

Disclaimer: The actual exam is different. Use this as a study aid.

Use synthetic division to perform the division.

1) $\frac{x^3 - x^2 + 7}{x + 2}$

1) _____

2)

$$\frac{x^3 + \frac{5}{2}x^2 + \frac{3}{2}x - \frac{3}{2}}{x - \frac{1}{2}}$$

2) _____

3) $\frac{x^5 - 1}{x - 1}$

3) _____

4) $\frac{x^4 + 16}{x - 2}$

4) _____

Express $f(x)$ in the form $f(x) = (x - k)q(x) + r$ for the given value of k .

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

5) _____

6) $f(x) = -6x^3 + 2x^2 + 5x - 10$; $k = 2$

6) _____

7) $f(x) = 3x^4 - 9x^3 + 2x^2 - 6x$; $k = 3$

7) _____

Use the remainder theorem and synthetic division to find $f(k)$.

8) $k = -2$; $f(x) = 2x^3 - 8x^2 - 4x + 18$

8) _____

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

9) _____

10) $k = 2 + i$; $f(x) = x^3 + 10$

10) _____

Use synthetic division to decide whether the given number k is a zero of the given polynomial function.

11) 3 ; $f(x) = -x^4 + 4x^2 - x + 1$

11) _____

12) $\frac{2}{5}$; $f(x) = 5x^4 + 3x^2 - 4$

12) _____

13) $-4 + 2i$; $f(x) = x^2 + 8x + 20$

13) _____

Use the factor theorem to decide whether or not the second polynomial is a factor of the first.

14) $4x^2 - 30x + 54; x - 3$ 14) _____

15) $5x^4 + 14x^3 - 3x^2 + x + 4; x + 3$ 15) _____

Factor $f(x)$ into linear factors given that k is a zero of $f(x)$.

16) $f(x) = 4x^3 + 16x^2 + 9x - 9; k = \frac{1}{2}$ 16) _____

17) $f(x) = 3x^3 + (5 - 3i)x^2 + (-11 - 8i)x + 3 + 3i;$
 $k = 1 + i$ 17) _____

For the polynomial, one zero is given. Find all others.

18) $P(x) = x^3 - 2x^2 - 11x + 52; -4$ 18) _____

19) $P(x) = x^4 - 45x^2 - 196; -2i$ 19) _____

Give all possible rational zeros for the following polynomial.

20) $P(x) = 2x^3 + 8x^2 + 5x - 8$ 20) _____

21) $P(x) = 3x^3 + 32x^2 + 32x + 27$ 21) _____

22) $P(x) = 2x^3 - 5x^2 + 7x - 5$ 22) _____

Find all rational zeros and factor $f(x)$.

23) $f(x) = 4x^3 - 28x^2 - x + 7$ 23) _____

24) $f(x) = 4x^3 - 16x^2 - x + 4$ 24) _____

25) $f(x) = 6x^3 + 19x^2 + 8x - 5$ 25) _____

Find the zeros of the polynomial function and state the multiplicity of each.

26) $f(x) = 2(x + 8)^2(x - 8)^3$ 26) _____

27) $f(x) = -5x^2(x - 9)(x + 4)^3$ 27) _____

28) $5x(x - 7)^3(x^2 - 4)$ 28) _____

Find a polynomial of degree 3 with real coefficients that satisfies the given conditions.

29) Zeros of $-3, -1, 4$ and $P(2) = 5$ 29) _____

30) Zeros of $3, i, -i$ and $P(2) = 15$ 30) _____

31) Zeros of $-3, 2, 4$ and $P(1) = 12$ 31) _____

32) Zeros of $-4, i, -i$ and $P(-3) = 60$ 32) _____

Find a polynomial of lowest degree with only real coefficients and having the given zeros.

33) $2 + i, 2$ 33) _____

34) $-\sqrt{6}, \sqrt{6},$ and $-9i$ 34) _____

35) $8, -14,$ and $3 + 8i$ 35) _____

36) $-\sqrt{6}, \sqrt{6},$ and -8 (multiplicity 2) 36) _____

Use Descartes' Rule of Signs to determine the possible number of positive real zeros and the possible number of negative real zeros for the function.

