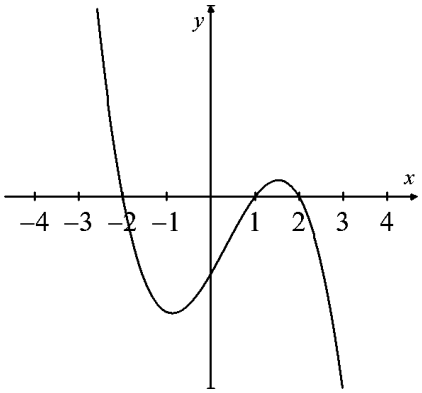
## JAN 1991

1. Which one of the following functions could describe the graph illustrated?




A. $f(x) = (x - 2)(x + 1)(x + 2)$

B. $f(x) = -(x - 2)(x + 1)(x + 2)$

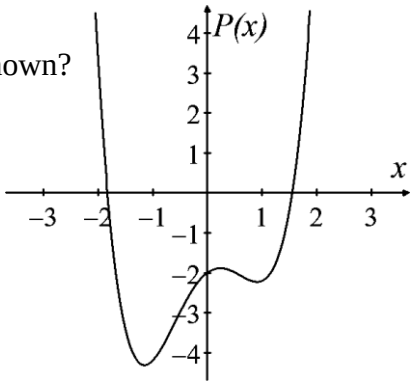
C. $f(x) = (x + 2)(x - 1)(x - 2)$

D. $f(x) = -(x + 2)(x - 1)(x - 2)$

2. If $2x + 1$ is a factor of a polynomial $P(x)$, which of the following must have a value of zero?

A. $P(1)$ B. $P(-1)$ C. $P\left(\frac{1}{2}\right)$ D. $P\left(-\frac{1}{2}\right)$

3. Which of the following approximates the zeros of the function shown?



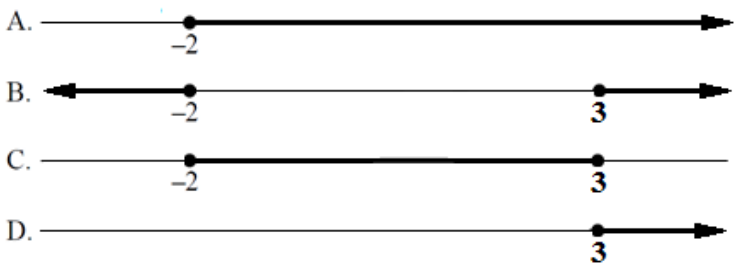

A. –2.2, 1.6

B. –1.8, 1.6

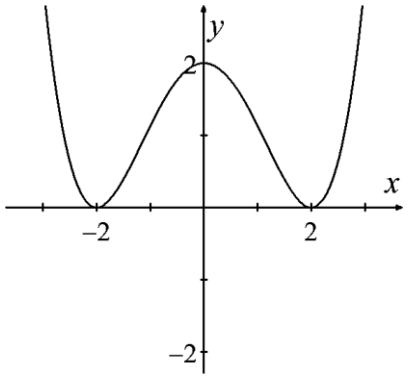
C. –2.2, –2, 1.6

D. –1.8, –2, 1.6

4. Which graph below illustrates the solution set for the inequality $(x+2)(x-3)^2 \geq 0$ ?



5. Given the graph of the function $y = P(x)$, how many positive zeros does the function $y = P(x - 2) - 1$ have?




A. 0 B. 2 C. 3 D. 4

6. Solve: $3x^3 - 2x^2 - 7x - 2 = 0$

## JUNE 1991

7. Which of the following is a possible root of the equation $4x^4 + 2x^3 + kx + 7 = 0$, where $k$ is an integer ?

A. 2 B. 4 C. $\frac{7}{2}$ D. $\frac{2}{7}$

8. Given a polynomial $P(x)$, what condition must be true for $x - 2$ to be factor of $P(x)$?

A. $P(2) = 0$ B. $P(-2) = 0$ C. $P(x) = 2$ D. $P(x) = -2$

9. What is the quotient when $5x^3 - 6x^2 + 64$ is divided by $x + 2$ ?

A. $5x^2 + 4x + 8$

B. $5x^2 - 16x + 32$

C. $5x^2 + 4x + 72$

D. $5x^2 - 16x + 96$

10. Select a cubic equation with roots $-1$, $1$ and $\frac{2}{3}$:

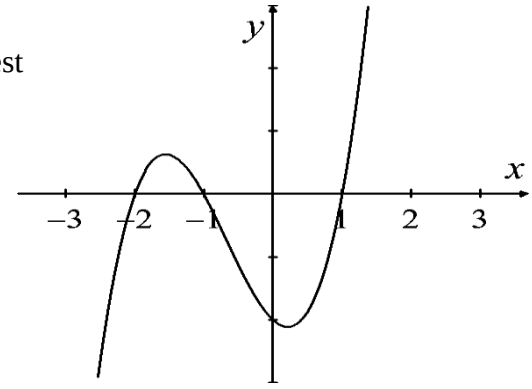
A. $2x^3 + 3x^2 - 2x - 3$

B. $2x^3 - 3x^2 - 2x + 3$

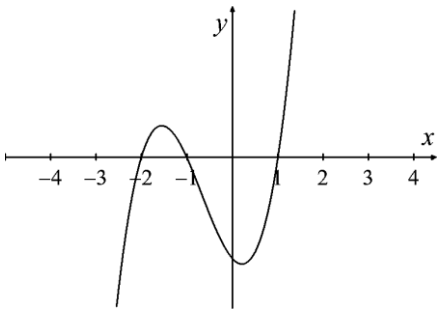
C. $3x^3 + 2x^2 - 3x - 2$

D. $3x^3 - 2x^2 - 3x + 2$

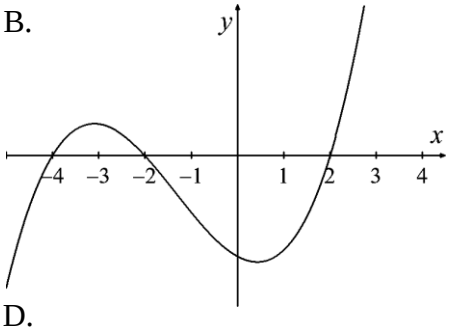
11. Given the graph of $y = P(x)$, which of the following best represents $y = xP(x)$ ?



