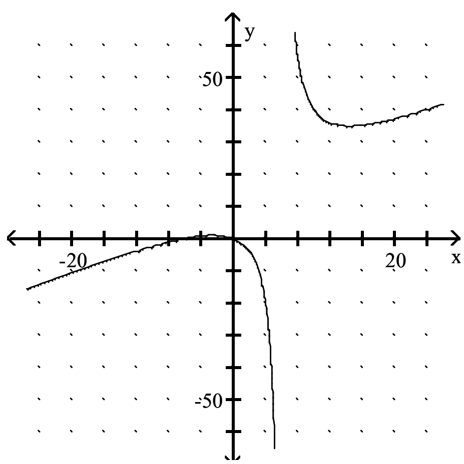
B)



C)

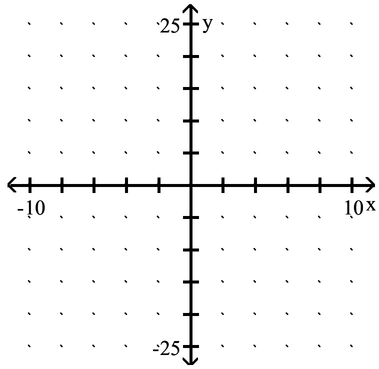


D)

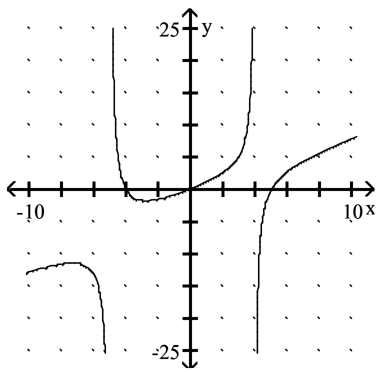


Answer: A

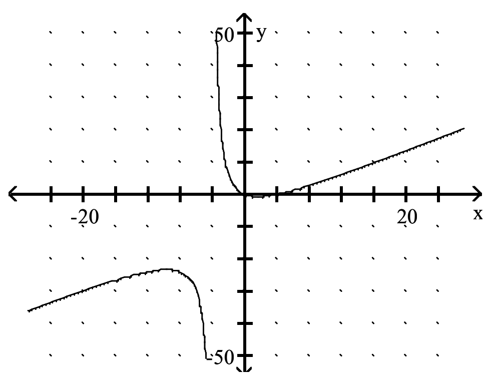
238) $f(x) = \dfrac{x^3 + x^2 - 20x}{x^2 - x - 20}$



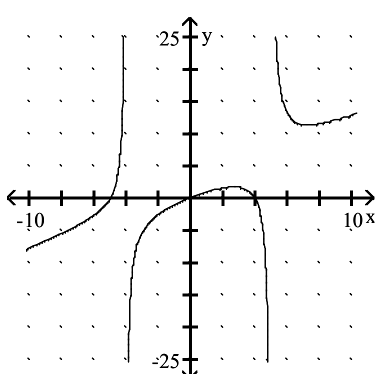
A)



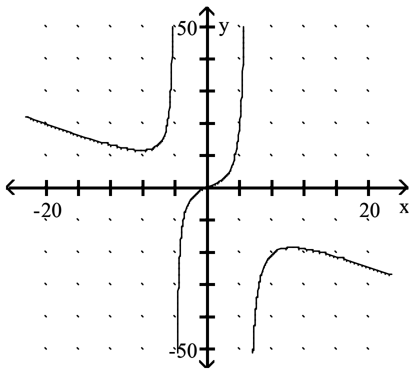
B)



C)

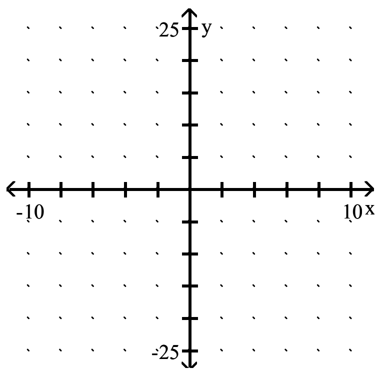


D)

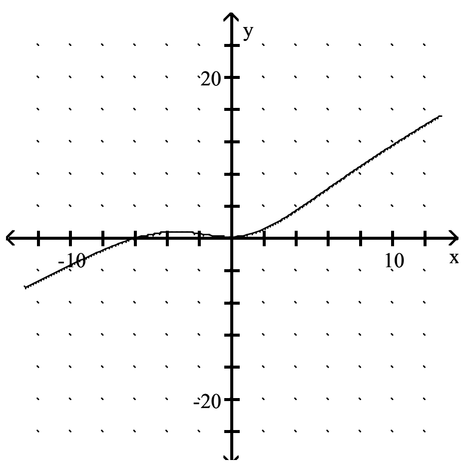


Answer: C

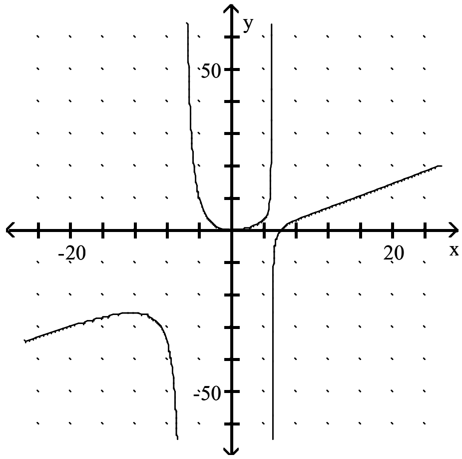
239) $f(x) = \dfrac{x^3 + 6x^2 + x + 6}{x^2 + x - 30}$



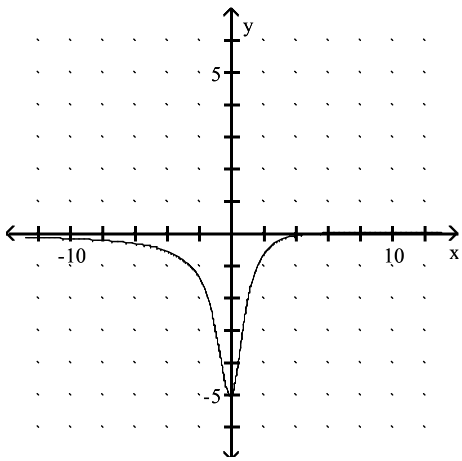
A)



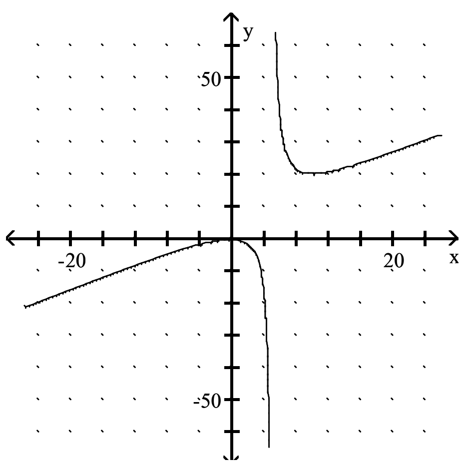
B)



C)

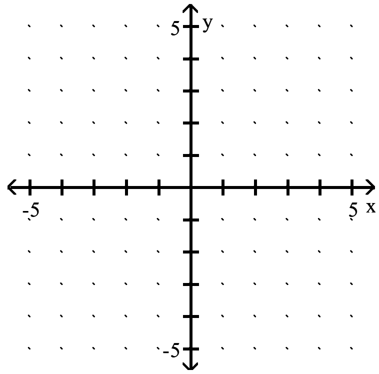


D)

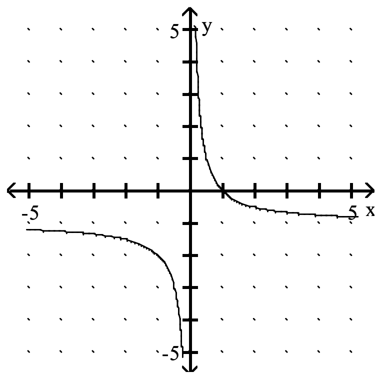


Answer: D

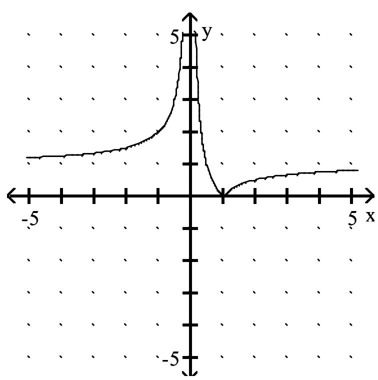
240) $f(x) = \left| \frac{1}{x} - 1 \right|$



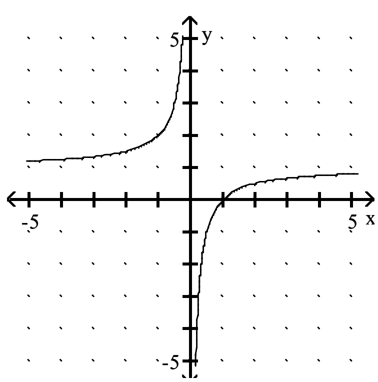
A)



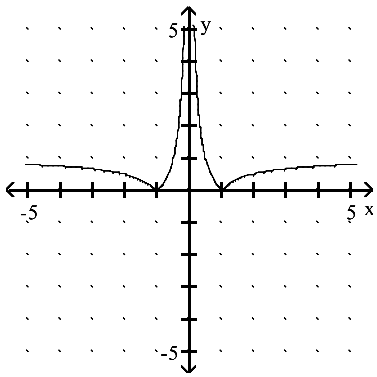
B)



C)

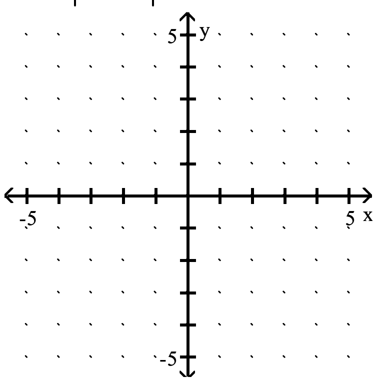


D)

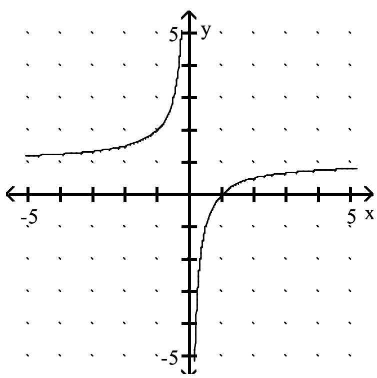


Answer: B

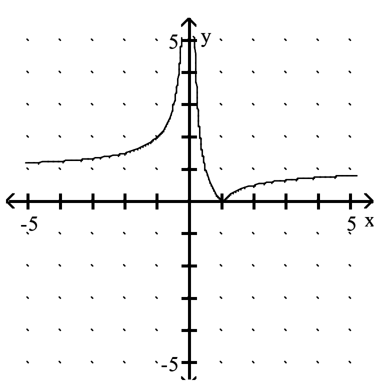
241) $f(x) = \left|1 - \frac{1}{x}\right|$



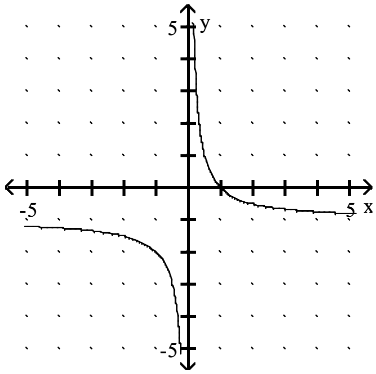
A)



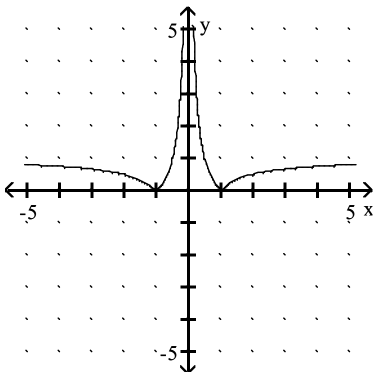
B)



C)

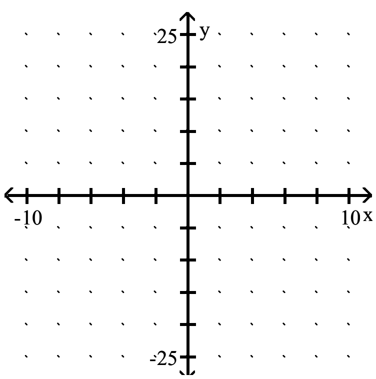


D)

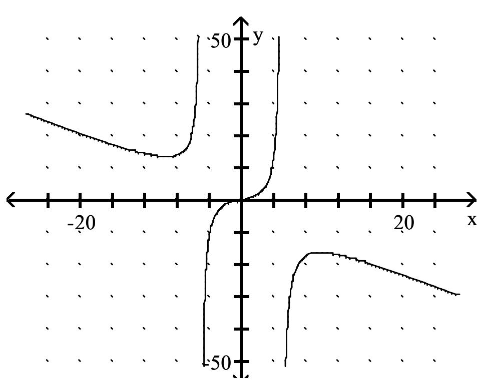


Answer: B

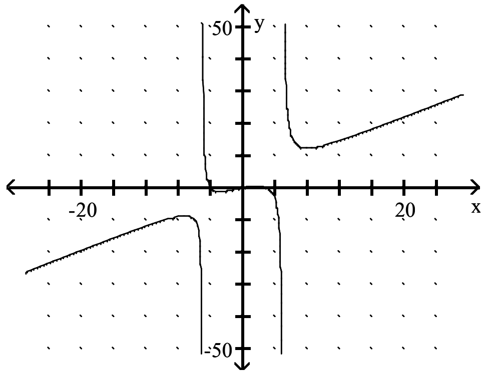
242) $f(x) = \dfrac{x^3 + x^2 - 12x}{x^2 - 25}$



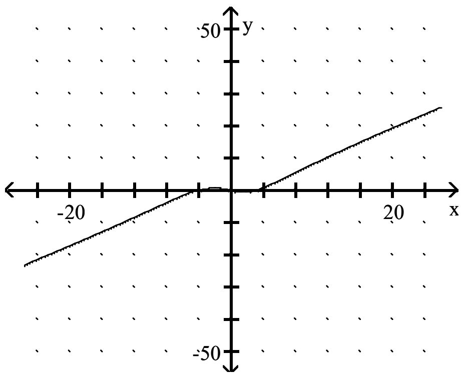
A)



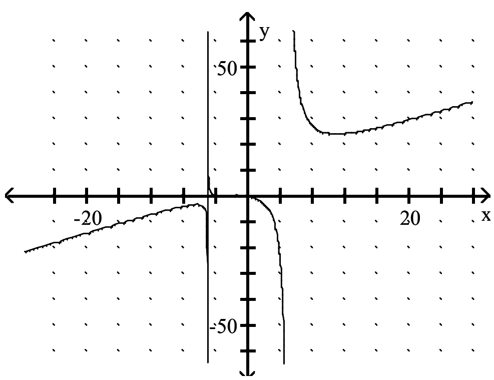
B)



C)



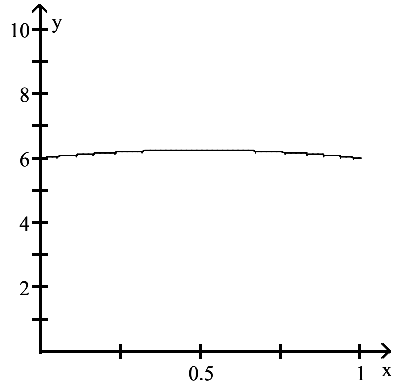
D)



Answer: B

Find the absolute maximum and absolute minimum values of the function, if they exist, over the indicated interval, and indicate the x–values at which they occur.