37) $3x^3 - 7x^2 + 2x + 2 = 0$ 37) _____

38) $-6x^4 - 8x^3 - 7x^2 - 5x + 7 = 0$ 38) _____

39) $3x^6 - 6x^4 - 3x^3 + 3x^2 - 2x = 0$ 39) _____

Find all complex zeros of the polynomial function. Give exact values. List multiple zeros as necessary.

40) $f(x) = x^3 - 3x^2 - 5x + 39$ 40) _____

41) $f(x) = x^3 - 64$ 41) _____

42) $f(x) = x^4 - 36$ 42) _____

Determine whether the statement is true or false. No need to show work.

43) If $f(x)$ is a polynomial and $f(3) = 0$, then $x + 3$ is a factor of $f(x)$. 43) _____

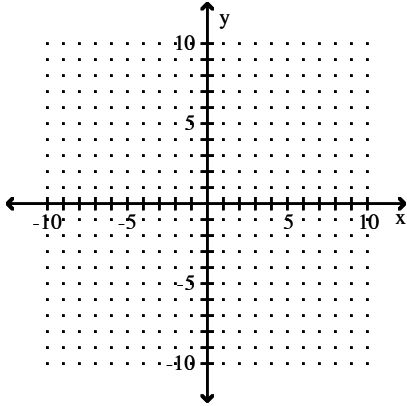
Determine whether the statement is true or false.

44) If $f(x)$ is a polynomial having only real coefficients and $1 - 4i$ is a zero of $f(x)$, then $-1 + 4i$ is also a zero. 44) _____

45) If c and d are complex numbers, then $\overline{c - d} = \overline{c} - \overline{d}$ 45) _____

Sketch the graph of the polynomial function. Label at least two points on the graph.

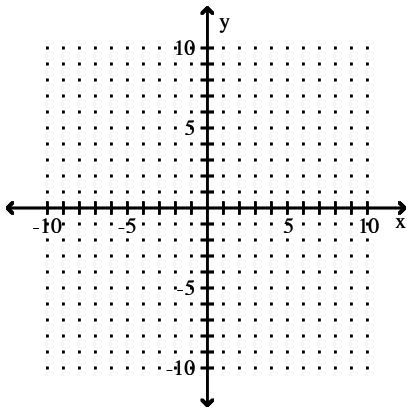
46) $f(x) = x^3 - 1$



46) _____

Sketch the graph of the polynomial function. Label at least two points on the graph.

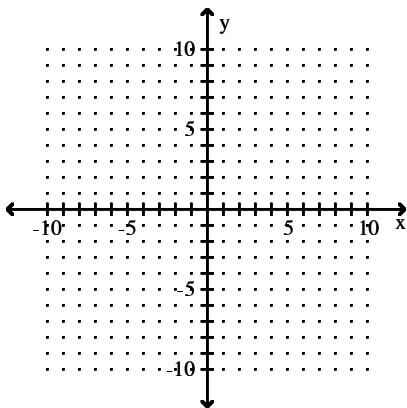
47) $f(x) = -\frac{1}{3}(x - 4)^2$



47) _____

Sketch the graph of the polynomial function. Label at least two points on the graph.

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



48) _____

Find the correct end behavior diagram for the given polynomial function.

49) $P(x) = -x^5 - 4x^3 - 8x + 1$

49) _____

50) $P(x) = 5x^6 - x^5 + 5x^2 - 8$

50) _____

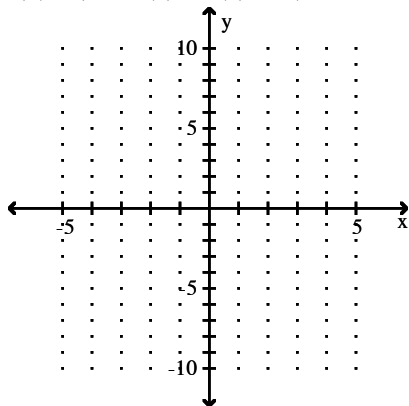
51) $P(x) = -2x^6 + 3x^5 - x^2 - 9x + 2$

51) _____

Graph the polynomial function. Factor first if the expression is not in factored form. Label at least two points on the graph.