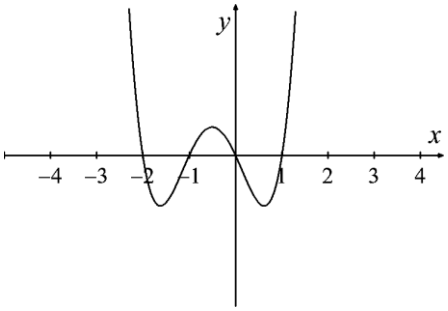

A.



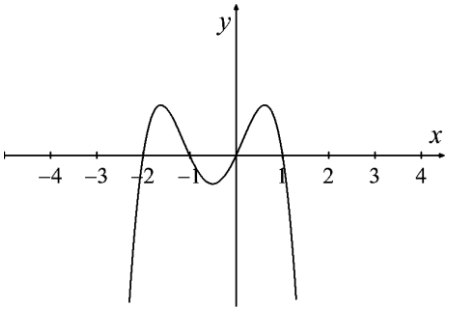

B.




C.




D.




## JAN 1992

12. If $x + 7$ is a factor of a polynomial $p(x)$, which of the following must be true?

A. $p(x) = 0$ B. $p(7) = 0$ C. $p(-7) = 0$ D. $p(x) = -7$

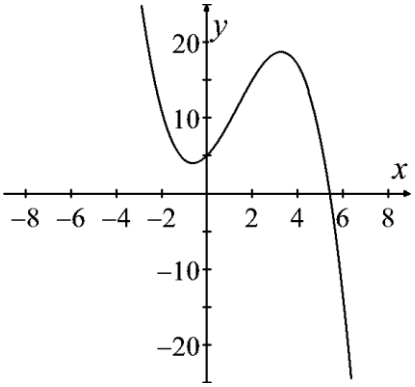
13. Using the Rational Zero Theorem, determine all possible rational roots of $2x^3 + x^2 - 5x + 3 = 0$.

A. $\pm 1, \pm 2$ B. $\pm 1, \pm 2, \pm 3$ C. $\pm 1, \pm\frac{1}{2}, \pm\frac{3}{2}, \pm 3$ D. $\pm 1, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm 2$

14. What is the remainder when $x^{21} - 1$ is divided by $x + 1$?

A. $-22$ B. $-2$ C. $-1$ D. 0

15. What is the minimum degree of the polynomial function shown?

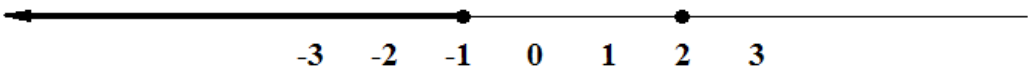



A. 1 B. 2 C. 3 D. 4

16. Which of the following is a factor of $x^3 + 5x^2 + 2x - 8$ ?

A. $x^2 + 6x + 8$ B. $x^2 + 3x + 2$ C. $x - 2$ D. $x - 4$

17. Determine a polynomial inequality whose solution is graphed below:




A. $(x-1)(x+2)^2 \le 0$ B. $(x+1)(x-2)^2 \le 0$

C. $(x+1)(x-2)^2 \ge 0$ D. $(x-1)(x-2)^2 \ge 0$

18. Determine all real roots of the equation $x^3 + x^2 - 5x - 5 = 0$ .

## JUNE 1992

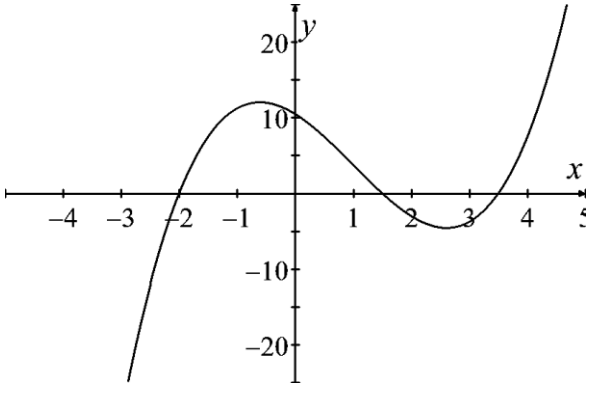
19. Let $p(x)$ be a polynomial such that $p(-3) = 0$ . Which of the following must be a factor of $p(x)$?

A. $x$ B. $x - 3$ C. $x + 3$ D. $x^2 - 9$

20. Determine all possible rational roots of $2x^3 - 5x^2 + 3x - 5 = 0$.

A. $\pm 1, \pm 2$ B. $\pm 1, \pm 5$ C. $\pm 1, \pm 5, \pm\frac{1}{2}, \pm\frac{5}{2}$ D. $\pm 1, \pm 2, \pm\frac{1}{5}, \pm\frac{2}{5}$

21. Estimate the real zeros of the function shown:



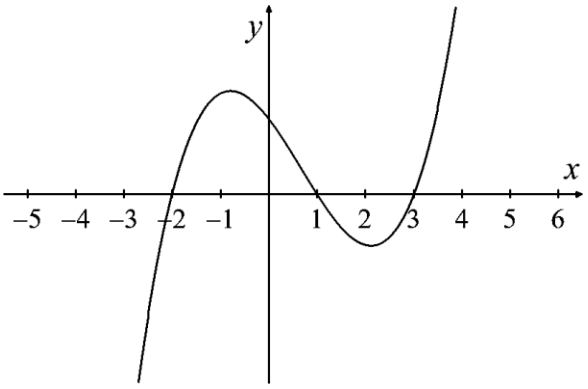

A. 10 B. –2, 1.5, 3.5

C. 2, –1.5, –3.5 D. 10, –2, 1.5, 3.5

22. Determine the remainder when $p(x) = x^{28} - 2x^5 + 3$ is divided by $x - 1$.

A. 2 B. 3 C. 4 D. 6

23. Using the graph of the polynomial function $f(x)$ shown, determine all values of $x$ such that $f(x + 3) > 0$.




A. $-5 < x < -2$ or $x > 0$

B. $x < -5$ or $-2 < x < 0$

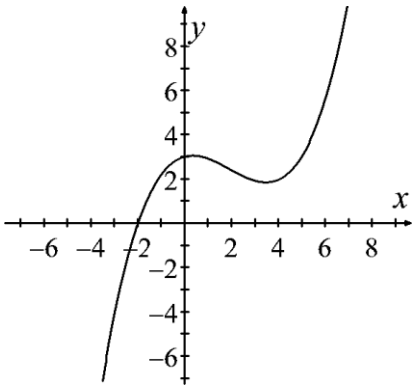
C. $-2 < x < 1$ or $x > 3$

D. $1 < x < 4$ or $x > 6$

24. A polynomial function $p(x)$, of degree 3, has the real zeros $-2$, $1$ and $4$, and a $y$–intercept of 24. Determine the value of $p(6)$.