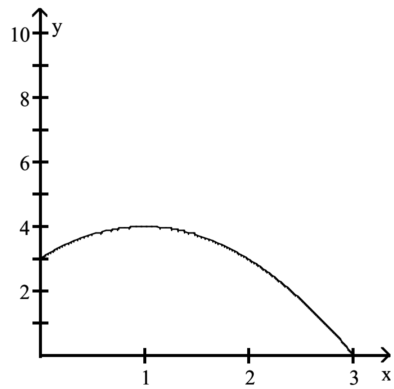
243) $f(x) = 6 + x - x^2$; [0, 1]



A) Absolute maximum = 6.5 at x = 0.5; absolute minimum = 6 at x = 0 and x = 1
B) Absolute maximum = 6.5 at x = 0.5; absolute minimum = 4 at x = 0
C) Absolute maximum = 6.75 at x = 1 and x = 2; absolute minimum = 6 at x = 0.5
D) Absolute maximum = 6.25 at x = 0.5; absolute minimum = 6 at x = 0 and x = 1

Answer: D

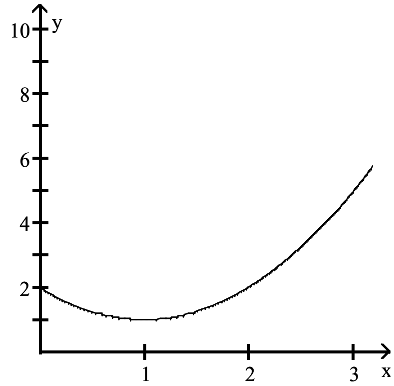
244) $f(x) = 3 + 2x - x^2$; [0, 3]



A) Absolute maximum = 4 at x = 1; absolute minimum = 3 at x = 0
B) Absolute maximum = 5 at x = 1; absolute minimum = 0 at x = 3
C) Absolute maximum = 4 at x = 1; absolute minimum = 0 at x = 3
D) Absolute maximum = 2 at x = 2; absolute minimum = 0 at x = 0

Answer: C

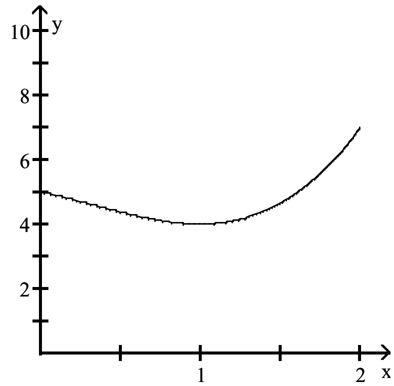
245) $f(x) = x^2 - 2x + 2$; [0, 3]



A) Absolute maximum = 5 at x = 3; absolute minimum = 3 at x = 0
B) Absolute maximum = 5 at x = 3; absolute minimum = 1 at x = 1
C) Absolute maximum = 2 at x = 0; absolute minimum = 3 at x = 3
D) Absolute maximum = 2 at x = 0; absolute minimum = 1 at x = 1

Answer: B

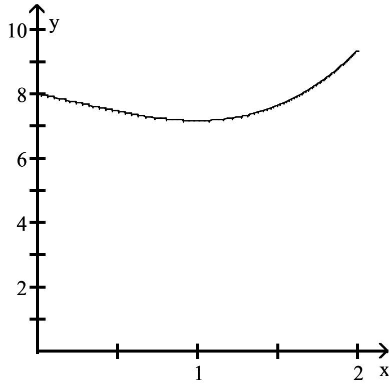
246) $f(x) = x^3 - x^2 - x + 5$; [0, 2]



A) Absolute maximum = 7 at x = 2; absolute minimum = 4 at x = 1
B) Absolute maximum = 5.2 at x = 2; absolute minimum = 4 at x = 0
C) Absolute maximum = 7 at x = 2; absolute minimum = 5.2 at x = 0
D) Absolute maximum = 5 at x = 0; absolute minimum = 4 at x = 1

Answer: A

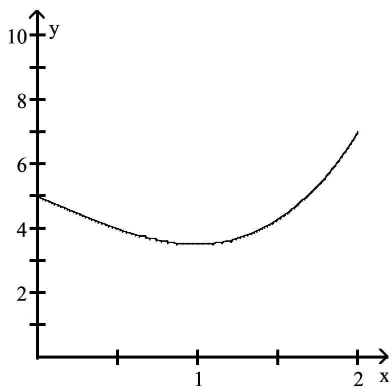
247) $f(x) = \frac{2}{3}x^3 - \frac{1}{2}x^2 - x + 8$; [0, 2]



A) Absolute maximum = 8.29 at x = 0; absolute minimum = 7.17 at x = 1
B) Absolute maximum = 9.33 at x = 2; absolute minimum = 7.17 at x = 1
C) Absolute maximum = 8 at x = 2; absolute minimum = 7.17 at x = 1
D) Absolute maximum = 9.33 at x = 2; absolute minimum = 8.29 at x = 0

Answer: B

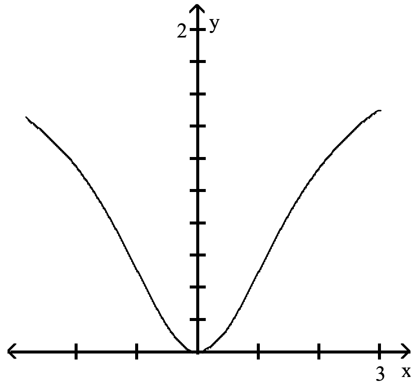
248) $f(x) = x^3 - \frac{1}{2}x^2 - 2x + 5$; [0, 2]



A) Absolute maximum = 5 at x = 2; absolute minimum = 3.5 at x = 1
B) Absolute maximum = 4.0 at x = 0; absolute minimum = 3.5 at x = 2
C) Absolute maximum = 7 at x = 2; absolute minimum = 3.5 at x = 1
D) Absolute maximum = 7 at x = 0; absolute minimum = 4.0 at x = 1

Answer: C

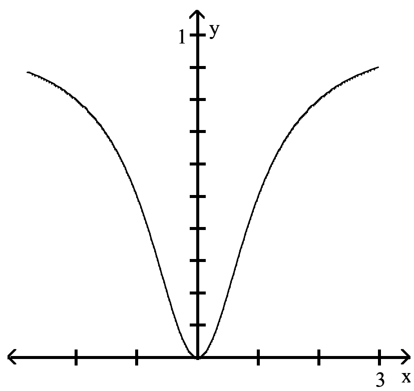
249) $f(x) = \frac{2x^2}{x^2 + 3}$; [−3, 3]



A) Absolute maximum = 1.5 at x = −3 and x = 3; absolute minimum = 0 at x = 0
B) Absolute maximum = 1 at x = 3; absolute minimum = 0 at x = 0
C) Absolute maximum = 1.5 at x = −3; absolute minimum = −1.5 at x = 3
D) Absolute maximum = 2 at x = −3 and x = 3; absolute minimum = 0 at x = 0

Answer: A

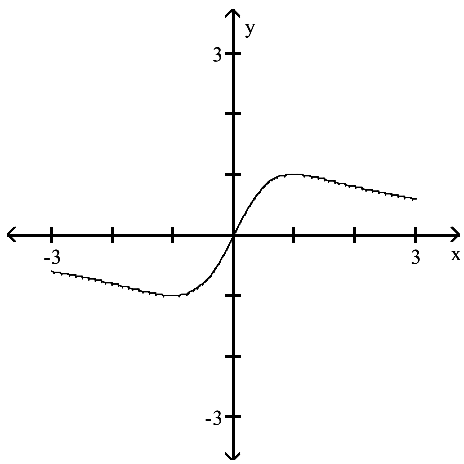
250) $f(x) = \frac{x^2}{x^2 + 1}$; [−3, 1]



A) Absolute maximum = 0.9 at x = −3; absolute minimum = 0 at x = 0
B) Absolute maximum = 1 at x = −3; absolute minimum = −3 at x = 2
C) Absolute maximum = 0.9 at x = 2; absolute minimum = −3 at x = 0
D) Absolute maximum = 0.5 at x = −3; absolute minimum = 0 at x = 0

Answer: A

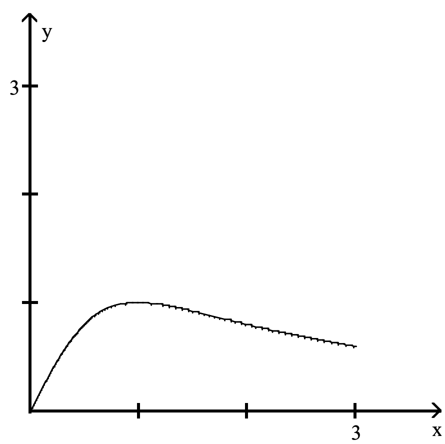
251) $f(x) = \frac{2x}{x^2 + 1}$; [–3, 3]



A) Absolute maximum = 0.6 at x = –1; absolute minimum = 0 at x = 0
B) Absolute maximum = 1 at x = 1; absolute minimum = –1 at x = –1
C) Absolute maximum = 1 at x = 1; absolute minimum = 0 at x = 0
D) Absolute maximum = 0.6 at x = 1; absolute minimum = –0.6 at x = –1

Answer: B

252) $f(x) = \frac{2x}{x^2 + 1}$; [0, 3]



A) Absolute maximum = 1 at x = 1; absolute minimum = 0 at x = 0
B) Absolute maximum = 1 at x = 1; absolute minimum = –1 at x = 0
C) Absolute maximum = 0 at x = 0; absolute minimum = –0.6 at x = 1
D) Absolute maximum = 0.6 at x = 1; absolute minimum = 0 at x = 0

Answer: A

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 (-∞, ∞).

253) f(x) = –24; [–9, 9]

A) Absolute maximum: –24, absolute minimum: –24
B) Absolute maximum: 24, absolute minimum: 0
C) Absolute maximum: 24, absolute minimum: –24
D) There are no absolute extrema.

Answer: A

254) $f(x) = 6x - 3$; $[-3, 3]$

A) Absolute maximum: 18, absolute minimum: –18

B) Absolute maximum: 15, absolute minimum: –21

C) Absolute maximum: –3, absolute minimum: 3

D) There are no absolute extrema.

Answer: B

255) $f(x) = -3 - 2x$; $[-7, 5]$

A) There are no absolute extrema

B) Absolute maximum: 17, absolute minimum: –7

C) Absolute maximum: –13, absolute minimum: –17

D) Absolute maximum: 11, absolute minimum: –13

Answer: D

256) $f(x) = 3x^2 - 4x^3$; $[0, 6]$

A) Absolute maximum: 1, absolute minimum: 0

B) No absolute maximum, absolute minimum: –756

C) Absolute maximum: $\frac{1}{4}$, absolute minimum: 0

D) Absolute maximum: $\frac{1}{4}$, absolute minimum: –756

Answer: D

257) $f(x) = x^4 - 5x^3$; $[-5, 5]$

A) Absolute maximum: 0, absolute minimum: $-\frac{16875}{256}$

B) Absolute maximum: 625, absolute minimum: $-\frac{16875}{64}$

C) Absolute maximum: 1250, absolute minimum: 0

D) Absolute maximum: 1250, absolute minimum: $-\frac{16875}{256}$

Answer: D

258) $f(x) = x + \frac{16}{x}$; $[-6, -1]$

A) Absolute maximum: –8, absolute minimum: –15

B) Absolute maximum: $-\frac{26}{3}$, absolute minimum: –17

C) Absolute maximum: –8, absolute minimum: $-\frac{26}{3}$

D) Absolute maximum: –8, absolute minimum: –17

Answer: D

259) $f(x) = \frac{1}{3}x^3 - 3x$;   [−6, 6]

A) Absolute maximum: 3.46, absolute minimum: −3.46
B) Absolute maximum: 3.46, absolute minimum: − 54
C) Absolute maximum: 54, absolute minimum: − 54
D) Absolute maximum: 54, absolute minimum: −3.46

Answer: C

260) $f(x) = \frac{1}{4}x^4 - x$;   [−4, 4]

A) Absolute maximum: 68, absolute minimum: $-\frac{3}{4}$

B) Absolute maximum: 68, absolute minimum: 60

C) Absolute maximum: 60, absolute minimum: $-\frac{3}{4}$

D) Absolute maximum: $\frac{3}{4}$, absolute minimum: $-\frac{3}{4}$

Answer: A

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

261) $f(x) = x^3 + \frac{1}{2}x^2 - 4x + 2$; [−9, 0]

A) Absolute maximum: $-\frac{1301}{2}$, absolute minimum: $\frac{158}{27}$

B) There are no absolute extrema.