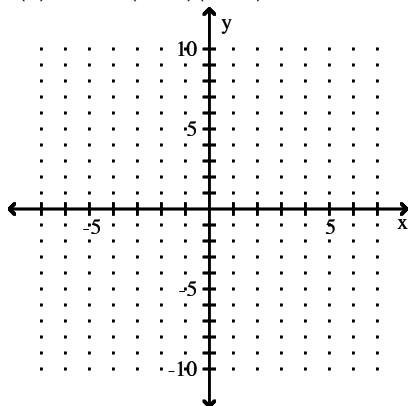
52) $f(x) = (3x - 2)(x + 1)(x - 1)$

52) _____



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

53) _____



Use the intermediate value theorem for polynomials to show that the polynomial function has a real zero between the numbers given.

54) $f(x) = 7x^5 + 9x^3 + 5x^2 + 7$; -1 and 0

54) _____

Use the boundedness theorem to determine whether the statement is true or false.

55) The polynomial $f(x) = x^4 - x^3 + 2x^2 - 4x - 10$ has no real zero greater than 3.

55) _____

56) The polynomial $f(x) = x^4 - x^3 + 2x^2 - 4x - 10$ has no real zero less than -1.

56) _____

57) The polynomial $f(x) = x^4 - x^3 + 2x^2 - 4x - 10$ has no real zero less than -1.

57) _____

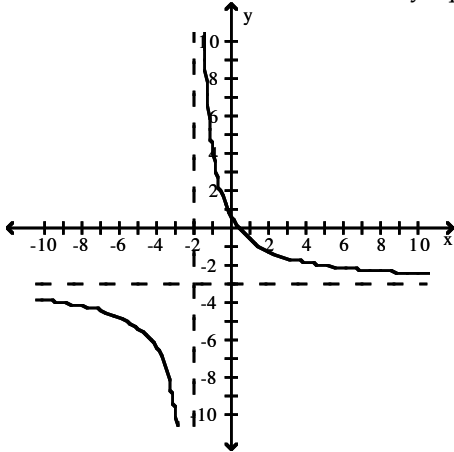
58) The polynomial $f(x) = x^5 - 5x^3 + 4x$ has no real zero greater than 2.

58) _____

Use the graph to answer the question.

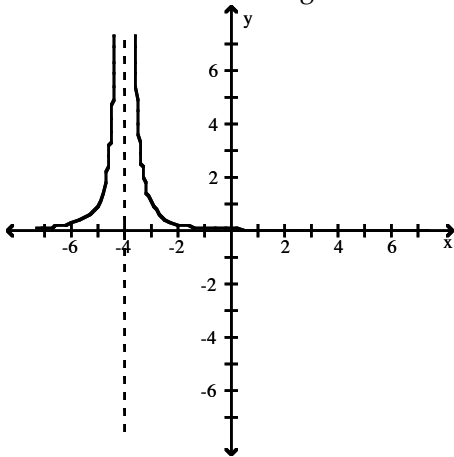
59) Find the horizontal and vertical asymptotes of the rational function graphed below.

59) _____



60) Find the domain and range of the rational function graphed below.

60) _____



Give the domain and range for the rational function. Use interval notation.

61) $f(x) = \frac{9}{x} + 10$

61) _____

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

62) _____

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

63) _____

Determine which of the rational functions given below has the following feature(s).