## JAN 1993

25. Determine a real zero of the function shown:




A. $-2$ B. 2 C. 3 D. 4

26. Determine all possible rational roots of $6x^3 - 5x^2 - 7x - 3 = 0$.

A. $\pm 1, \pm 3$

B. $\pm 1, \pm 2, \pm 3, \pm 6$

C. $\pm\frac{1}{3}, \pm\frac{2}{3}, \pm 1, \pm 2, \pm 3, \pm 6$

D. $\pm\frac{1}{6}, \pm\frac{1}{3}, \pm\frac{1}{2}, \pm 1, \pm\frac{3}{2}, \pm 3$

27. Determine the remainder if $x^3 - 2x^2 + 3x - 7$ is divided by $x + 1$.

A. $-13$ B. $-9$ C. $-5$ D. 5

28. Solve: $x^3 + 5x^2 + 6x = 0$

A. $-2, -3$ B. $1, -6$ C. $0, -2, -3$ D. $0, 1, -6$

29. Determine a polynomial equation that has roots $\pm 3$ and $2$.

A. $x^3 - 2x^2 - 9x + 18 = 0$ B. $x^3 + 2x^2 - 9x - 18 = 0$

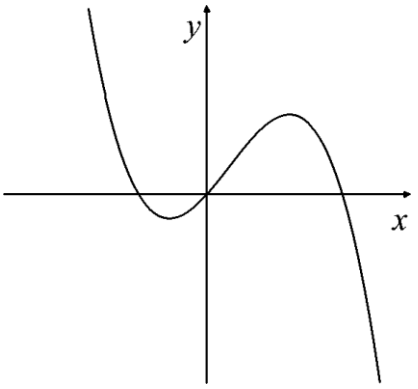
C. $x^3 - 2x^2 + 9x + 18 = 0$ D. $x^3 + 2x^2 - 9x - 18 = 0$

30. How many real roots are there for the polynomial equation $x(x^2 - 4)(x + 3)(x^2 + 5) = 0$ ?

A. 3 B. 4 C. 5 D. 6

31. Graph the solution of the inequality for $(x - 3)(x + 1)(x - 1) \geq 0$


32. If the graph of the polynomial function shown is of the form $y = ax^3 + bx^2 + cx + d$ (where $a$, $b$, $c$, and $d$ are constants), what are the conditions on $a$ and $d$ ?

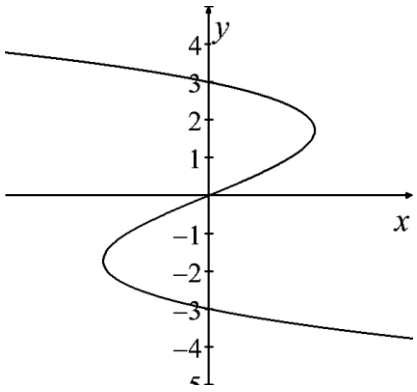



A. $a > 0, d = 0$ B. $a > 0, d = 0$

C. $a < 0, d = 0$ D. $a < 0, d = 0$

## JUNE 1993

33. Determine a possible equation of the inverse of the relation shown.



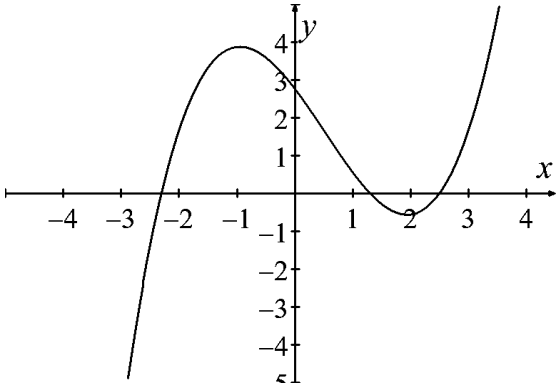

A. $y = x^3 - 3x$ B. $y = 3x - x^3$

C. $y = x^3 - 9x$ D. $y = 9x - x^3$

34. If a polynomial $p(x)$ is divided by $x - 5$, what is the remainder?

A. $p(-5)$ B. $p(5)$ C. $p(x - 5)$ D. $p(x + 5)$

35. Estimate the real zeros of the function shown:




A. −2.3, 1.3, 2.5

B. 2.3, −1.3, −2.5

C. −2.7, 1.3, 2.5

D. 2.7, −1.3, −2.5

36. Determine a polynomial equation that has roots $\sqrt{2},\ -\sqrt{2}$ and $1$.

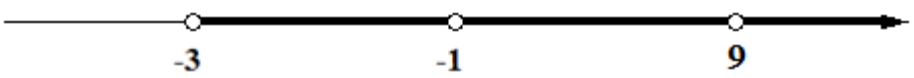
A. $x^3 - x^2 - 4x + 4 = 0$ B. $x^3 + x^2 - 4x - 4 = 0$