C) Absolute maximum: $\frac{158}{27}$, absolute minimum: $-\frac{1301}{2}$

D) Absolute maximum: $\frac{286}{27}$, absolute minimum: $\frac{1615}{2}$

Answer: C

262) $f(x) = x^2 - 8x + 17$; [0, 6]

A) Absolute maximum: 1
B) Absolute maximum: 17, absolute minimum: 1
C) Absolute maximum: 5, absolute minimum: 1
D) Absolute maximum: 17, absolute minimum: 5

Answer: B

263) $f(x) = x^3 - 3x + 5$; [−1, 5]

A) Absolute maximum: 115, absolute minimum: 3
B) Absolute minimum: 1
C) Absolute maximum: 3, absolute minimum: 1
D) Absolute maximum: 115

Answer: A

264) $f(x) = -5 - 4x - 2x^2$; [−2, 1]

A) Absolute maximum: −5, absolute minimum: −11
B) Absolute maximum: −3; absolute minimum: −11
C) Absolute maximum: 7
D) Absolute maximum: 7; absolute minimum: −5

Answer: B

265) $f(x) = x^4 - 32x^2 + 1$; [−5, 5]

A) Absolute maximum: 0, absolute minimum: −255
B) Absolute maximum: −255
C) Absolute minimum: 0
D) Absolute maximum: 1, absolute minimum: −255

Answer: D

266) $f(x) = 2 - x^{2/3}$; [−64, 64]

A) Absolute maximum: 64, absolute minimum: −64
B) There are no absolute extrema.
C) Absolute maximum: 2, absolute minimum: −14
D) Absolute maximum: 2

Answer: C

267) $f(x) = -\dfrac{2}{x^2}$; [0.5, 5]

A) Absolute maximum = 5, absolute minimum = $-\dfrac{1}{2}$

B) Absolute maximum = $\dfrac{1}{2}$, absolute minimum = −8

C) Absolute maximum: $-\dfrac{2}{25}$, absolute minimum: −8

D) Absolute maximum = $\dfrac{2}{25}$, absolute minimum = −8

Answer: C

268) $f(x) = -x^2 + 11x - 30$: [6, 5]

A) Absolute maximum: $\dfrac{5}{4}$; absolute minimum: 0

B) Absolute maximum: $\dfrac{1}{4}$; absolute minimum: $\dfrac{1}{4}$

C) Absolute maximum: $\dfrac{1}{4}$; absolute minimum: 0

D) Absolute maximum: $\dfrac{241}{4}$; absolute minimum: $\dfrac{1}{4}$

Answer: C

269) $F(x) = \sqrt[3]{x}$; [0, 8]

A) Absolute maximum: 8, absolute minimum: 0

B) Absolute maximum: 2, absolute minimum: 0

C) Absolute maximum: 2, absolute minimum: –2

D) Absolute maximum: 0, absolute minimum: –2

Answer: B

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 (-∞, ∞).

270) $f(x) = x(30 - x)$

A) Absolute maximum: 225; absolute minimum: 0

B) No absolute maximum; absolute minimum: 15

C) Absolute maximum: 15; no absolute minimum

D) Absolute maximum: 225; no absolute minimum

Answer: D

271) $f(x) = 6x + 5$; [–3, 2)

A) Absolute maximum: 17, absolute minimum: –13

B) No absolute maximum, absolute minimum: –13

C) Absolute maximum: 17, no absolute minimum

D) No absolute extrema.

Answer: B

272) $f(x) = 2x^2 - 12x + 75$

A) Absolute maximum: 57; no absolute minimum

B) No absolute maximum; absolute minimum: 57;

C) Absolute maximum: 129; absolute minimum: 57

D) No absolute extrema

Answer: B

273) $f(x) = 20x - x^2$

A) No absolute maximum; absolute minimum: 10;

B) Absolute maximum: 100; no absolute minimum

C) Absolute maximum: 100; absolute minimum: 0

D) Absolute maximum: 200; no absolute minimum

Answer: B

274) $f(x) = x^3 + x^2 - 5x + 6$; (0, ∞)

A) Absolute maximum: 11; absolute minimum: 3

B) No absolute maximum; absolute minimum: 3

C) Absolute maximum: 6; no absolute minimum

D) No absolute extrema

Answer: B

275) $f(x) = -x^3 - x^2 + 5x - 9$; $(0, \infty)$

A) No absolute maximum; absolute minimum: -14

B) Absolute maximum: -6; no absolute minimum

C) Absolute maximum: -9; absolute minimum: -14

D) No absolute extrema

Answer: B

276) $f(x) = x^3 - 3x^2 + 3$; $(0, \infty)$

A) No absolute maximum; absolute minimum $= -1$

B) Absolute maximum: 3; no absolute minimum

C) Absolute maximum: 3; absolute minimum $= -1$

D) No absolute extrema

Answer: A

277) $f(x) = \frac{2}{3}x^3 + \frac{3}{2}x^2 - 27x + 2$; $(0, \infty)$

A) Absolute maximum $= \frac{745}{8}$; no absolute minimum

B) No absolute maximum; absolute minimum $= -\frac{95}{2}$

C) Absolute maximum $= \frac{745}{8}$; absolute minimum $= -\frac{95}{2}$

D) No absolute extrema

Answer: B

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

A) Absolute maximum $= \frac{16}{3}$; absolute minimum $= -16$

B) No absolute maximum; absolute minimum $= -16$

C) Absolute maximum $= \frac{16}{3}$; no absolute minimum

D) No absolute extrema

Answer: D

279) $f(x) = \frac{2}{3}x^3 + \frac{3}{2}x^2 - 27x + 2$; $(-\infty, 0)$

A) Absolute maximum $= \frac{745}{8}$; absolute minimum $= -\frac{95}{2}$

B) Absolute maximum $= \frac{745}{8}$; no absolute minimum

C) No absolute maximum; absolute minimum $= -\frac{95}{2}$

D) No absolute extrema

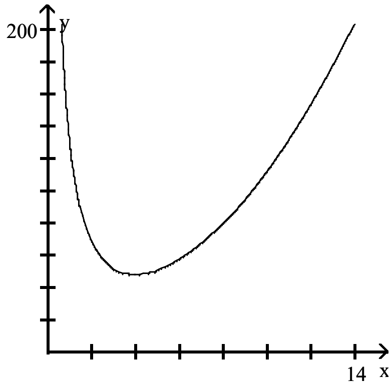
Answer: B

280) $f(x) = x + \frac{196}{x}$; $(0, \infty)$

A) No absolute maximum; absolute minimum: 28
B) Absolute maximum: −28; no absolute minimum
C) Absolute maximum: −28; absolute minimum: 28
D) No absolute extrema

Answer: A

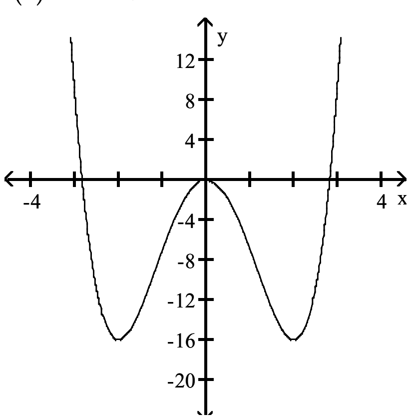
281) $f(x) = x^2 + \frac{128}{x}$; $(0, \infty)$



A) No absolute maximum; absolute minimum: 48
B) Absolute maximum: 196; absolute minimum: 4
C) No absolute maximum; absolute minimum: 4
D) No absolute extrema

Answer: A

282) $f(x) = x^4 - 8x^2$



A) Absolute maximum: 0; no absolute minimum
B) No absolute maximum; absolute minimum: −16
C) Absolute maximum: 0; absolute minimum: −16
D) No absolute extrema

Answer: B

283) $f(x) = (x - 3)^3$

A) Absolute maximum: 3; no absolute minimum
B) Absolute maximum: 3; absolute minimum: 0
C) No absolute maximum: 0; absolute minimum: 3
D) No absolute extrema

Answer: D

284) $f(x) = 3x + 5$

A) Absolute maximum: 5; no absolute minimum
B) No absolute maximum; absolute minimum: 3
C) Absolute maximum: 3; no absolute minimum
D) No absolute extrema

Answer: D

285) $f(x) = -\frac{1}{3}x^3 + 4x - 1$; $(-\infty, 0)$

A) Absolute minimum: −4.3; absolute maximum: 6.3
B) Absolute maximum: 2; absolute minimum: −2
C) No absolute maximum; absolute minimum: −6.3
D) No absolute extrema

Answer: C

Solve the problem.

286) $P(x) = -x^3 + \frac{27}{2}x^2 - 60x + 100$, $x \geq 5$ is an approximation to the total profit (in thousands of dollars) from the sale of x hundred thousand tires. Find the number of tires that must be sold to maximize profit.

A) 450,000
B) 500,000
C) 500,000
D) 550,000

Answer: B

287) $S(x) = -x^3 + 6x^2 + 288x + 4000$, $4 \leq x \leq 20$ is an approximation to the number of salmon swimming upstream to spawn, where x represents the water temperature in degrees Celsius. Find the temperature that produces the maximum number of salmon. Round to the nearest tenth, if necessary.

A) 12°C
B) 20°C
C) 8°C
D) 4°C

Answer: A

288) The velocity of a particle (in $\frac{ft}{s}$) is given by $v = t^2 - 6t + 2$, where t is the time (in seconds) for which it has traveled. Find the time at which the velocity is at a minimum.

A) 6 s
B) 1 s
C) 3 s
D) 2 s

Answer: C

289) For a simply supported beam with a load that increases uniformly from left to right, the bending moment M (in ft·lb) at a distance of x (in ft) from the left end is given by $M = \frac{1}{6}(wl^2x - wx^3)$. Determine the location of the maximum bending moment. In the formula, w is the rate of load increase $\left(\text{in } \frac{lb}{ft}\right)$ and l is the length (in ft) of the beam.

A) $x = l\sqrt{6}$
B) $x = \frac{l\sqrt{2}}{2}$
C) $x = \frac{l}{3}$
D) $x = \frac{l\sqrt{3}}{3}$

Answer: D

290) A truck burns fuel at the rate (gallons per mile) of $G(x) = \frac{1}{31}\left(\frac{81}{x} + \frac{x}{25}\right)$ while traveling at x mph. If fuel costs \$1.3 per gallon, find the speed that minimizes fuel cost for a 200-mile trip.

A) 32.5 mph
B) 53 mph
C) 56 mph
D) 45 mph

Answer: D

291) The price P of a certain computer system decreases immediately after its introduction and then increases. If the price P is estimated by the formula $P = 110t^2 - 1900t + 6300$, where t is the time in months from its introduction, find the time until the minimum price is reached.

A) 9.5 months
B) 17.3 months
C) 8.6 months
D) 34.5 months

Answer: C

292) 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 $C = 13S^2 - 7S + 1500$, where S is the processor speed in MHz. Find the processor speed for which cost is at a minimum.

A) 0.4 MHz
B) 0.3 MHz
C) 5.4 MHz
D) 2.2 MHz

Answer: B

293) For a dosage of x cubic centimeters (cc) of a certain drug, assume that the resulting blood pressure B is approximated by $B(x) = 0.03x^2 - 0.2x^3$. Find the dosage at which the resulting blood pressure is maximized. Round your answer to the nearest hundredth.

A) 0.08 cc
B) 0.10 cc
C) 0.23 cc
D) 0.15 cc

Answer: B

294) Assume that the temperature T of a person during a certain illness is given by $T(t) = -0.1t^2 + 1.3t + 98.6$, $0 \le t \le 12$ where T = the temperature (°F) at time t, in days. Find the maximum value of the temperature and when it occurs. Round your answer to the nearest tenth, if necessary.

A) 101.3°F at 5.2 days
B) 101.8°F at 6.5 days
C) 102.8°F at 6.5 days
D) 102.8°F at 3.9 days

Answer: C

295) The total-revenue and total-cost functions for producing x clocks are $R(x) = 500x - 0.01x^2$ and $C(x) = 160x + 100{,}000$, where $0 \le x \le 25{,}000$. What is the maximum annual profit?

A) \$2,790,000
B) \$2,990,000
C) \$3,090,000
D) \$2,890,000

Answer: A

Use a graphing calculator or computer graphing software to solve the problem (correct to one decimal place).

296) Find where the absolute minimum value occurs for the function $f(x) = (x - 7)(x + 3)$ over the interval $[0, \infty)$.

A) 2.6
B) 2.0
C) 2.3
D) 1.7

Answer: B

297) Find the absolute minimum value for the function $f(x) = x^2 + 5x + 4.9$ over the interval $[0, \infty)$.

A) 4.9
B) 5.6
C) 4.6
D) 5.3

Answer: A

298) Find the absolute maximum value for the function $f(x) = x^2 + 8x + 5$ over the interval $[3, \infty)$.

A) 367.3
B) 12,368.4
C) 150.8
D) There is no absolute maximum.

Answer: D

299) Find the absolute maximum value for the function $f(x) = x(x - 9)^{2/3}$.

A) 8.5
B) 9.3
C) 12.7
D) There is no absolute maximum.

Answer: D

300) Find where the absolute minimum value occurs for the function $f(x) = x(x - 8)^{2/3}$.

A) 6.9
B) 7.7
C) 8.0
D) There is no absolute minimum.

Answer: D

301) Find the absolute maximum value for the function $f(x) = x(x - 8)^{2/3}$ over the interval $[-1, 7]$.

A) 6.9
B) 8.2
C) 10.4
D) 7.7

Answer: C

Solve the problem.

302) Of all numbers whose sum is 270, find the two that have the maximum product. That is, maximize $Q = xy$, where $x + y = 270$.

A) 10 and 260
B) 1 and 269
C) 135 and 135
D) 134 and 136

Answer: C

303) Maximize $Q = x^2y$, where x and y are positive numbers, such that $x + y = 480$.

A) $x = 160$, $y = 320$
B) $x = 120$, $y = 360$
C) $x = 360$, $y = 120$
D) $x = 320$, $y = 160$

Answer: D

304) Of all numbers whose difference is 2, find the two that have the minimum product.

A) 0 and 2
B) 1 and -1
C) 1 and 3
D) 4 and 2

Answer: B

305) Maximize $Q = xy^2$, where x and y are positive numbers, such that $x + y^2 = 4$.

A) $x = 2$, $y = \sqrt{2}$
B) $x = 0$, $y = 2$
C) $x = \sqrt{2}$, $y = 2$
D) $x = 1$, $y = \sqrt{3}$

Answer: A

306) Maximize $Q = xy$, where x and y are positive numbers, such that $\frac{4}{3}x^2 + y = 9$.