64) The y-intercept is 4

64) _____

A) $f(x) = \frac{x-8}{x-2}$

B) $f(x) = \frac{x+8}{x-2}$

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

D) $f(x) = \frac{3x-1}{x+4}$

65) The vertical asymptote is $x = 5$

A) $f(x) = \frac{x+9}{x-5}$

B) $f(x) = \frac{x+9}{x+5}$

C) $f(x) = \frac{x-5}{x+9}$

D) $f(x) = \frac{5x-1}{x+9}$

65) _____

66) There is a "hole" in its graph at $x = 4$

A) $f(x) = \frac{(x-4)(x+9)}{(x+5)(x-4)}$

B) $f(x) = \frac{x+4}{(x+9)(x+4)}$

C) $f(x) = \frac{x+9}{x-4}$

D) $f(x) = \frac{4x-1}{x+9}$

66) _____

67) The x -axis is its horizontal asymptote

A) $f(x) = \frac{9}{x-4}$

B) $f(x) = \frac{x+4}{x+9}$

C) $f(x) = \frac{x-4}{x}$

D) $f(x) = \frac{4x-1}{x+9}$

67) _____

68) x -intercepts: -5 and -1 , y -intercepts: $\frac{5}{16}$, vertical asymptote: $x = 4$, horizontal asymptote: $y = 1$

A) $f(x) = \frac{(x+5)(x+1)}{(x-4)^2}$

B) $f(x) = \frac{(x+5)(x+1)}{(x-4)}$

C) $f(x) = \frac{(x-5)(x-1)}{(x+4)^2}$

D) $f(x) = \frac{(x-5)(x-1)}{(x+4)}$

68) _____

69) x -intercepts: -1 and 5 , y -intercepts: none, vertical asymptotes: $x = 0$ and $x = -5$, horizontal asymptote: $y = 1$

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

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

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

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

69) _____

Find any vertical asymptotes.

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

70) _____

Find any vertical asymptotes. Give LINE EQUATION(S) not just a number

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

71) _____

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

72) _____

Find any vertical asymptotes.

$$73) h(x) = \frac{3x - 1}{x^2 + 3x - 4}$$

73) _____

Find the horizontal asymptote of the given function.

$$74) h(x) = \frac{16x^2}{8x^2 - 3}$$

74) _____

Find the horizontal asymptote of the given function. Give a LINE EQUATION not just a number

$$75) h(x) = \frac{28x^2}{7x^2 - 3}$$

75) _____

Find the horizontal asymptote of the given function.

$$76) h(x) = \frac{4 - 9x}{-3x + 7}$$

76) _____

Give the equation of the oblique asymptote, if any. Give a LINE EQUATION not just a number

$$77) f(x) = \frac{x^2 + 9x - 3}{x - 2}$$

77) _____

Give the equation of the oblique asymptote, if any.

$$78) f(x) = \frac{3x^2}{7x^2 + 9}$$

78) _____

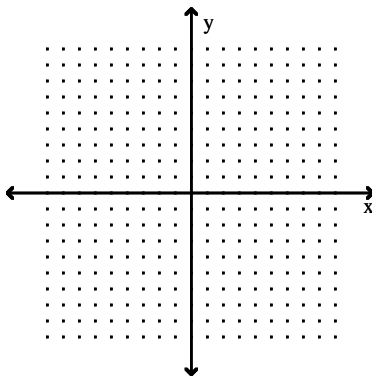
$$79) f(x) = \frac{x^2 + 3x + 9}{x + 8}$$

79) _____

Sketch the graph of the rational function. Label asymptotes, and at least two points on the graph.

$$80) f(x) = \frac{2x}{(x + 5)(x - 1)}$$

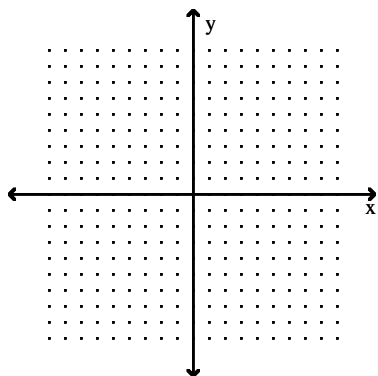
80) _____



Sketch the graph of the rational function. Label asymptotes and at least two points on the graph.