C. $x^3 + x^2 - 2x - 2 = 0$ D. $x^3 - x^2 - 2x + 2 = 0$

37. Determine the remainder when $6x^3 - 11x^2 + 14x - 5$ is divided by $2x^2 - 7x + 3$.

A. $-107x - 53$ B. $-107x + 43$ C. $40x - 20$ D. 20

38. What is the minimum degree of a polynomial inequality whose solution is shown below?




A. 3 B. 4 C. 5 D. 6

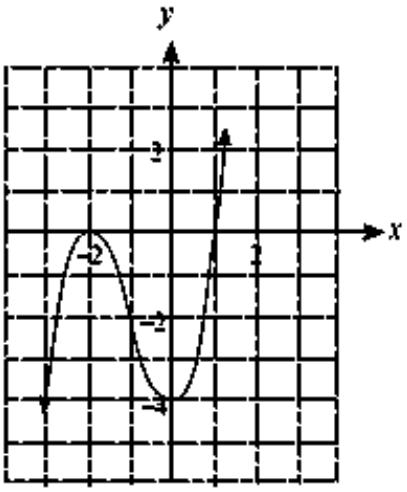
39. Solve: $2x^3 + 3x^2 - 11x - 6 = 0$

## JAN 1994

40. According to the Rational Root Theorem, what are the possible rational roots of $2x^4 + 3x^2 - 7x + 3 = 0$ ?

A. $\pm 1, \pm 3$ B. $\pm 1, \pm 2, \pm\frac{1}{3}, \pm\frac{2}{3}$ C. $\pm 1, \pm 3, \pm\frac{1}{2}, \pm\frac{3}{2}$ D. $\pm 1, \pm 2, \pm 3, \pm\frac{1}{2}, \pm\frac{3}{2}$

41. Which equation could represent the following graph?




A. $y = (x + 2)^2 (x - 1)$

B. $y = (x + 2)^2 (x + 1)$

C. $y = (x - 2)^2 (x - 1)$

D. $y = (x - 2)^2 (x + 1)$

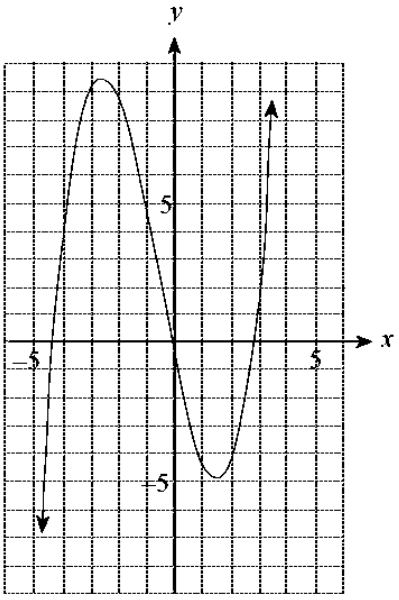
42. Determine the quotient when $x^3 - 2x^2 - 9$ is divided by $x - 3$.

A. $x^2 + 5x + 15$ B. $x^2 + x - 6$ C. $x^2 - 5x + 6$ D. $x^2 + x + 3$

43. What value of $k$ would make $x + 2$ a factor of $2x^3 - 5x^2 - 2kx + 8$ ?

A. –7 B. –1 C. 1 D. 7

44. From the graph of $y = f(x)$ shown, find the approximate solutions to $f(x) = 2$.



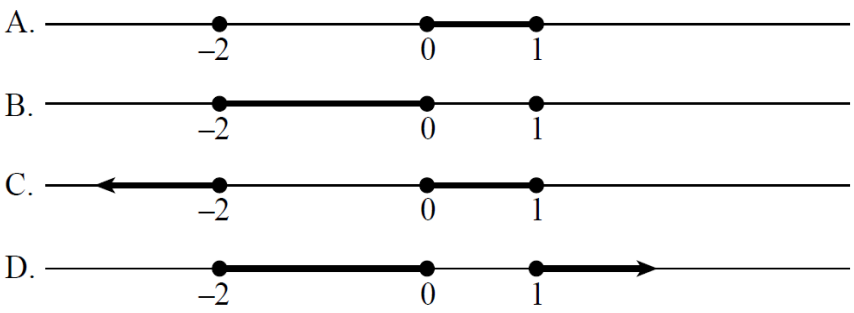

A. –4.2

B. 8.6

C. –4.5, 0.3, 2.5

D. –4.2, –0.5, 3.0

45. Determine the graph of the solution set of the inequality $x(x - 1)^n (x + 2)^m > 0$, if $n$ is an even positive integer and $m$ is an odd positive integer.



46. Solve: $2x^3 - x^2 - 8x + 4 = 0$

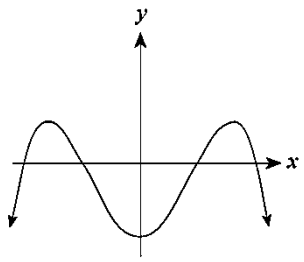
## JUNE 1994

47. According to the Rational Root Theorem, which one of the following is a possible root of the equation $8x^4 + 19x^3 - 13x^2 + 7x - 3 = 0$ ?

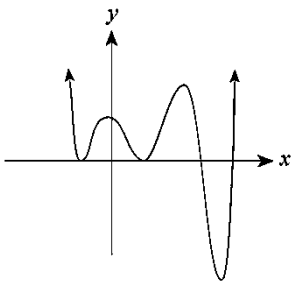
A. 2 B. 3 C. 4 D. 8

48. Which graph could represent a polynomial function of degree 5?

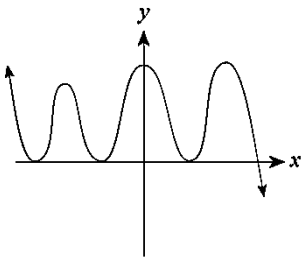
A.



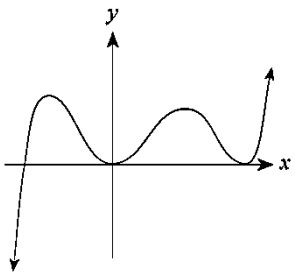

B.




C.




D.