A) $x = \frac{9}{4}$, $y = 6$

B) $x = \sqrt{\frac{9}{2}}$, $y = 3$

C) $x = \sqrt{\frac{9}{4}}$, $y = 6$

D) $x = 6$, $y = \sqrt{\frac{9}{4}}$

Answer: C

307) For what positive number is the sum of its reciprocal and three times its square a minimum?

A) $\sqrt{\frac{1}{6}}$

B) $\sqrt[3]{\frac{1}{3}}$

C) $\sqrt[3]{\frac{1}{6}}$

D) $\sqrt[3]{6}$

Answer: C

308) Minimize $Q = 3x^2 + 5y^2$, where $x + y = 8$.

A) $x = 3$; $y = 5$

B) $x = 8$; $y = 0$

C) $x = 0$; $y = 8$

D) $x = 5$; $y = 3$

Answer: D

309) Minimize $Q = \sqrt{x} + \sqrt{y}$, where $x + y = 16$.

A) $x = 8$ and $y = 8$ or $x = 16$ and $y = 0$

B) $x = 8$ and $y = 8$

C) $x = 16$ and $y = 0$ or $x = 0$ and $y = 16$

D) $x = 4$ and $y = 4$ or $x = 0$ and $y = 0$

Answer: C

310) A carpenter is building a rectangular room with a fixed perimeter of 120 ft. What are the dimensions of the largest room that can be built? What is its area?

A) 60 ft by 60 ft; 3600 ft^2

B) 30 ft by 30 ft; 900 ft^2

C) 30 ft by 90 ft; 2700 ft^2

D) 12 ft by 108ft; 1296 ft^2

Answer: B

311) Find the dimensions that produce the maximum floor area for a one-story house that is rectangular in shape and has a perimeter of 162 ft. Round to the nearest hundredth, if necessary.

A) 40.5 ft x 162 ft
B) 13.5 ft x 40.5 ft
C) 81 ft x 81 ft
D) 40.5 ft x 40.5 ft

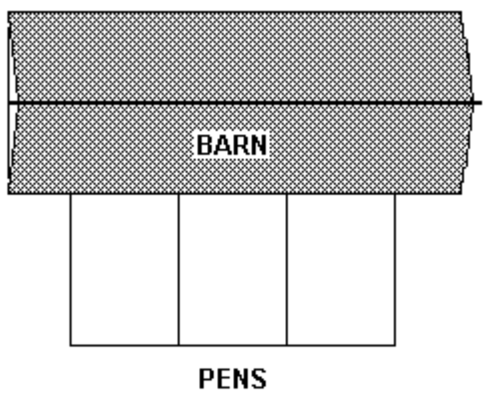
Answer: D

312) An architect needs to design a rectangular room with an area of 89 ft^2. What dimensions should he use in order to minimize the perimeter? Round to the nearest hundredth, if necessary.

A) 9.43 ft x 22.25 ft
B) 22.25 ft x 22.25 ft
C) 17.8 ft x 89 ft
D) 9.43 ft x 9.43 ft

Answer: D

313) A farmer decides to make three identical pens with 64 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) 8 ft by 32 ft
B) 8 ft by 8 ft
C) 10.67 ft by 53.33 ft
D) 16 ft by 16 ft

Answer: A

314) A company wishes to manufacture a box with a volume of 16 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) 4.2 ft
B) 2.1 ft
C) 5.8 ft
D) 2.9 ft

Answer: B

315) From a thin piece of cardboard 10 in. by 10 in., square corners are cut out so that the sides can be folded up to make a box. What dimensions will yield a box of maximum volume? What is the maximum volume? Round to the nearest tenth, if necessary.

A) 3.3 in. by 3.3 in. by 3.3 in.; 37 $in.^3$

B) 6.7 in. by 6.7 in. by 1.7 in.; 74.1 $in.^3$

C) 6.7 in. by 6.7 in. by 3.3 in.; 148.1 $in.^3$

D) 5 in. by 5 in. by 2.5 in.; 62.5 $in.^3$

Answer: B

316) A company is constructing an open–top, square–based, rectangular metal tank that will have a volume of 48 ft^3. What dimensions yield the minimum surface area? Round to the nearest tenth, if necessary.

A) 5.2 ft by 5.2 ft. by 1.7 ft

B) 9.8 ft by 9.8 ft. by 0.5 ft

C) 4.6 ft by 4.6 ft. by 2.3 ft

D) 3.6 ft by 3.6 ft. by 3.6 ft

Answer: C

317) A 33–in. piece of string is cut into two pieces. One piece is used to form a circle and the other to form a square. How should the string be cut so that the sum of the areas is a minimum? Round to the nearest tenth, if necessary.

A) Square piece = 8.2 in., circle piece = 7.7 in.

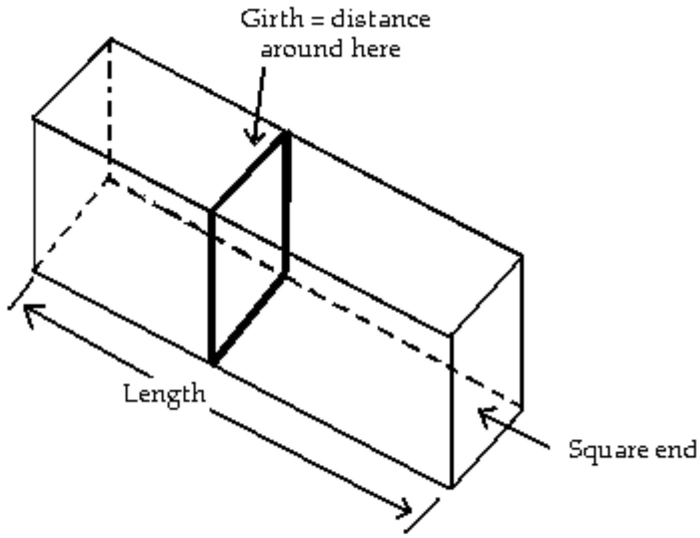
B) Square piece = 0 in., circle piece = 33 in.

C) Square piece = 8 in., circle piece = 25 in.

D) Circle piece = 8 in., square piece = 25 in.

Answer: C

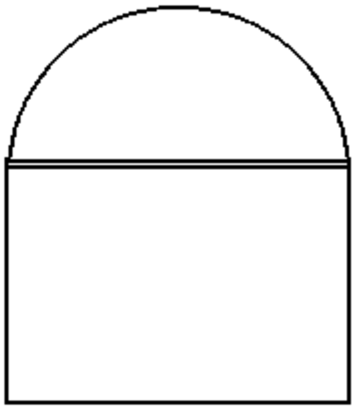
318) A private shipping company will accept a box for domestic shipment only if the sum of its length and girth (distance around) does not exceed 102 in. What dimensions will give a box with a square end the largest possible volume?



A) 17 in. x 34 in. x 34 in.
B) 34 in. x 34 in. x 34 in.
C) 17 in. x 17 in. x 34 in.
D) 17 in. x 17 in. x 85 in.

Answer: C

319) A window is in the form of a rectangle surmounted by a semicircle. The rectangle is of clear glass, whereas the semicircle is of tinted glass that transmits only one–fifth as much light per unit area as clear glass does. The total perimeter is fixed. Find the proportions of the window that will admit the most light. Neglect the thickness of the frame.



A) $\dfrac{\text{width}}{\text{height}} = \dfrac{20}{10 + 4\pi}$

B) $\dfrac{\text{width}}{\text{height}} = \dfrac{20}{10 + \pi}$

C) $\dfrac{\text{width}}{\text{height}} = \dfrac{5}{10 + 4\pi}$

D) $\dfrac{\text{width}}{\text{height}} = \dfrac{20}{5 + 4\pi}$

Answer: A

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

$R(x) = 20x - 0.5x^2$

$C(x) = 6x + 5.$

A) 15 units

B) 14 units

C) 19 units

D) 26 units

Answer: B

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

$R(x) = 3x$

$C(x) = 0.001x^2 + 0.7x + 10.$

A) 1850 units

B) 3700 units

C) 2300 units

D) 1150 units

Answer: D

322) Find the maximum profit given the following revenue and cost functions:

$R(x) = 118x - x^2$

$C(x) = \frac{1}{3}x^3 - 9x^2 + 82x + 34$

where x is in thousands of units and R(x) and C(x) are in thousands of dollars.

A) 1262 thousand dollars
B) 2234 thousand dollars
C) 1330 thousand dollars
D) 776 thousand dollars

Answer: A

323) An appliance company determines that in order to sell x dishwashers, the price per dishwasher must be $p = 420 - 0.3x$.
It also determines that the total cost of producing x dishwashers is given by
$C(x) = 5000 + 0.3x^2$.
How many dishwashers must the company produce and sell in order to maximize profit?

A) 300
B) 350
C) 700
D) 400

Answer: B

324) An appliance company determines that in order to sell x dishwashers, the price per dishwasher must be $p = 420 - 0.4x$.
It also determines that the total cost of producing x dishwashers is given by
$C(x) = 4000 + 0.8x^2$.
What is the maximum profit?

A) $40,750
B) $69,500
C) $36,750
D) $32,750

Answer: D

325) An appliance company determines that in order to sell x dishwashers, the price per dishwasher must be $p = 600 - 0.3x$.
It also determines that the total cost of producing x dishwashers is given by
$C(x) = 5000 + 0.7x^2$.
What price must be charged per dishwasher in order to maximize profit?

A) $1020
B) $480
C) $510
D) $490

Answer: C

326) A hotel has 300 units. All rooms are occupied when the hotel charges $70 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 $26 per day to service and maintain. What should the hotel charge per day in order to maximize daily profit?

A) $178
B) $185
C) $128
D) $198

Answer: D

327) 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 $6 for each kayak ordered. In what lot size should the store order kayaks in order to minimize inventory costs?

A) 32
B) 34
C) 36
D) 30

Answer: A

328) An outdoor sports company sells 250 kayaks per year. It costs $8 to store one kayak for a year. Each reorder costs $10, plus an additional $8 for each kayak ordered. How many times per year should the store order kayaks in order to minimize inventory costs?

A) 7
B) 14
C) 10
D) 15

Answer: C

329) If the price charged for a candy bar is p(x) cents, then x thousand candy bars will be sold in a certain city, where $p(x) = 124 - \frac{x}{16}$. How many candy bars must be sold to maximize revenue?

A) 1984 candy bars
B) 992 thousand candy bars
C) 1984 thousand candy bars
D) 992 candy bars

Answer: B

330) If the price charged for a bolt is p cents, then x thousand bolts will be sold in a certain hardware store, where $p = 19 - \frac{x}{18}$. How many bolts must be sold to maximize revenue?

A) 171 bolts
B) 342 bolts
C) 342 thousand bolts
D) 171 thousand bolts

Answer: D

331) A rectangular field is to be enclosed on four sides with a fence. Fencing costs $8 per foot for two opposite sides, and $5 per foot for the other two sides. Find the dimensions of the field of area 660 ft^2 that would be the cheapest to enclose.

A) 41.1 ft @ $8 by 16.1 ft @ $5
B) 32.5 ft @ $8 by 20.3 ft @ $5
C) 16.1 ft @ $8 by 41.1 ft @ $5
D) 20.3 ft @ $8 by 32.5 ft @ $5

Answer: D

332) A baseball team is trying to determine what price to charge for tickets. At a price of $10 per ticket, it averages 40,000 people per game. For every increase of $1, it loses 5,000 people. Every person at the game spends an average of $5 on concessions. What price per ticket should be charged in order to maximize revenue?

A) $3.00
B) $6.50
C) $3.50
D) $13.50

Answer: B

333) The stadium vending company finds that sales of hot dogs average 34,000 hot dogs per game when the hot dogs sell for $2.50 each. For each 50 cent increase in the price, the sales per game drop by 5000 hot dogs. What price per hot dog should the vending company charge to realize the maximum revenue?

A) $0.90
B) $2.95
C) $3.20
D) $3.40

Answer: B

334) Find the optimum number of batches (to the nearest whole number) of an item that should be produced annually (in order to minimize cost) if 130,000 units are to be made, it costs $2 to store a unit for one year, and it costs $340 to set up the factory to produce each batch.

A) 22 batches
B) 20 batches
C) 14 batches
D) 16 batches

Answer: B

335) A bookstore has an annual demand for 28,000 copies of a best-selling book. It costs $0.50 to store one copy for one year, and it costs $65 to place an order. Find the optimum number of copies per order.

A) 3816 copies
B) 2698 copies
C) 2428 copies
D) 3257 copies

Answer: B

336) A certain company produces potting soil and sells it in 50 lb bags. Suppose that 300,000 bags are to be produced each year. It costs \$12 per year to store a bag of potting soil, and it costs \$2000 to set up the facility to produce a batch of bags. Find the number of bags per batch that should be produced.

A) 10,000
B) 14,121
C) 9574
D) 100,000

Answer: A

337) A local office supply store has an annual demand for 10,000 cases of photocopier paper per year. It costs \$4 per year to store a case of photocopier paper, and it costs \$60 to place an order. Find the optimum number of cases of photocopier paper per order.

A) 387
B) 300,000
C) 548
D) 173

Answer: C

338) A company estimates that the daily revenue (in dollars) from the sale of x cookies is given by
$R(x) = 790 + 0.02x + 0.0006x^2$.
Currently, the company sells 390 cookies per day. Use marginal revenue to estimate the increase in revenue if the company increases sales by one cookie per day.

A) \$48.80
B) \$41.00
C) \$0.41
D) \$0.49

Answer: D

339) A grocery store estimates that the weekly profit (in dollars) from the production and sale of x cases of soup is given by
$P(x) = -5600 + 9.8x - 0.0017x^2$
and currently 1100 cases are produced and sold per week. Use the marginal profit to estimate the increase in profit if the store produces and sells one additional case of soup per week.

A) \$5.52
B) \$6.06
C) \$7.93
D) \$3123.00

Answer: B

340) A company estimates that the daily cost (in dollars) of producing x chocolate bars is given by
$C(x) = 1035 + 0.03x + 0.0003x^2$.
Currently, the company produces 510 chocolate bars per day. Use marginal cost to estimate the increase in the daily cost if one additional chocolate bar is produced per day.

A) \$33.60
B) \$54.00
C) \$0.54
D) \$0.34

Answer: D

341) The weekly profit, in dollars, from the production and sale of x bicycles is given by

$P(x) = 80.00x - 0.005x^2$

Currently, the company produces and sells 800 bicycles per week. Use the marginal profit to estimate the change in profit if the company produces and sells one more bicycle per week.