$$81) f(x) = \frac{(x-1)(x+4)}{(x-1)^2}$$

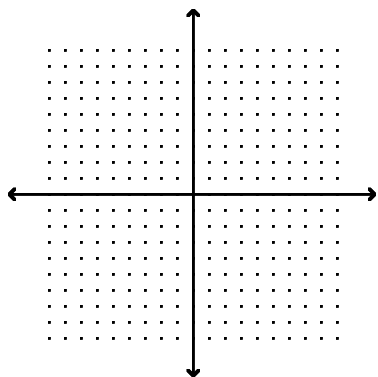
81) _____



Sketch the graph of the rational function. Label asymptotes and at least two points on the graph

$$82) f(x) = \frac{x+2}{x^2-16}$$

82) _____



Answer Key

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- 1) $x^2 - 3x + 6 + \frac{-5}{x+2}$
- 2) $x^2 + 3x + 3$
- 3) $x^4 + x^3 + x^2 + x + 1$
- 4) $x^3 + 2x^2 + 4x + 8 + \frac{32}{x-2}$
- 5) $f(x) = (x+2)(x^2 - 3x + 6) - 7$
- 6) $f(x) = (x-2)(-6x^2 - 10x - 15) - 40$
- 7) $f(x) = (x-3)(3x^3 + 2x)$
- 8) -22
- 9) 12
- 10) $12 + 11i$
- 11) No
- 12) No
- 13) Yes
- 14) Yes
- 15) No
- 16) $(2x-1)(2x+3)(x+3)$
- 17) $(x-(1+i))(x+3)(3x-1)$
- 18) $3+2i, 3-2i$
- 19) $2i, 7, -7$
- 20) $\pm 1, \pm 1/2, \pm 2, \pm 4, \pm 8$
- 21) $\pm 1, \pm 1/3, \pm 3, \pm 9, \pm 27$
- 22) $\pm 1, \pm 5, \pm 1/2, \pm 5/2$
- 23) $\frac{1}{2}, -\frac{1}{2}, 7; f(x) = (2x-1)(2x+1)(x-7)$
- 24) $\frac{1}{2}, -\frac{1}{2}, 4; f(x) = (2x-1)(2x+1)(x-4)$
- 25) $-1, -\frac{5}{2}, \frac{1}{3}; f(x) = (x+1)(3x-1)(2x+5)$
- 26) -8, multiplicity 2; 8, multiplicity 3
- 27) -4, multiplicity 3; 0, multiplicity 2; 9, multiplicity 1
- 28) Multiplicity 1 : 0
Multiplicity 1 : ± 2
Multiplicity 3 : 7
- 29) $P(x) = -\frac{x^3}{6} + \frac{13x}{6} + 2$
- 30) $P(x) = -3x^3 + 9x^2 - 3x + 9$
- 31) $P(x) = x^3 - 3x^2 - 10x + 24$
- 32) $P(x) = 6x^3 + 24x^2 + 6x + 24$
- 33) $f(x) = x^3 - 6x^2 + 13x - 10$
- 34) $f(x) = x^4 + 75x^2 - 486$

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35) $f(x) = x^4 - 75x^2 + 1110x - 8176$

36) $f(x) = x^4 + 16x^3 + 58x^2 - 96x - 384$

37) Positive (2, 0), negative (1)

38) Positive (1), negative (3, 1)

39) Positive (3, 1), negative (2, 0)

40) $-3, 3 + 2i, 3 - 2i$

41) $4, -2 + 2\sqrt{3}i, -2 - 2\sqrt{3}i$

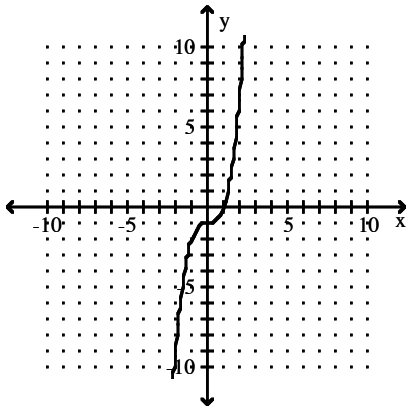
42) $\sqrt{6}, -\sqrt{6}i, \sqrt{6}i, -\sqrt{6}$

43) FALSE

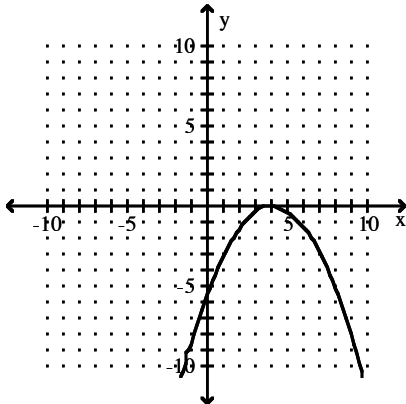
44) FALSE

45) TRUE

46)