49. When $4x^2 + 2kx - 5$ is divided by $x + 2$ the remainder is 3. What is the value of $k$ ?

A. $-6$ B. $-2$ C. 2 D. $\frac{11}{4}$

50. Solve: $x^3 - 2x^2 - 5x + 6 = 0$

A. 1, 2, –3 B. 1, –2, 3 C. –1, 2, –3 D. –1, –2, 3

51. Determine the remainder when $p(x) = 4x^3 - 6x^2 + 4x - 3$ is divided by $2x - 1$.

A. –7 B. –4 C. –3 D. –2

52. Determine a polynomial equation that has roots of $\sqrt{3}$, $-\sqrt{3}$ and 2.

A. $x^3 - 2x^2 - 3x + 6 = 0$ B. $x^3 + 2x^2 - 3x - 6 = 0$

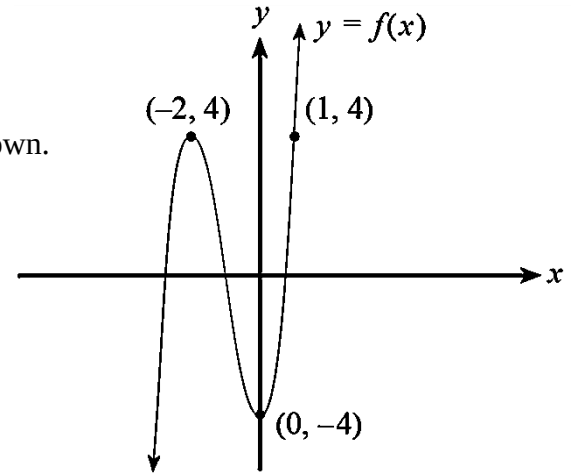
C. $x^3 - 2x^2 - 9x + 18 = 0$ D. $x^3 + 2x^2 - 9x - 18 = 0$

53. Which polynomial inequality has the solution $-3 < x < -2$ or $x > 1$ ?

A. $(x + 3)(x + 2)(x - 1) < 0$ B. $(x + 3)(x + 2)(x - 1) > 0$

C. $(x - 3)(x - 2)(x + 1) < 0$ D. $(x - 3)(x - 2)(x + 1) > 0$

54. The graph of a cubic polynomial function, $y = f(x)$, is shown. Determine the equation of $y = f(x) - 4$.




A. $y = (x + 2)^2(x + 1)$

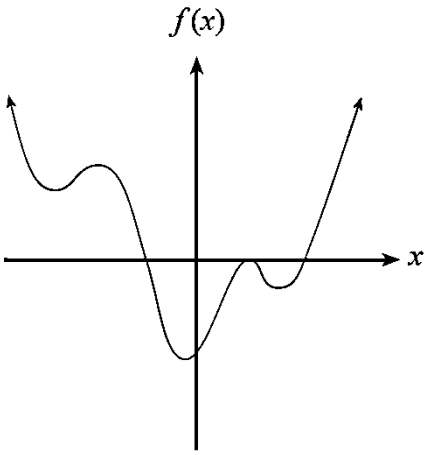
B. $y = (x + 2)^2(x - 1)$

C. $y = 2(x + 2)^2(x + 1)$

D. $y = 2(x + 2)^2(x - 1)$

## JAN 1995

55. Determine the minimum degree of the polynomial function shown.




A. 3 B. 4 C. 5 D. 6

56. If $p(x) = x^3 - 3x^2 + k\,x + 1$, determine $k$ if $p(3) = -5$.

A. –12 B. –2 C. 4 D. 16

57. Determine all real roots of the equation $(x^2 - 4)(x^2 + 9)(x - 5)^2 = 0$.

A. 2, 3, 5 B. ±2, 5 C. ±2, ±3, 5 D. ±2, ±3, ±5

58. The polynomial equation $x^3 - ax^2 + bx - c = 0$, where $a$, $b$ and $c$ are integers, has 6 as one of its roots. According to the Rational Root Theorem, which of the following could be a value of $c$?

A. 2 B. 3 C. 9 D. 18

59. Determine the quotient and remainder: $(t^4 + 3t^3 + 5t^2 + 21t - 14) \div (t^2 + 3t - 2)$

A. quotient: $t^2 + 7$, remainder: 0
B. quotient: $t^2 + 7$, remainder: $-28$
C. quotient: $t^2 + 3$, remainder: $12t - 8$
D. quotient: $t^2 + 3$, remainder: $30t - 20$

60. Find the remainder when $x^{39} - 3x^{15} - 2x + 1$ is divided by $x - 1$.

A. $-3$ B. $-1$ C. 1 D. 5

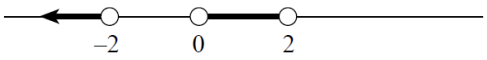
61. Determine all real solutions for $x^3 - 2x^2 - 5x + 6 = 0$.

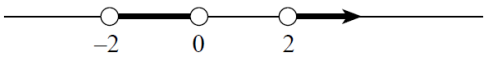
A. $-1, 3, -2$ B. $-1, -3, 2$ C. $1, 3, -2$ D. $1, -3, 2$

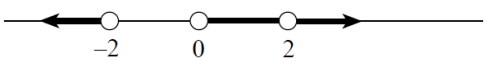
62. Solve the inequality: $x(x - 2)(x^2 - 4) < 0$

A.



B.



C.



D.



63. A square piece of cardboard 10 cm by 10 cm will have equal squares with sides of length $x$ cm cut from each corner. The sides will then be folded up to create a box with no top. Determine the value of $x$ that will give the box a maximum volume.

## JUNE 1995

64. If $x + 8$ is a factor of the polynomial $P(x)$, which of the following must be true?

A. $P(-8) = 0$ B. $P(8) = 0$ C. $P(x) = 8$ D. $P(x) = -8$

65. What is the maximum number of real roots that a polynomial equation can have if its degree is 6?

A. 3 B. 5 C. 6 D. 7

66. According to the Rational Zero Theorem, which number is a possible zero of the function $f(x) = 6x^3 + 7x^2 - 3x + 4$ ?

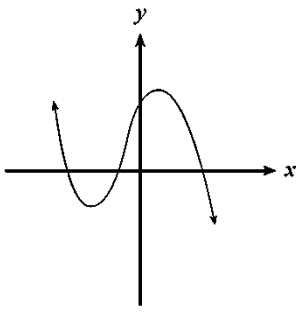
A. $-\frac{3}{2}$ B. $\frac{1}{4}$ C. $\frac{1}{3}$ D. 3

67. Determine the remainder when $2x^4 + 4x^3 - 5x^2 + 8$ is divided by $x - 2$.

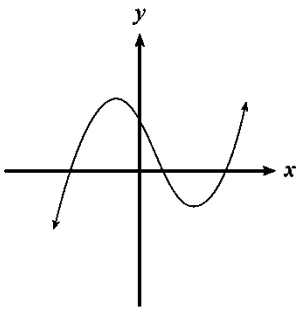
A. –12 B. 18 C. 30 D. 52

68. Which graph is the best representation of $y = ax^3 + bx^2 + cx - 24$ where $a > 0$?

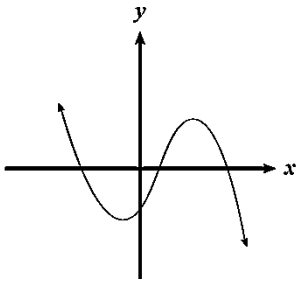
A.