A) 80.00 dollars
B) 10.00 dollars
C) 88.00 dollars
D) 72.00 dollars

Answer: D

342) A company finds that when it spends x million dollars on advertising, its profit P, in thousands of dollars, is given by

$P(x) = 1180 + 35x - 4x^2$

Currently the company spends 18 million dollars on advertising. Use the marginal profit to estimate the change in profit if the company increases its advertising expenditure by one million dollars.

A) 630 thousand dollars
B) 486 thousand dollars
C) 1180 thousand dollars
D) -109 thousand dollars

Answer: D

343) The total cost, in dollars, to produce x DVD players is $C(x) = 130 + 6x - x^2 + 5x^3$. Find the marginal cost when $x = 4$.

A) \$238
B) \$328
C) \$368
D) \$458

Answer: A

344) The profit, in dollars, from the sale of x compact disc players is $P(x) = x^3 - 5x^2 + 4x + 6$. Find the marginal profit when $x = 10$.

A) \$210
B) \$204
C) \$596
D) \$590

Answer: B

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

$C(x) = 0.003x^3 + 0.1x^2 + 68x + 620,$

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.

A) \$6045
B) \$6051
C) \$5978
D) \$5841

Answer: A

346) Suppose that the weekly profit, in dollars, of producing and selling x cars is

$P(x) = -0.005x^3 - 0.3x^2 + 980x - 1100$,

and currently 60 cars are produced and sold weekly. Use P(60) and the marginal profit when $x = 60(P'(60))$ to estimate the weekly profit of producing and selling 63 cars. Round to the nearest dollar.

A) $58,199
B) $58,210
C) $59,310
D) $57,943

Answer: B

347) For the total-cost function

$C(x) = 0.01x^2 + 0.8x + 50$,

find ΔC and $C'(x)$ when $x = 50$ and $\Delta x = 1$.

A) $\Delta C = \$1.00$; $C'(50) = \$1.00$
B) $\Delta C = \$1.81$; $C'(50) = \$1.80$
C) $\Delta C = \$1.81$; $C'(50) = \$1.00$
D) $\Delta C = \$1.81$; $C'(50) = \$1.30$

Answer: B

348) For the total-cost function

$C(x) = 0.01x^2 + 2.2x + 80$,

find ΔC and $C'(x)$ when $x = 100$ and $\Delta x = 1$.

A) $\Delta C = \$4.20$; $C'(100) = \$4.20$
B) $\Delta C = \$4.21$; $C'(100) = \$3.20$
C) $\Delta C = \$4.21$; $C'(100) = \$2.22$
D) $\Delta C = \$4.21$; $C'(100) = \$4.20$

Answer: D

349) For the total-cost function

$C(x) = x^3 - 2x^2 + 5x + 100$,

find ΔC and $C'(x)$ when $x = 50$ and $\Delta x = 1$.

A) $\Delta C = \$7,354$; $C'(50) = \$7,305$
B) $\Delta C = \$7,454$; $C'(50) = \$2,305$
C) $\Delta C = \$7,654$; $C'(50) = \$7,300$
D) $\Delta C = \$7,454$; $C'(50) = \$7,305$

Answer: D

350) For the total-cost function

$C(x) = x^3 - 8x^2 + 6x + 50,$

find ΔC and $C'(x)$ when $x = 50$ and $\Delta x = 1$.
A) $\Delta C = \$6{,}799$; $C'(50) = \$6{,}706$
B) $\Delta C = \$6{,}899$; $C'(50) = \$6{,}706$
C) $\Delta C = \$6{,}849$; $C'(50) = \$6{,}706$
D) $\Delta C = \$6{,}849$; $C'(50) = \$6{,}700$

Answer: C

351) For the total-revenue function

$R(x) = 3x,$

find ΔR and $R'(x)$ when $x = 50$ and $\Delta x = 1$.
A) $\Delta R = \$6.00$; $R'(50) = \$6.00$
B) $\Delta R = \$1.50$; $R'(50) = \$1.50$
C) $\Delta R = \$6.00$; $R'(50) = \$3.00$
D) $\Delta R = \$3.00$; $R'(50) = \$3.00$

Answer: D

352) For the total-revenue function

$R(x) = 5x,$

find ΔR and $R'(x)$ when $x = 7700$ and $\Delta x = 1$.
A) $\Delta R = \$2.50$; $R'(7700) = \$2.50$
B) $\Delta R = \$10.00$; $R'(7700) = \$10.00$
C) $\Delta R = \$10.00$; $R'(7700) = \$5.00$
D) $\Delta R = \$5.00$; $R'(7700) = \$5.00$

Answer: D

353) Given the total-revenue function
$R(x) = 2x,$
and the total-cost function
$C(x) = 0.01x^2 + 0.8x + 50,$
if $P(x)$ is the total profit function, find ΔP and $P'(x)$ when $x = 50$ and $\Delta x = 1$.
A) $\Delta P = \$0.21$; $P'(50) = \$0.20$
B) $\Delta P = \$0.19$; $P'(50) = \$0.20$
C) $\Delta P = \$1.81$; $P'(50) = \$1.80$
D) $\Delta P = \$0.20$; $P'(50) = \$0.19$

Answer: B

354) Given the total–revenue function
$R(x) = 5x$,
and the total–cost function
$C(x) = 0.01x^2 + 2.2x + 80$,
if P(x) is the total profit function, find ΔP and $P'(x)$ when $x = 100$ and $\Delta x = 1$.

A) $\Delta P = \$0.79$; $P'(100) = \$0.80$
B) $\Delta P = \$1.79$; $P'(100) = \$1.80$
C) $\Delta P = \$4.19$; $P'(100) = \$4.20$
D) $\Delta P = \$5.19$; $P'(100) = \$5.20$

Answer: A

355) Given the total–revenue function
$R(x) = 7600x$,
and the total–cost function
$C(x) = x^3 - 2x^2 + 5x + 100$,
if P(x) is the total profit function, find ΔP and $P'(x)$ when $x = 50$ and $\Delta x = 1$.

A) $\Delta P = \$141$; $P'(50) = \$295$
B) $\Delta P = \$146$; $P'(50) = \$290$
C) $\Delta P = \$149$; $P'(50) = \$141$
D) $\Delta P = \$146$; $P'(50) = \$295$

Answer: D

356) A supply function for a certain product is given by
$S(p) = 0.08p^3 + 2p^2 + 7p + 2$,
where S(p) is the number of items produced when the price is p dollars. Use $S'(p)$ to estimate how many more units a producer will supply when the price changes from \$14.00 per unit to \$14.50 per unit.

A) 55
B) 48
C) 4
D) 24

Answer: A

357) Suppose the demand for a certain item is given by $D(p) = -4p^2 + 8p + 2$, where p represents the price of the item. Find D'(p), the rate of change of demand with respect to price.

A) $D'(p) = -8p + 8$
B) $D'(p) = -8p^2 + 8$
C) $D'(p) = -4p + 8$
D) $D'(p) = -4p^2 + 8$

Answer: A

358) Suppose the demand for a certain item is given by
$D(p) = -4p^2 + 8p + 8$,
where p represents the price of the item in dollars. Currently the price of the item is \$19. Use marginal demand to estimate the change in demand when the price is increased by one dollar.

A) 8
B) −136
C) 0
D) −144

Answer: D

359) The average cost for a company to produce x thousand units of a product is given by the function

$A(x) = \dfrac{1024 + 1500x}{x}$

Use $A'(x)$ to estimate the change in average cost if production is increased by one thousand units from the current level of 16 thousand.

A) Average cost will increase by $64
B) Average cost will decrease by $64
C) Average cost will decrease by $4
D) Average cost will increase by $4

Answer: C

360) The diameter of a circle is given by the formula $D = \dfrac{C}{\pi}$, where C is the circumference. The diameter of a tree was 8 in. During the following year, the circumference increased by 2 in. Use $D'(C)$ to estimate how much the tree's diameter increased in that year.

A) $\dfrac{2}{\pi}$ in.

B) $\dfrac{8}{\pi}$ in.

C) $\dfrac{\pi}{2}$ in.

D) $\dfrac{10}{\pi}$ in.

Answer: A

361) The volume of a sphere is given by the formula $V = \dfrac{4}{3}\pi r^3$ 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 4 mm to 7 mm. Round to the nearest 100 mm^3.

A) 600 mm^3
B) 200 mm^3
C) 100 mm^3
D) 1900 mm^3

Answer: A

Find Δy and $f'(x)\,\Delta x$ for the given function.

362) $y = f(x) = x^2$, $x = 9$, and $\Delta x = 0.03$

A) 0.5409; 0.54
B) 0.5409; 0.27
C) 0.5409; 0.03
D) 0.27; 0.27

Answer: A

363) $y = f(x) = \sqrt{x}$, $x = 2$, and $\Delta x = 0.05$

A) 0.01757; 0.01757
B) 0.01757; 0.03536
C) 0.01757; 0.01768
D) 0.01768; 0.01768

Answer: C

364) $y = f(x) = x^3$, $x = 3$, and $\Delta x = 0.04$

A) 1.094464; 0.36
B) 1.08; 1.08
C) 1.094464; 1.094464
D) 1.094464; 1.08

Answer: D

365) $y = f(x) = x + x^2$, $x = 7$, and $\Delta x = 0.04$

A) 0.6; 0.48
B) 0.6016; 0.6
C) 0.6016; 0.72192
D) 0.6016; 0.48

Answer: B

366) $y = f(x) = x - x^2$, $x = 5$, and $\Delta x = 0.05$

A) −0.4525; −0.36
B) −0.4525; −0.45
C) −0.4525; −0.543
D) −0.45; −0.36

Answer: B

367) $y = f(x) = x^2 - x$, $x = 6$, and $\Delta x = 0.05$

A) 0.5525; 0.25
B) 0.5525; 0.5525
C) 0.55; 0.25
D) 0.5525; 0.55

Answer: D

368) $y = f(x) = \frac{1}{x^2}$, $x = 2$, and $\Delta x = 0.7$

A) −0.11283; −0.0875
B) −0.05796; −0.35
C) 0.02435; −0.35
D) −0.11283; −0.175

Answer: D

369) $y = f(x) = \frac{1}{x}$, $x = 3$, and $\Delta x = 0.6$

A) 0.05556; -0.13333
B) -0.05556; -0.2
C) 0.22222; -0.13333
D) -0.05556; -0.06667

Answer: D

370) $y = f(x) = 2x - 1$, $x = 3$, and $\Delta x = 3$
A) 6; 6
B) 8; 6
C) 5; 6
D) 7; 6

Answer: A

371) $y = f(x) = 3x + 2$, $x = 9$, and $\Delta x = 2$
A) 10; 6
B) 8; 6
C) 10; 10
D) 6; 6

Answer: D

Use the differential to find a decimal approximation of the radical expression. Round to four decimal places.

372) $\sqrt{48}$
A) 6.8571
B) 6.9286
C) 6.0000
D) 7.0714

Answer: B

373) $\sqrt{15.97}$
A) 4.0038
B) 3.9700
C) 3.9963
D) 3.9925

Answer: C

374) $\sqrt{108}$
A) 10.4000
B) 10.3000
C) 10.5000
D) 10.5500

Answer: A

375) $\sqrt[3]{11}$
A) 2.1500
B) 2.2500
C) 2.3500
D) 2.4500

Answer: B

376) $\sqrt[3]{32}$

A) 3.3852
B) 3.1852
C) 3.2852
D) 3.0852

Answer: B

Find dy.

377) $y = \sqrt{6x + 4}$

A) $\dfrac{1}{2\sqrt{6x + 4}}\,dx$
B) $3\sqrt{6x + 4}\,dx$
C) $\dfrac{3}{\sqrt{6x + 4}}\,dx$
D) $\dfrac{6}{\sqrt{6x + 4}}\,dx$

Answer: C

378) $y = (6x^2 + 8)^{3/2}$

A) $\dfrac{3}{2}\sqrt{6x^2 + 8}\,dx$
B) $18x\sqrt{6x^2 + 8}\,dx$
C) $3x\sqrt{6x^2 + 8}\,dx$
D) $12x\,(6x^2 + 8)^{3/2}\,dx$

Answer: B

379) $y = x^2(9x + 4)^2$

A) $4x(9x + 2)(9x + 4)\,dx$
B) $4x(9x + 4)\,dx$
C) $4x(9x + 4)(x + 2)\,dx$
D) $(9x + 4)(9x + 2)\,dx$

Answer: A

380) $y = \sqrt[3]{x - 6}$

A) $\dfrac{dx}{3\sqrt[3]{x - 6}}$
B) $\dfrac{dx}{(x - 6)^{2/3}}$
C) $-\dfrac{(x - 6)^{2/3}\,dx}{3}$
D) $\dfrac{dx}{3(x - 6)^{2/3}}$

Answer: D

381) $y = \frac{x^2 + x + 4}{x + 5}$

A) $\frac{x^2 + 10x + 1}{x + 5}$ dx

B) $\frac{x^2 + 10x + 9}{(x + 5)^2}$ dx

C) $\frac{x^2 + 10x + 1}{(x + 5)^2}$ dx

D) (2x + 1) dx

Answer: C

382) $y = \frac{x^3 + 10x + 1}{x^2 + 2}$

A) $\frac{x^4 - 4x^2 - 2x + 20}{(x^2 + 2)^2}$ dx

B) $\frac{x^4 - 4x^2 - 2x + 20}{x^2 + 2}$ dx

C) $\frac{x(x^3 - 4x - 2)}{(x^2 + 2)^2}$ dx

D) $\frac{3x^2 + 10}{2x}$ dx

Answer: A

383) $y = 2x^4 + 2x^3 - 4x^2 + 3$

A) $(8x^3 + 6x^2 - 8x)$ dx

B) $(2x^3 + 2x^2 - 4x)$ dx

C) $(4x^3 + 3x^2 - 8x)$ dx

D) $(8x^3 + 6x^2 - 2x)$ dx

Answer: A

384) $y = (4 - x)^5$

A) $5(4 - x)$ dx

B) $5(4 - x)^4$ dx

C) $-5(4 - x)^4$ dx

D) $-5(4 - x)$ dx

Answer: C

385) $y = (2 + 3x)^6$

A) $18x^5$ dx

B) $6(2 + 3x)^5$ dx

C) $6(2 + 3x)$ dx

D) $18(2 + 3x)^5$ dx

Answer: D

386) $y = \sqrt{\dfrac{x - 1}{x + 1}}$

A) $\dfrac{dx}{(x + 1)\sqrt{x^2 - 1}}$

B) $\dfrac{x - 1}{2x + 2}\,dx$

C) $\dfrac{dx}{\sqrt{x^2 - 1}}$

D) $\dfrac{dx}{(x + 1)\sqrt{x^2 + 1}}$

Answer: A

Find dy for the given values of x and dx.