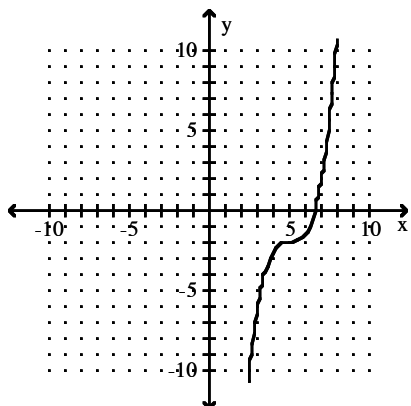
47)



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48)

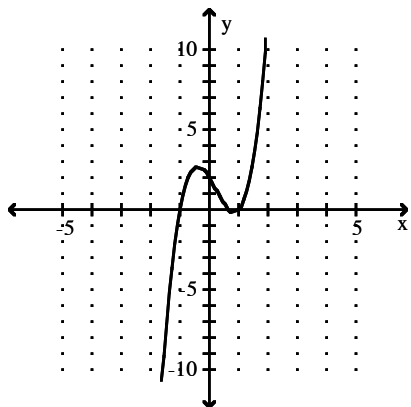


49) $\leftarrow \rightarrow$

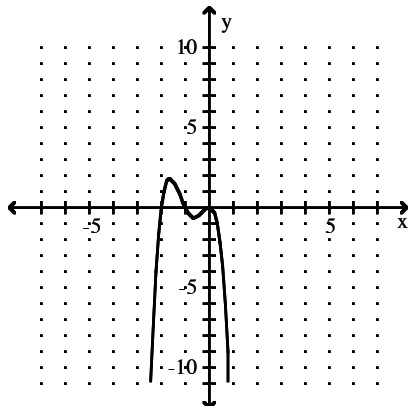
50) $\leftarrow \rightarrow$

51) $\leftarrow \rightarrow$

52)



53)



54) $f(-1) = -4$ and $f(0) = 7$

55) True

56) False

57) False

58) True

59) Horizontal: $y = -3$; vertical: $x = -2$

60) Domain: $(-\infty, -4) \cup (-4, \infty)$; Range: $(0, \infty)$

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61) Domain: $(-\infty, 0) \cup (0, \infty)$; Range: $(-\infty, 10) \cup (10, \infty)$

62) Domain: $(-\infty, -4) \cup (-4, \infty)$; Range: $(-\infty, 0) \cup (0, \infty)$

63) Domain: $(-\infty, 2) \cup (2, \infty)$; Range: $(1, \infty)$

64) A

65) A

66) A

67) A

68) A

69) A

70) None

71) None

72) $x = 0, x = -3$

73) $x = 1, x = -4$

74) $y = 2$

75) $y = 4$

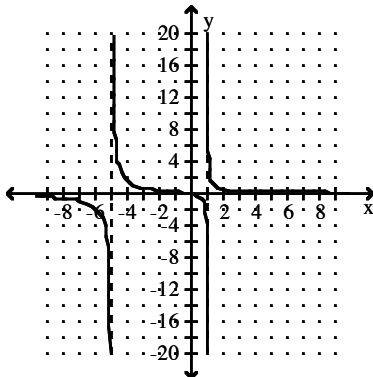
76) $y = 3$

77) $y = x + 11$

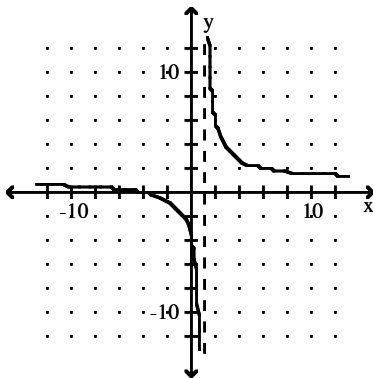
78) None

79) $y = x - 5$

80)



81)



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82)