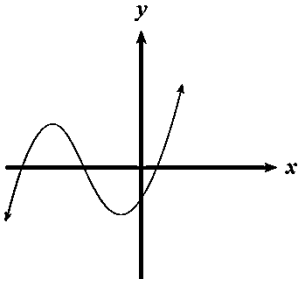

B.




C.




D.



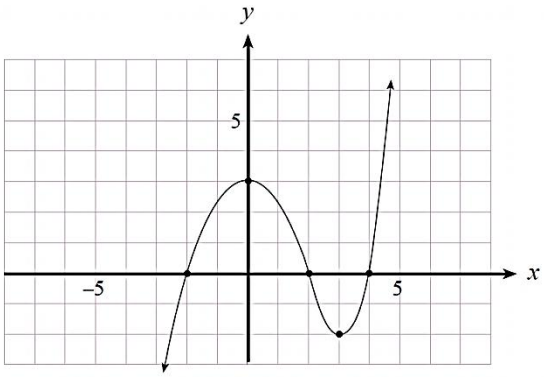
69. Determine all the real zeros of the function $P(x) = 2x(x^2 + 9)(x^2 - 2)$.

A. $0, \pm\sqrt{2}$ B. $0, \pm 3$ C. $0, \sqrt{2}, 3$ D. $0, \pm\sqrt{2}, \pm 3$

70. Solve the inequality: $(x + 2)^2(x - 2)(x - 4) < 0$

A. $x < -2$ B. $-2 < x < 4$ C. $2 < x < 4$ D. $x < 2$ or $x > 4$

71. The graph of the function $f(x)$ is shown.
If $g(x) = 3f(x)$, determine the zeros of $g(x)$.




A. –2, 2, 4 B. –6, 6, 12

C. –6, 9 D. –2, 3

## JAN 1996

72. According to the Rational Root Theorem, determine all possible rational roots of $3x^3 - 8x^2 + 16x - 4 = 0$.

A. $\pm 1, \pm 3$ B. $\pm 1, \pm 2, \pm 4$

C. $\pm 1, \pm\frac{1}{2}, \pm\frac{1}{4}, 3, \pm\frac{3}{2}, \pm\frac{3}{4}$ D. $\pm 1, \pm\frac{1}{3}, 2, \pm\frac{2}{3}, \pm 4, \pm\frac{4}{3}$

73. If $p(x)$ is a polynomial function where $p(-2) = 5$, then which of the following could not be a zero of this function?

A. –5 B. –2 C. 2 D. 5

74. Find the remainder when $x^3 - 2x^2 + 5$ is divided by $x^2 + x - 1$.

A. 4 B. $2x + 2$ C. $2x + 4$ D. $4x + 2$

75. Solve for $x$: $x^3 - 2x^2 - 5x + 6 = 0$

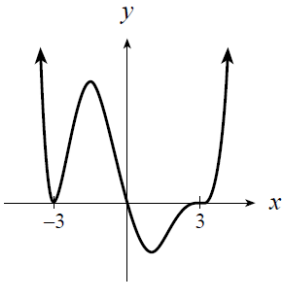
A. –1, –2, 3 B. –1, 2, 3 C. 1, –2, 3 D. 1, 2, –3

76. Determine the value of $k$ such that $x + 2$ is a factor of the polynomial $2x^3 + 5x^2 + kx - 12$.

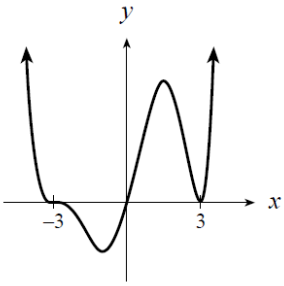
A. $-12$ B. $-4$ C. 4 D. 12

77. Which graph best represents $y = -x(x + 3)^2 (x - 3)^3$ ?

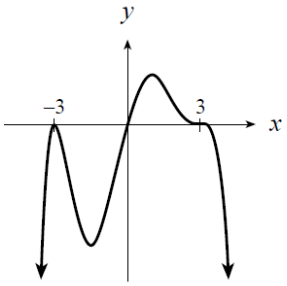
A.



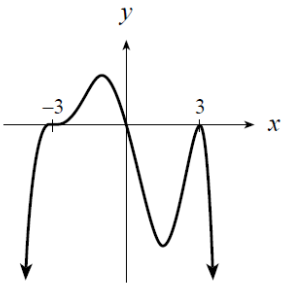

B.



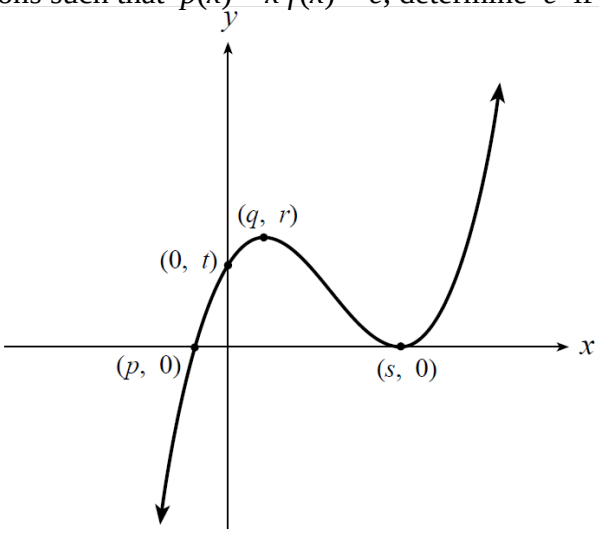

C.




D.




78. Given that $p(x)$ and $f(x)$ are polynomial functions such that $p(x) = x\,f(x) + c$, determine $c$ if the graph of $p(x)$ is shown.