387) $y = x^3$, $x = 7$, $dx = 0.05$

A) 7.35
B) 7.16
C) 7.402625
D) 1.05

Answer: A

388) $y = x + x^2$, $x = 8$, $dx = 0.02$

A) 0.3404
B) 0.272
C) 0.34
D) 0.40848

Answer: C

389) $y = x - x^2$, $x = 2$, $dx = 0.05$

A) −0.12
B) −0.1525
C) −0.183
D) −0.15

Answer: D

390) $y = \dfrac{1}{x}$, $x = 2$, $dx = 0.3$

A) −0.075
B) −0.15
C) −0.06522
D) 0.1087

Answer: A

391) $y = 2x - 1$, $x = 7$, $dx = 4$

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

Answer: D

392) $y = 5x^2 - 2x + 3$; $x = 2$, $dx = -\frac{1}{6}$

A) 6
B) −6
C) 3
D) −3

Answer: D

393) $y = 2x^5 - 3x^2 + x - 1$; $x = -1$, $dx = \frac{1}{3}$

A) $\frac{25}{3}$

B) $\frac{19}{3}$

C) $\frac{17}{3}$

D) $\frac{22}{3}$

Answer: C

394) $y = \frac{3x - 7}{x - 1}$; $x = 2$, $dx = 0.1$

A) 4
B) 0.4
C) 6
D) 0.6

Answer: B

395) $y = \frac{x^2}{\sqrt{x^2 + 21}}$; $x = 10$, $dx = 0.1$

A) $\frac{144}{1331}$

B) $\frac{146}{1331}$

C) $\frac{148}{1331}$

D) $\frac{142}{1331}$

Answer: D

396) $y = x^3 - 4x^2 + 2x + 1$; $x = 8$, $dx = -0.3$

A) 37
B) −37
C) −39
D) 39

Answer: C

Find the elasticity.

397) $q = D(x) = 500 - x$

A) $E(x) = \dfrac{x}{x - 500}$

B) $E(x) = x(500 - x)$

C) $E(x) = \dfrac{1}{500 - x}$

D) $E(x) = \dfrac{x}{500 - x}$

Answer: D

398) $q = D(x) = 800 - 4x$

A) $E(x) = x(200 - x)$

B) $E(x) = \dfrac{x}{800 - 4x}$

C) $E(x) = \dfrac{x}{x - 200}$

D) $E(x) = \dfrac{x}{200 - x}$

Answer: D

399) $q = D(x) = \dfrac{1100}{x}$

A) $E(x) = \dfrac{1}{x}$

B) $E(x) = \dfrac{1100}{x}$

C) $E(x) = 1$

D) $E(x) = \dfrac{x}{1100}$

Answer: C

400) $q = D(x) = \sqrt{200 - x}$

A) $E(x) = \dfrac{x}{\sqrt{200 - x}}$

B) $E(x) = \dfrac{x}{400 - 2x}$

C) $E(x) = \dfrac{x}{2x - 400}$

D) $E(x) = \dfrac{1}{400 - 2x}$

Answer: B

401) $q = D(x) = \frac{900}{(x + 7)^2}$

A) $E(x) = \frac{2}{x + 7}$

B) $E(x) = \frac{1800x}{(x + 7)^3}$

C) $E(x) = 1800x(x + 7)$

D) $E(x) = \frac{2x}{x + 7}$

Answer: D

402) $q = D(x) = \frac{335}{(4x + 5)^2}$

A) $E(x) = \frac{8}{4x + 5}$

B) $E(x) = \frac{8x}{4x + 5}$

C) $E(x) = \frac{2x}{4x+ 5}$

D) $E(x) = 8x(4x + 5)$

Answer: B

For the demand function given, find the elasticity at the given price and state whether the demand is elastic, inelastic, or whether it has unit elasticity.

403) $q = D(x) = 800 - x;\quad x = 83$

A) 717; elastic

B) $\frac{83}{717}$; inelastic

C) $\frac{1}{717}$; inelastic

D) $\frac{83}{717}$; elastic

Answer: B

404) $q = D(x) = 300 - 4x;\quad x = 62$

A) $\frac{62}{13}$; elastic

B) $\frac{1}{13}$; inelastic

C) 52; elastic

D) $\frac{13}{62}$; inelastic

Answer: A

405) $q = D(x) = \frac{300}{x}$; $x = 57$

A) $\frac{19}{100}$; elastic

B) $\frac{100}{19}$; inelastic

C) 1; unit elasticity

D) $\frac{1}{57}$; inelastic

Answer: C

406) $q = D(x) = \sqrt{720 - x}$; $x = 540$

A) $\frac{3}{2}$; inelastic

B) 1; unit elasticity

C) $\frac{3}{2}$; elastic

D) 3; elastic

Answer: C

407) $q = D(x) = \frac{700}{(x + 4)^2}$; $x = 3$

A) $\frac{7}{3}$; elastic

B) $\frac{6}{7}$; inelastic

C) $\frac{7}{6}$; inelastic

D) -4; inelastic

Answer: B

408) $q = D(x) = \frac{347}{(8x + 19)^2}$; $x = 1$

A) $\frac{16}{27}$; inelastic

B) $\frac{8}{27}$; elastic

C) 1; unit elasticity

D) $\frac{2}{27}$; inelastic

Answer: A

For the given demand function, find the value(s) of x for which total revenue is a maximum.

409) $x = D(x) = 800 - x$

A) 320
B) 400
C) 800
D) 1600

Answer: B

410) $x = D(x) = 900 - 5x$

A) 360
B) 144
C) 90
D) 180

Answer: C

411) $x = D(x) = \frac{1000}{x}$

A) 1000
B) 10
C) All values of x.
D) 2000

Answer: C

412) $x = D(x) = \sqrt{500 - x}$

A) 500
B) $\frac{1000}{3}$
C) 250
D) 1000

Answer: B

413) $x = D(x) = \frac{400}{(x + 3)^2}$

A) 4
B) 6
C) 400
D) 3

Answer: D

Solve the problem.

414) A beverage company works out a demand function for its sale of soda and finds it to be

$$q = D(x) = 4300 - 29x,$$

where q = the quantity of sodas sold when the price per can, in cents, is x. At what price is the revenue a maximum?

A) 74 cents
B) 148 cents
C) 82 cents
D) 59 cents

Answer: A

415) A beverage company works out a demand function for its sale of soda and finds it to be

$$q = D(x) = 3900 - 29x$$

where q = the quantity of sodas sold when the price per can, in cents, is x. At what price, x, is the elasticity of demand inelastic?

A) For $x < 134$ cents
B) For $x < 67$ cents
C) For $x > 56{,}550$ cents
D) For $x > 269$ cents

Answer: B

416) A beverage company works out a demand function for its sale of soda and finds it to be

$$q = D(x) = 3400 - 28x,$$

where q = the quantity of sodas sold when the price per can, in cents, is x. At a price of 107 cents per can, will a small increase in price cause the total revenue to increase, decrease, or stay the same?

A) Stay the same
B) Decrease
C) Increase

Answer: B

417) A CD store determines the following demand function for a particular CD

$$q = D(x) = \sqrt{340 - x^2},$$

where q = the number of CDs sold per day when the price per CD is x dollars. At what price is the revenue a maximum? Round your answer to the nearest dollar.

A) \$15
B) \$13
C) \$18
D) \$12

Answer: B

418) A CD store determines the following demand function for a particular CD

$$q = D(x) = \sqrt{410 - x^2},$$

where q = the number of CDs sold per day when the price per CD is x dollars. Find the elasticity at a price of $ 12 per CD and state whether the demand is elastic or inelastic.

A) 0.54; inelastic
B) 0.05; elastic
C) 0.54; elastic
D) 0.05; inelastic

Answer: A

419) A CD store determines the following demand function for a particular CD

$$q = D(x) = \sqrt{490 - x^2},$$

where q = the number of CDs sold per day when the price per CD is x dollars. At a price of $9 per CD will a small increase in price cause the total revenue to increase, decrease, or stay the same?

A) Decrease
B) Stay the same
C) Increase

Answer: C

420) An electronics store determines the following demand function for phones of a particular type

$$q = D(x) = \frac{3x + 320}{14x + 15},$$

where q = the number of phones sold per day when the price per phone is x dollars. Find the elasticity.

A) $E(x) = \dfrac{4435x}{42x^2 + 4525x + 4800}$

B) $E(x) = \dfrac{4435}{42x^2 + 4480x + 4800}$

C) $E(x) = \dfrac{x}{42x^2 + 4525x + 4800}$

D) $E(x) = \dfrac{4525x}{42x^2 + 4480x + 4800}$

Answer: A

421) An electronics store determines the following demand function for phones of a particular type

$$q = D(x) = \frac{4x + 320}{13x + 12},$$

where q = the number of phones sold per day when the price per phone is x dollars. Find the elasticity when x = $50 per phone.

A) $E(x) = 0.6$
B) $E(x) = 1.54$
C) $E(x) = 0.96$
D) $E(x) = 0.44$

Answer: A

Determine whether the statement is true or false.

422) If demand is inelastic for a particular value of p, an increase in price will bring an increase in revenue.

A) True
B) False

Answer: A

423) If demand is elastic for a particular value of p, an increase in price will bring an increase in revenue.

A) True
B) False

Answer: B

424) If $E(x) < 1$ for a particular value of x, an increase in price will bring a decrease in revenue.

A) True
B) False

Answer: B

425) If demand has unit elasticity for a particular value of x, revenue is at a maximum.

A) True
B) False

Answer: A

426) If demand is inelastic for a particular value of x, a small increase in price will cause a percentage decrease in the quantity sold that is smaller than the percentage change in price.

A) True
B) False

Answer: A

427) If $q = D(x) = \frac{k}{x^n}$ and $n > 1$, demand is elastic for all values of x.

A) True
B) False

Answer: A

428) If $q = D(x) = \frac{k}{x^n}$ and $n < 1$, revenue is decreasing for all values of x.

A) True
B) False

Answer: B

Differentiate implicitly to find the slope of the curve at the given point.

429) $y^3 + yx^2 + x^2 - 3y^2 = 0$; (0, 3)

A) 0
B) $-\frac{1}{2}$
C) -1
D) $\frac{3}{2}$

Answer: A

430) $x^2 + y^2 = 1$; (2, 3)

A) $-\frac{3}{2}$
B) $\frac{5}{3}$
C) $\frac{2}{3}$
D) $-\frac{2}{3}$

Answer: D

431) $x^3 - y^3 = 5$; (5, 9)

A) $\frac{25}{9}$
B) $-\frac{81}{25}$
C) $\frac{25}{81}$
D) $-\frac{25}{81}$

Answer: C

432) $y^6 + x^3 = y^2 + 11x$; (0, 1)

A) $-\frac{5}{2}$

B) $\frac{11}{4}$

C) $\frac{11}{8}$

D) $\frac{11}{6}$

Answer: B

433) $x^6y^6 = 64$; (2, 1)

A) $-\frac{1}{4}$

B) $-\frac{1}{2}$

C) -32

D) 2

Answer: B

434) $xy^3 - x^5y^2 = -4$; $(-1, 2)$

A) $-\frac{3}{2}$

B) $\frac{2}{3}$

C) $-\frac{6}{5}$

D) $-\frac{3}{4}$

Answer: A

435) $x^2 + y^2 + 2y = 0$; $(0, -2)$

A) 1

B) 0

C) 2

D) -2

Answer: B

436) $xy^2 = 12$; $(3, -2)$

A) 3

B) $\frac{1}{3}$

C) $-\frac{1}{3}$

D) -3

Answer: B

437) $x^2 + 3y^2 = 13$;   (1, 2)

A) $-\frac{1}{6}$

B) -6

C) $\frac{1}{6}$

D) 6

Answer: A

438) $xy + x = 2$;   (1, 1)

A) $\frac{1}{2}$

B) 2

C) -2

D) $-\frac{1}{2}$

Answer: C

Find dy/dx by implicit differentiation.

439) $3y^2 - 7x^2 = 5$

A) $\frac{7x^2}{6y}$

B) $\frac{7x}{3y}$

C) $\frac{7x}{3}$

D) $\frac{14x + 5}{6y}$

Answer: B

440) $xy^2 = 4$

A) $\frac{x}{2y}$

B) $-\frac{y}{2x}$

C) $\frac{2x}{y}$

D) $-\frac{2y}{x}$

Answer: B

441) $\frac{1}{3}x^3 - 4y^2 = 11$

A) $\frac{x^2}{8y}$

B) $\frac{8y}{x^2 + 11}$

C) $\frac{8y}{x^2}$

D) $\frac{x^2}{4y}$

Answer: A

442) $2y - x + xy = 3$

A) $\frac{y + 1}{x + 2}$

B) $\frac{1 - y}{2 + x}$

C) $-\frac{1 - y}{x + 2}$

D) $-\frac{1 + y}{x + 2}$

Answer: B

443) $y^2 - xy + x^2 = 7$

A) $\frac{2x + y}{x - 2y}$

B) $\frac{2x - y}{x - 2y}$

C) $\frac{2x - y}{x + 2y}$

D) $\frac{2x + y}{x + 2y}$

Answer: B

444) $y^2 - x^2 = 5$

A) $-\frac{x}{y}$

B) $\frac{x}{y}$

C) $\frac{y}{x}$

D) $-\frac{y}{x}$

Answer: B

445) $x^3 + y^3 = 8$

A) $\frac{y^2}{x^2}$

B) $-\frac{y^2}{x^2}$

C) $-\frac{x^2}{y^2}$

D) $\frac{x^2}{y^2}$

Answer: C

446) $-8xy + 5y - 5 = 0$

A) $\frac{8y}{-8x + 5}$

B) $\frac{8y}{-8xy + 5}$

C) $\frac{8y(x + 1)}{5}$

D) $\frac{8(x + y)}{5}$

Answer: A

447) $y^3 + 4xy + 4x^3 - 8x = 0$

A) $\frac{8 - 4y - 12x^2}{3y^2 + 4x}$

B) $\frac{8 + 4y - 12x^2}{3y^2 + 4x}$

C) $\frac{8 - 4y - 12x^2}{3y^2 - 4x}$

D) $\frac{8 + 4y - 12x^2}{3y^2 - 4x}$

Answer: A

448) $7x^3 - x^2y^3 = 7$

A) $\frac{21x^2 - 2xy^2}{xy^2}$

B) $\frac{21x^2 - 2xy^2}{3x^2y^2}$

C) $\frac{21x^2 - 2xy^3}{3xy^2}$

D) $\frac{21x^2 - 2xy^3}{3x^2y^2}$

Answer: D

449) $x^3 + 3x^2y + y^3 = 8$

A) $\frac{x^2 + 2xy}{x^2 + y^2}$

B) $\frac{x^2 + 3xy}{x^2 + y^2}$

C) $-\frac{x^2 + 2xy}{x^2 + y^2}$

D) $-\frac{x^2 + 3xy}{x^2 + y^2}$

Answer: C

450) $xy + x + y - x^2y^2 = 0$

A) $\frac{2xy^2 + y}{2x^2y - x}$

B) $\frac{2xy^2 - y}{2x^2y + x}$

C) $\frac{2xy^2 - y - 1}{-2x^2y + x + 1}$

D) $\frac{2xy^2 + y + 1}{-2x^2y - x - 1}$

Answer: C

451) $x^{1/3} - y^{1/3} = 1$

A) $-(y/x)^{2/3}$

B) $(y/x)^{2/3}$

C) $-(x/y)^{2/3}$

D) $(x/y)^{2/3}$

Answer: B

452) $x^{4/3} + y^{4/3} = 1$

A) $-(x/y)^{1/3}$

B) $-(y/x)^{1/3}$

C) $(x/y)^{1/3}$

D) $(y/x)^{1/3}$

Answer: A

453) $\dfrac{x + y}{x - y} = x^2 + y^2$

A) $\dfrac{x(x - y)^2 - y}{x + y(x - y)^2}$

B) $\dfrac{x(x - y)^2 + y}{x + y(x - y)^2}$

C) $\dfrac{x(x - y)^2 + y}{x - y(x - y)^2}$

D) $\dfrac{x(x - y)^2 - y}{x - y(x - y)^2}$

Answer: C

454) $y\sqrt{x + 1} = 4$

A) $\dfrac{2y}{x + 1}$

B) $-\dfrac{2y}{x + 1}$

C) $\dfrac{y}{2(x + 1)}$

D) $-\dfrac{y}{2(x + 1)}$

Answer: D

For the given demand equation, differentiate implicitly to find dp/dx.

455) $9p^2 + x^2 = 1500$

A) $\dfrac{dp}{dx} = \dfrac{-p}{9x}$

B) $\dfrac{dp}{dx} = \dfrac{-x}{9p}$

C) $\dfrac{dp}{dx} = \dfrac{-9p}{x}$

D) $\dfrac{dp}{dx} = \dfrac{-9x}{p}$

Answer: B

456) $(p + 7)(x + 5) = 25$

A) $\frac{dp}{dx} = -\frac{x + 5}{p + 7}$

B) $\frac{dp}{dx} = -\frac{p + 7}{6}$

C) $\frac{dp}{dx} = -\frac{p + 7}{x + 5}$

D) $\frac{dp}{dx} = -\frac{7}{x + 5}$

Answer: C

457) $xp^4 = 34$

A) $\frac{dp}{dx} = -\frac{p}{4}$

B) $\frac{dp}{dx} = -\frac{p}{4x}$

C) $\frac{dp}{dx} = -\frac{1}{4xp}$

D) $\frac{dp}{dx} = -\frac{4x}{p}$

Answer: B

458) $20p^2 - 400p + 608 = x$

A) $\frac{dp}{dx} = \frac{401}{40}$

B) $\frac{dp}{dx} = \frac{1}{40p - 400}$

C) $\frac{dp}{dx} = \frac{40p}{401}$

D) $\frac{dp}{dx} = \frac{40}{401}$

Answer: B

459) $\frac{xp^2 - xp + 8}{2x - p} = 1$

A) $\frac{dp}{dx} = \frac{2 + p - p^2}{x - 2xp - 1}$

B) $\frac{dp}{dx} = \frac{2 + p - p^2}{2xp - x + 1}$

C) $\frac{dp}{dx} = \frac{2}{2p + 1}$

D) $\frac{dp}{dx} = \frac{2 + p - p^2}{2xp - x}$

Answer: B

Calculate dy/dt using the given information.

460) $xy + x = 12$; $dx/dt = -3$, $x = 2$, $y = 5$

A) 3
B) −3
C) 9
D) −9

Answer: C

461) $x^3 + y^3 = 9$; $dx/dt = -3$, $x = 1$, $y = 2$

A) $-\frac{4}{3}$

B) $-\frac{3}{4}$

C) $\frac{3}{4}$

D) $\frac{4}{3}$

Answer: C

462) $x^{4/3} + y^{4/3} = 2$; $dx/dt = 6$, $x = 1$, $y = 1$

A) $-\frac{1}{6}$

B) 6
C) −6
D) $\frac{1}{6}$

Answer: C

463) $xy^2 = 4$; $dx/dt = -5$, $x = 4$, $y = 1$

A) $-\frac{5}{8}$

B) $\frac{8}{5}$

C) $\frac{5}{8}$

D) $-\frac{8}{5}$

Answer: C

464) $\frac{x + y}{x - y} = x^2 + y^2$; $dx/dt = 12$, $x = 1$, $y = 0$

A) $-\frac{1}{12}$

B) 12
C) −12
D) $\frac{1}{12}$

Answer: B

465) $y\sqrt{x + 1} = 12$; $dx/dt = 8$, $x = 15$, $y = 3$

A) $\frac{4}{3}$

B) $-\frac{3}{4}$

C) $\frac{3}{4}$

D) $-\frac{4}{3}$

Answer: B

Solve the problem.

466) A company knows that unit cost C(x) and unit revenue R(x) from the production and sale of x units are related by $C(x) = \frac{[R(x)]^2}{96,000} + 6977$. Find the rate of change of revenue per unit when the cost per unit is changing by $9 and the revenue is $2000.

A) $456.85/unit
B) $90/unit
C) $216/unit
D) $697.7/unit

Answer: C

467) Given the revenue and cost functions $R(x) = 26x - 0.4x^2$ and $C(x) = 5x + 13$, where x is the daily production, find the rate of change of revenue with respect to time when x = 15 units and $\frac{dx}{dt} = 8$ units per day.

A) $156/day
B) $161.6/day
C) $72/day
D) $112/day

Answer: D

468) Given the revenue and cost functions $R(x) = 32x - 0.4x^2$ and $C(x) = 6x + 14$, where x is the daily production, find the rate of change of profit with respect to time when x = 10 units and $\frac{dx}{dt} = 5$ units per day.

A) $126/day
B) $120/day
C) $122/day
D) $90/day

Answer: D

469) A product sells by word of mouth. The company that produces the product has noticed that revenue from sales is given by $R(x) = 5\sqrt{x}$, where x is the number of units produced and sold. If the revenue keeps changing at a rate of $400 per month, how fast is the rate of sales changing when 1900 units have been made and sold? (Round to the nearest dollar per month.)

A) $174,356/month
B) $3487/month
C) $4/month
D) $6974/month

Answer: D

470) Water is discharged from a pipeline at a velocity v given by $v = 1602p^{(1/2)}$, where p is the pressure (in psi). If the water pressure is changing at a rate of 0.447 psi/second, find the acceleration (dv/dt) of the water when p = 37 psi.

A) 48.72 ft/sec^2
B) 2177.91 ft/sec^2
C) 58.86 ft/sec^2
D) 131.68 ft/sec^2

Answer: C

471) Water is falling on a surface, wetting a circular area that is expanding at a rate of 9 mm^2/sec. How fast is the radius of the wetted area expanding when the radius is 159 mm? (Round approximations to four decimal places.)

A) 0.0566 mm/sec
B) 0.0090 mm/sec
C) 111.0028 mm/sec
D) 0.0180 mm/sec

Answer: B

472) A piece of land is shaped like a right triangle. Two people start at the right angle at the same time, and walk at the same speed along different legs of the triangle while spraying the land. If the area covered is changing at 2 m^2/sec, how fast are the people moving when they are 4 m from the right angle? (Round approximations to two decimal places.)

A) 0.25 m/sec
B) 8.00 m/sec
C) 0.50 m/sec
D) 1.00 m/sec

Answer: C

473) One airplane is approaching an airport from the north at 192 km/hr. A second airplane approaches from the east at 164 km/hr. Find the rate at which the distance between the planes changes when the southbound plane is 27 km away from the airport and the westbound plane is 24 km from the airport.

A) 102 km/hr
B) 1262 km/hr
C) 358 km/hr
D) 1441 km/hr

Answer: C

474) A man 6 ft tall walks at a rate of 5 ft/sec away from a lamppost that is 22 ft high. At what rate is the length of his shadow changing when he is 40 ft away from the lamppost?

A) $\frac{15}{28}$ ft/sec

B) $\frac{15}{8}$ ft/sec

C) $\frac{15}{14}$ ft/sec

D) $\frac{100}{3}$ ft/sec

Answer: B

475) A zoom lens in a camera makes a rectangular image on the film that is 9 cm length by 8 cm width. As the lens zooms in and out, the size of the image changes. Find the rate at which the area of the image begins to change (dA/df) if the length of the frame changes at 0.8 cm/sec and the width of the frame changes at 0.4 cm/sec.

A) 10.4 cm^2/sec

B) 1.25 cm^2/sec

C) $\frac{9}{8}$ cm^2/sec

D) 10 cm^2/sec

Answer: D

476) A heart attack victim is given a blood vessel dilator to increase the radii of the blood vessels. After receiving the dilator, the radii of the affected blood vessels increase at about 3% per minute. According to Poiseulle's law, the volume of blood flowing through a vessel and the radius of the vessel are related by the formula $V = kr^4$ where k is a constant. What will be the percentage rate of increase in the blood flow after the dilator is given?

A) 15%/min

B) 9%/min

C) 12%/min

D) 18%/min

Answer: C

477) A metal cube dissolves in acid such that an edge of the cube decreases by 0.48 mm/min. How fast is the volume of the cube changing when the edge is 7.4 mm?

A) –342 mm^3/min

B) –195 mm^3/min

C) –26 mm^3/min

D) –79 mm^3/min

Answer: D

478) The radius of a right circular cylinder is increasing at the rate of 4 in./s, while the height is decreasing at the rate of 2 in./s. At what rate is the volume of the cylinder changing when the radius is 18 in. and the height is 11 in.?

A) 144 $in.^3$/s

B) 144π $in.^3$/s

C) 936π $in.^3$/s

D) –52 $in.^3$/s

Answer: C

479) Electrical systems are governed by Ohm's law, which states the
$V = IR$, where V = voltage, I = current, and R = resistance. If the current in an electrical system is decreasing at a rate of 5 A/s while the voltage remains constant at 26 V, at what rate is the resistance increasing when the current is 48 A?

A) $\frac{325}{24}$ ohms/s

B) $\frac{65}{24}$ ohms/s

C) $\frac{65}{1152}$ ohms/s

D) $\frac{24}{65}$ ohms/s

Answer: C

480) A spherical balloon is inflated with helium at a rate of 110π ft^3/min. How fast is the balloon's radius increasing when the radius is 3 ft?

A) 9.17 ft/min
B) 3.06 ft/min
C) 1.02 ft/min
D) 4.58 ft/min

Answer: B

481) A man flies a kite at a height of 50 m. The wind carries the kite horizontally away from him at a rate of 7 m/sec. How fast is the distance between the man and the kite changing when the kite is 130 m away from him?

A) 7 m/sec
B) 6.5 m/sec
C) 50.5 m/sec
D) 7.6 m/sec

Answer: B

482) A rectangular swimming pool 18 m by 10 m is being filled at the rate of 0.6 m^3/min. How fast is the height h of the water rising?

A) 0.20 m/min
B) 108 m/min
C) 0.84 m/min
D) 0.0033 m/min

Answer: D

483) A container is the shape of an inverted right circular cone has a radius of 5.00 inches at the top and a height of 7.00 inches. At the instant when the water in the container is 6.00 inches deep, the surface level is falling at the rate of –1.60 in./s. Find the rate at which water is being drained.

A) –93.3 $in.^3s$
B) –117 $in.^3/s$
C) –92.3 $in.^3/s$
D) –88.2 $in.^3/s$

Answer: C

484) A ladder is slipping down a vertical wall. If the ladder is 20 ft long and the top of it is slipping at the constant rate of 5 ft/s, how fast is the bottom of the ladder moving along the ground when the bottom is 16 ft from the wall?

A) 3.8 ft/s
B) 0.31 ft/s
C) 6.3 ft/s
D) 0.8 ft/s

Answer: A

485) The volume of a sphere is increasing at a rate of 6 cm^3/sec. Find the rate of change of its surface area when its volume is $\frac{32\pi}{3}$ cm^3. (Do not round your answer.)

A) 4 cm^2/sec
B) 12π cm^2/sec
C) $\frac{8}{3}$ cm^2/sec
D) 6 cm^2/sec

Answer: D

486) A storage tank used to hold sand is leaking. The sand forms a conical pile whose height is twice the radius of the base. The radius of the pile increases at the rate of 3 inches per minute. Find the rate of change of volume when the radius is 4 inches.

A) 192π $in.^3$/min
B) 24π $in.^3$/min
C) 48π $in.^3$/min
D) 96π $in.^3$/min

Answer: D

Differentiate implicitly to find d^2y/dx^2.