A. $p$

B. $t$

C. $r$

D. $s$

## JUNE 1996

79. If the polynomial $p(x)$ is divided by $x - 6$, which of the following represents the remainder?

A. $p(6)$ B. $p(-6)$ C. $p(x) + 6$ D. $p(0)$

80. Determine the value of $k$ if 2 is a zero of the function $p(x) = x^3 - 7x^2 + kx + 12$.

A. $k = -16$ B. $k = 4$ C. $k = 5$ D. $k = 16$

81. Determine the quotient when $x^3 - 12x^2 + 9x - 5$ is divided by $x - 3$.

A. $x^2 - 9x - 16$ B. $x^2 - 9x - 18$ C. $x^2 - 15x + 54$ D. $x^2 + 9x + 36$

82. If $x + 4$ is a factor of the polynomial $mx^3 - 11x^2 - 10x + n$, where $m$ and $n$ are integers, according to the Rational Root Theorem, which of the following could be a value for $n$ ?

A. 2 B. 6 C. 8 D. 10

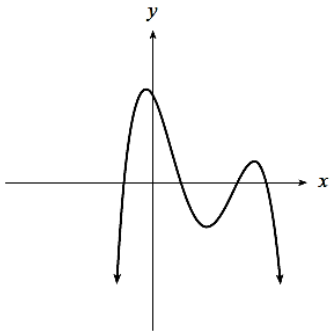
83. Solve: $x^3 - 4x^2 > 12x$

A. $-2 < x < 6$ B. $x < -2$ or $x > 6$

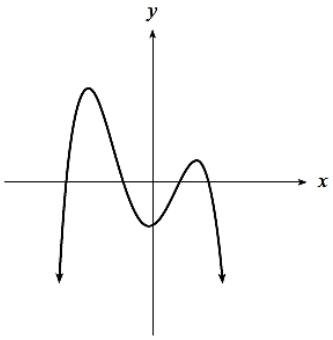
C. $-2 < x < 0$ or $x > 6$ D. $-6 < x < 0$ or $x > 2$

84. Which graph is a possible representation of $y = ax^4 + bx^3 + cx - 6$, where $a$ is a negative integer?

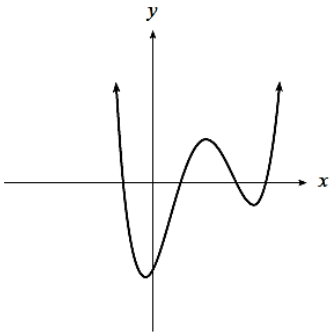
A.



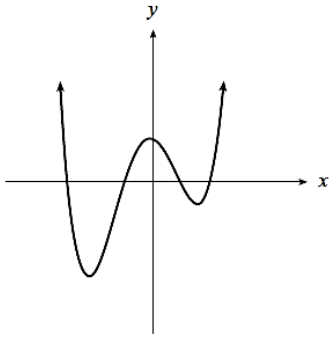

B.




C.




D.

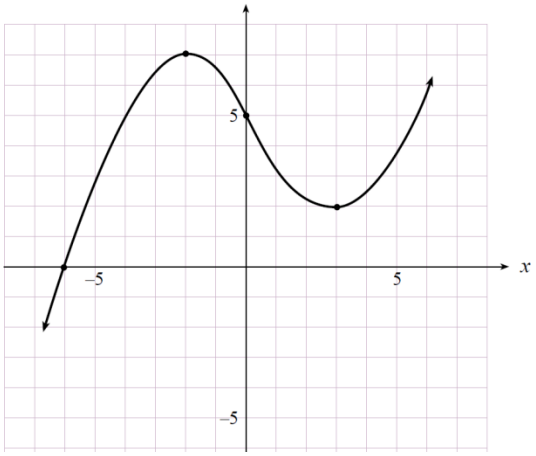


85. Determine a polynomial equation that has the following roots: $2, \pm\sqrt{5}$

A. $x^3 + 2x^2 - 5x - 10 = 0$ B. $x^3 - 2x^2 + 5x - 10 = 0$

C. $x^3 - 2x^2 - 5x + 10 = 0$ D. $x^3 + 2x^2 + 5x + 10 = 0$

86. The graph of the cubic polynomial function $p(x)$ is given below. Which of the following functions must have 3 unequal real zeros?




A. $p(x) - 7$

B. $p(x) - 3$

C. $p(x - 3)$

D. $p(x - 7)$

## JAN 1997

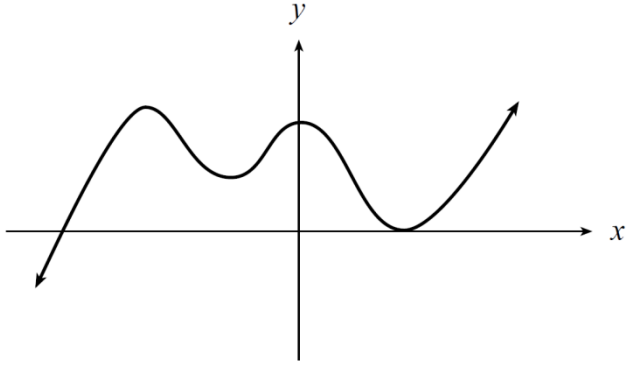
87. If $x + 4$ is a factor of the polynomial $p(x)$, then which of the following must be true?

A. $p(-4) = 0$ B. $p(4) = 0$ C. $p(0) = -4$ D. $p(0) = 4$

88. According to the Rational Root Theorem, which number could not be a root of the equation $4x^3 + kx^2 + 3x - 3 = 0$, where $k$ is an integer?