487) $x + xy + y = 2$

A) $\frac{2y + 2}{(x + 1)^2}$
B) $\frac{y + 1}{(x + 1)^2}$
C) $\frac{y - 2}{(x + 1)^2}$
D) $\frac{2y - 2}{(x + 1)^2}$

Answer: A

488) $2y - x + xy = 8$

A) $\frac{2y - 2}{(2 + x)^2}$

B) $\frac{y + 1}{(2 + x)^2}$

C) $\frac{y - 2}{(2 + x)^2}$

D) $\frac{2y + 2}{(2 + x)^2}$

Answer: A

489) $y^2 + xy + x^2 = 8$

A) $\frac{36}{(x - 2y)^3}$

B) $-\frac{36}{(x + 2y)^3}$

C) $\frac{36}{(x + 2y)^3}$

D) $-\frac{36}{(x - 2y)^3}$

Answer: B

490) $y^2 - x^2 = 3$

A) $\frac{y^2 - x^2}{y^2}$

B) $\frac{y - x^2}{y^3}$

C) $\frac{y^2 - x^2}{y^3}$

D) $\frac{y - x^2}{y^2}$

Answer: C

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

A) $\frac{6y^3 - 8x^2}{9y^3}$

B) $\frac{6y^3 - 8x^2}{9y^5}$

C) $\frac{5y^3 - 8x^2}{9y^5}$

D) $\frac{6y^3 - 8x^2}{9y^6}$

Answer: B

492) $x^3 + y^3 = 8$

A) $-\frac{2xy^3 + 2x^4}{y^6}$

B) $\frac{xy^3 - x^4}{y^6}$

C) $-\frac{2xy^3 + 2x^4}{y^5}$

D) $\frac{2xy^3 - 2x^4}{y^5}$

Answer: C

Provide an appropriate response.

493) Of all numbers whose sum is 20, find the two that have the maximum product. Is there a minimum product? Explain.

A) 10 and 10; The minimum product is 0.

B) 10 and 10; There is not a minimum product since the function that represents the product has just one critical point, and that critical point is a maximum. The domain is the real line, and on either side of the maximum the function decreases without bound.

C) 0 and 10 ; There is not a minimum product since the function that represents the product has just one critical point, and that critical point is a maximum. The domain is the real line, and on either side of the maximum the function decreases without bound.

D) 0 and 10; The minimum product is 0.

Answer: B

494) Of all numbers whose difference is 8, find the two that have the minimum product. Is there a maximum product? Explain.

A) 4 and −4; There is not a maximum product since the function that represents the product has just one critical point, and that critical point is a minimum. The domain is the real line, and on either side of the minimum the function increases without bound.

B) 4 and −4; The maximum product is 48.

C) 4 and 12; The maximum product is 48.

D) 4 and 12; There is not a maximum product since the function that represents the product has just one critical point, and that critical point is a minimum. The domain is the real line, and on either side of the minimum the function increases without bound.

Answer: A

495) Given that A(x) = C(x)/x , where A(x) is the average−cost function and C(x) is the total−cost function, find an expression for A′(x) and solve the equation A′(x) = 0 to find the minimum average cost.

A) $A'(x) = \dfrac{xC'(x) - C(x)}{x^2} = 0 \Rightarrow xC'(x) - C(x) = 0 \Rightarrow \dfrac{C(x)}{x} = A(x) = C'(x)$

B) $A'(x) = \dfrac{xC'(x) - C(x)}{x^2} = 0 \Rightarrow xC(x) - C'(x) = 0 \Rightarrow \dfrac{C'(x)}{x} = A(x) = \dfrac{C(x)}{x^2}$

C) $A'(x) = \dfrac{xC(x) - C'(x)}{x^2} = 0 \Rightarrow xC(x) - C'(x) = 0 \Rightarrow \dfrac{C(x)}{x} = A(x) = \dfrac{C'(x)}{x^2}$

D) $A'(x) = \dfrac{xC(x) - C'(x)}{x^2} = 0 \Rightarrow xC(x) - C'(x) = 0 \Rightarrow \dfrac{C'(x)}{x} = A(x) = C(x)$

Answer: A

496) Why is dy not generally equal to Δy?

A) Because dy is the change in f(x) over an interval x to x + Δx , whereas, over the same interval, Δy is the rise of the line tangent to f(x) at x = x.

B) Because Δy is the change in f(x) over an interval x to x + Δx , whereas, over the same interval, dy is the rise of the line tangent to f(x) at x = x.

C) Because Δy is the slope of f(x) at x + Δx , whereas, dy is the slope of f(x) at x + Δx.

D) Because Δy is the slope of f(x) at x + Δx , whereas, dy is the slope of the line tangent to f(x) at x = x.

Answer: B

497) When is dy equal to Δy for all Δx?

A) Always

B) Never

C) When f(x) is a linear function

D) When Δx is small

Answer: C

498) For a nonlinear function, dy is not equal to Δy, but dx is equal to Δx. When can one assume that dy/dx is about equal to Δy/Δx?

A) Always

B) When Δx is very close to Δy

C) When Δx is very close to zero

D) Never

Answer: C

499) Compare and contrast the meaning of dy/dx versus the meaning of $\Delta y/\Delta x$.

A) dy/dx is the instantaneous rate of change of y with respect to x at a point on the curve $y = f(x)$ at the beginning of an interval x to $x + \Delta x$, whereas $\Delta y/\Delta x$ is the instantaneous rate of change of y at the end of the interval x to $x + \Delta x$.

B) dy/dx is the derivative of y with respect to x, whereas $\Delta y/\Delta x$ is the derivative of Δy with respect to Δx.

C) $\Delta y/\Delta x$ is the instantaneous rate of change of y with respect to x, expressed as a function of x, whereas dy/dx is the average rate of change of y over a specific interval x to x + dx.

D) dy/dx is the instantaneous rate of change of y with respect to x, expressed as a function of x, whereas $\Delta y/\Delta x$ is the average rate of change of y over a specific interval x to $x + \Delta x$.

Answer: D

500) When an equation in x and y is differentiated implicitly to find dy/dx, any term in the equation that involves y will generate the factor dy/dx. Why?

A) Because of the Chain Rule

B) Because of the Reduced–Power Rule

C) Because the purpose of implicit differentiation is to find dy/dx.

D) Because of the Quotient Rule

Answer: A

501) Explain the idea of a related rate.

A) A function y = f(x) is a function of x, but if x can be expressed as a function of some other variable, such as time, t, then y is also a function of t, and the dependence of y on t is related to the dependence of x on t, which means, in turn, that the rate of change of y, dy/dt, is related to the rate of change of x, dx/dt, by the relation $\frac{dy}{dt} = \frac{dx}{dy} \cdot \frac{dt}{dx}$.

B) A function y = f(x) is a function of x, but if x can be expressed as a function of some other variable, such as time, t, then y is also a function of t, and the dependence of y on t is related to the dependence of x on t, which means, in turn, that the rate of change of y, dy/dt, is related to the rate of change of x, dx/dt, by the relation $\frac{dy}{dt} = \frac{dy}{dx} \cdot \frac{dx}{dt}$.

C) A function y = f(t) is a function of t, but y can generally be related to x if x is also a function of t; that is, $dy/dt \approx dx/dt$.

D) A function x = f(t) is a function of t, but x can generally be related to y if y is also a function of t; that is, $dx/dt \approx dx/dy$.

Answer: B

502) When is it advantageous to use implicit differentiation to find an expression for dy/dx?

A) When the relationship between x and y is not given in the explicit form y = f(x), and it is difficult to put the equation in this form.

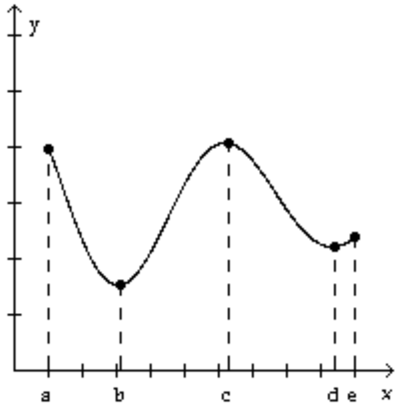
B) When the relationship between x and y can be expressed in the implicit form y = f(x), and it is difficult to express it any other way.

C) When the relationship between x and y is not given in the implicit form f(x,y) = 0, and it is difficult to put the equation in this form.

D) When the relationship between x and y can be expressed in the explicit form y = f(x), and it is difficult to express it any other way.

Answer: A

503) Consider this graph.



Using the graph and the intervals noted, explain how the first derivative of the depicted function indicates whether the function is increasing or decreasing.

A) The first derivative is negative on the intervals (a, b) and (c, d), which indicates that the function is decreasing on these intervals. The first derivative is positive on the intervals (b, c) and (d, e), which indicates that the function is increasing on these intervals.

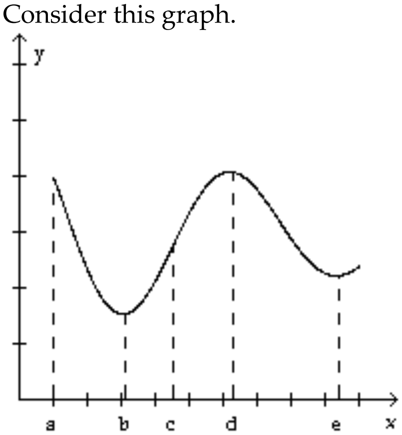
B) The first derivative is negative on the intervals (a, b) and (c, d), which indicates that the function is increasing on these intervals. The first derivative is positive on the intervals (b, c) and (d, e), which indicates that the function is decreasing on these intervals.

C) The first derivative is positive on the intervals (a, b) and (c, d), which indicates that the function is increasing on these intervals. The first derivative is negative on the intervals (b, c) and (d, e), which indicates that the function is decreasing on these intervals.

D) The first derivative is positive on the intervals (a, b) and (c, d), which indicates that the function is decreasing on these intervals. The first derivative is negative on the intervals (b, c) and (d, e), which indicates that the function is increasing on these intervals.

Answer: A

504) Consider this graph.



Determine which points on the graph are critical points and describe why each of the points is a critical point.

A) Since the point at $x = a$ is the only one for which the first derivative does not exist, this is the only critical point.

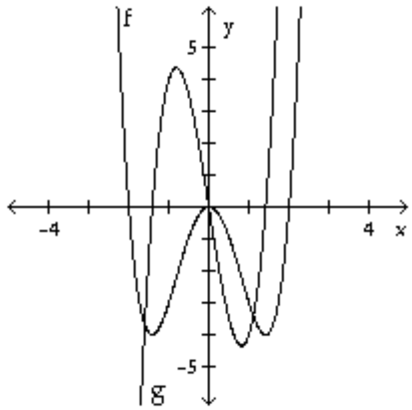
B) The points on the function at $x = a$, b, d, and e are critical points, because the derivative is zero at each of these points.

C) The points on the function at $x = a$, b, d, and e are critical points, because at $x = a$ the first derivative does not exist and at $x = b$, d, and e the derivative is zero.

D) The only critical points are those at $x = b$, d, and e, because the derivative is zero only at these points.

Answer: C

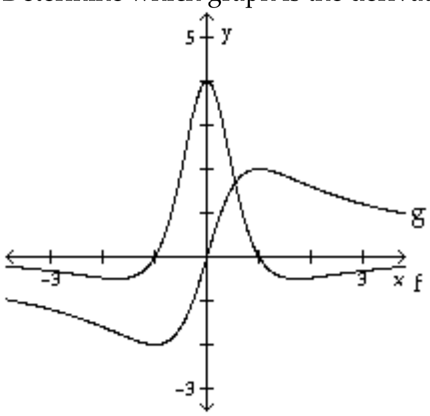
505) Determine which function is the derivative of the other.



A) f = g'
B) g = f'

Answer: B

506) Determine which graph is the derivative of the other.



A) g' = f
B) f' = g

Answer: B

507) Can a horizontal asymptote intersect the graph of a function?

A) No
B) Yes

Answer: B

508) What is an oblique asymptote? How can one identify functions that have oblique asymptotes? Can a graph cross an oblique asymptote?

A) An oblique asymptote is a nonhorizontal, nonvertical boundary that a function might approach increasingly closely, but never reach over some extended interval. Oblique asymptotes occur in rational functions when the degree of the numerator is equal to the degree of the denominator. A graph cannot cross an oblique asymptote.

B) An oblique asymptote is the same thing as a horizontal asymptote. Oblique asymptotes occur in rational functions when the degree of the numerator is less than or equal to the degree of the denominator. A graph can cross an oblique asymptote.

C) An oblique asymptote is a nonhorizontal, nonvertical boundary that a function might approach increasingly closely, but never reach over some extended interval. Oblique asymptotes occur in rational functions when the degree of the numerator is exactly one more than the degree of the denominator. A graph can cross an oblique asymptote.

D) An oblique asymptote is a nonhorizontal, nonvertical boundary that a function might approach increasingly closely, but never reach over some extended interval. Oblique asymptotes occur in rational functions when the degree of the numerator is less than or equal to the degree of the denominator. A graph can cross an oblique asymptote.

Answer: C

509) Find all of the asymptotes of the function

$f(x) = \frac{x^2 - 3}{x - 4}$.

A) Vertical asymptote: $x = -4$, oblique asymptote: $y = x$

B) Vertical asymptote: $x = -4$, oblique asymptote: $y = x + 4$

C) Vertical asymptote: $x = 4$, oblique asymptote: $y = x$

D) Vertical asymptote: $x = 4$, oblique asymptote: $y = x + 4$

Answer: D

510) Suppose a student finds that a function has exactly one critical point, determines that the point locates a maximum, and immediately concludes that the function has no minimum. What can you say about the x-interval considered by the student?

A) The interval is not closed, does not have endpoints, or does not contain its endpoints.

B) The endpoints of the interval yield values for the function that are larger than the value at the critical point.

C) The interval is closed.

D) The interval must be the real line.

Answer: A

511) Compare the behavior of the first derivative of a function around a point of inflection with its behavior around a maximum or minimum.

A) The first derivative maintains the same sign as x is followed from one side of a maximum, minimum, or point of inflection to the other.

B) The first derivative changes sign as x is followed from one side of a maximum or minimum to the other, but the first derivative maintains the same sign as x is followed from one side of a point of inflection to the other.

C) The first derivative maintains the same sign as x is followed from one side of a maximum or minimum to the other, but the first derivative changes sign as x is followed from one side of a point of inflection to the other.

D) The first derivative changes sign as x is followed from one side of a maximum, minimum, or point of inflection to the other.

Answer: B

512) Compare the behavior of the second derivative of a function around a point of inflection with its behavior around a maximum or minimum.

A) The second derivative maintains the same sign as x is followed from one side of a maximum or minimum to the other, but the second derivative changes sign as x is followed from one side of a point of inflection to the other.

B) The second derivative changes sign as x is followed from one side of a maximum or minimum to the other, but the second derivative maintains the same sign as x is followed from one side of a point of inflection to the other.

C) The second derivative changes sign as x is followed from one side of a maximum, minimum, or point of inflection to the other.

D) The second derivative maintains the same sign as x is followed from one side of a maximum, minimum, or point of inflection to the other.

Answer: A