A. –3 B. –1 C. $\frac{4}{3}$ D. $\frac{3}{2}$

89. What is the minimum degree of the polynomial function graphed below?




A. 3

B. 4

C. 5

D. 7

90. When $x^3 + x^2 - kx - 5$ is divided by $x - 2$, the remainder is 1. Find the value of $k$.

A. 3 B. 3.5 C. 4.5 D. 5

91. Determine a polynomial equation that has the roots $\pm 2, \pm\sqrt{7}$.

A. $x^4 - 11x^2 + 28 = 0$ B. $x^4 + 11x^2 + 28 = 0$

C. $x^4 - 9x^2 + 14 = 0$ D. $x^4 + 9x^2 + 14 = 0$

92. Find the remainder for the following division. $x^2 + 2x - 4\overline{)x^4 + 2x^3 - 3x^2 + 2x - 6}$

A. 2 B. 10 C. $4x + 2$ D. $16x - 22$

93. Determine the real root(s): $2x^3 - 3x^2 + 6x - 9 = 0$

A. $-\frac{3}{2}$ B. $\frac{3}{2}$ C. $-\frac{3}{2}, \pm\sqrt{3}$ D. $\frac{3}{2}, \pm\sqrt{3}$

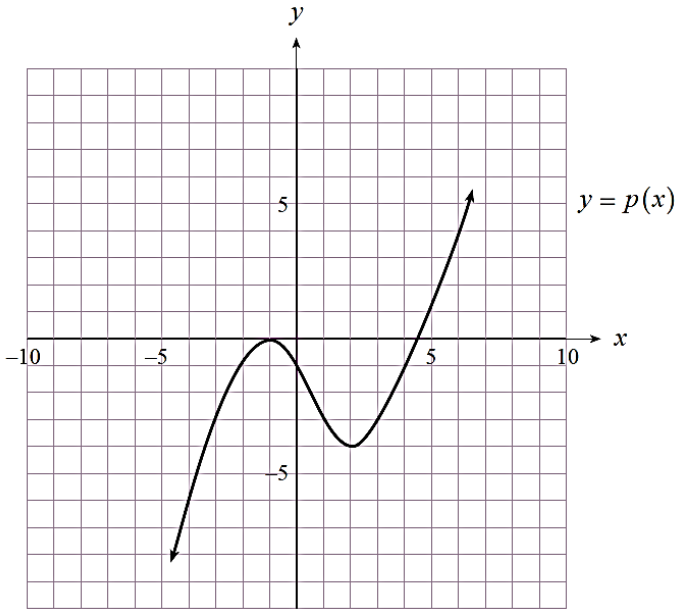
94. Use the graph of the function $y = p(x)$ shown to solve the equation $p(x - 5) + 6 = 0$.

A. –4

B. –1

C. 1

D. 4



## JUNE 1997

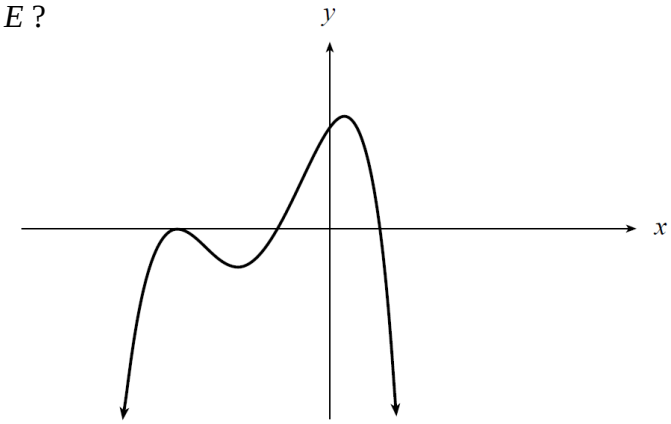
95. According to the Rational Root Theorem, list all possible rational roots of $2x^8 - 5x^3 + 6x^2 - 4 = 0$ .

A. $\pm 1 , \pm 2 , \pm 4$ B. $\pm\frac{1}{2}, \pm 1, \pm 2, \pm 4$ C. $\pm\frac{1}{4}, \pm\frac{1}{2}, \pm 1, \pm 2$ D. $\pm\frac{1}{2}, \pm 1, \pm 2, \pm 4, \pm 8$

96. Determine the remainder when $6x^3 - 11x^2 + 14x - 5$ is divided by $2x^2 - 7x + 3$ .

A. $-107x - 53$ B. $-107x + 43$ C. $40x - 20$ D. 20

97. The following graph represents the polynomial function $y = Ax^4 + Bx^3 + Cx^2 + Dx + E$ . What conditions must be satisfied by $A$ and $E$ ?



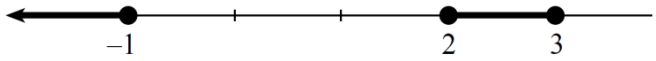

A. $A < 0$ and $E < 0$

B. $A < 0$ and $E > 0$

C. $A > 0$ and $E < 0$

D. $A > 0$ and $E > 0$

98. Which polynomial inequality describes the solution shown?




A. $(x - 1)(x + 2)(x + 3) \geq 0$ B. $(x - 1)(x + 2)(x + 3) \leq 0$

C. $(x + 1)(x - 2)(x - 3) \geq 0$ D. $(x + 1)(x - 2)(x - 3) \leq 0$

99. For the polynomial function $p(x) = ax^3 + bx - 3$, $p(-1) = 4$. Determine the value of $p(1)$.

A. $-10$ B. $-4$ C. 4 D. 10

100. If $-2$ is a root of $2x^3 + kx^2 - 11x + 6 = 0$, determine the other two roots.

## JAN 1998

101. Given a polynomial $p(x)$, what condition must be true for $x - 2$ to be a factor of $p(x)$ ?

A. $p(2) = 0$ B. $p(-2) = 0$ C. $p(x) = 2$ D. $p(x) = -2$

102. According to the Rational Root Theorem, give all possible rational roots of $2x^3 - 5x^2 + 12x - 6 = 0$ .

A. $\pm 1 , \pm 2 , \pm 3 , \pm 6$

B. $\pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm\frac{1}{6}$

C. $\pm 1, \pm 2, \pm 3, \pm 6, \pm\frac{1}{2}, \pm\frac{2}{3}$

D. $\pm 1, \pm 2, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm\frac{1}{6}$

103. What is the quotient when $5x^3 - 6x^2 + 64$ is divided by $x + 2$ ?

A. $5x^2 + 4x + 8$ B. $5x^2 - 16x + 32$ C. $5x^2 + 4x + 72$ D. $5x^2 - 16x + 96$

104. Find the remainder when $3x^{45} + 4x^8 - 5x^3 + 2$ is divided by $x + 1$ .

A. $-10$ B. $-2$ C. $4$ D. $8$

105. What is the least number of real zeros that a polynomial function can have if its degree is $5$ ?

A. 0 B. 1 C. 3 D. 5

106. Determine the real roots: $x^3 + 3x^2 - 6x - 8 = 0$

A. $-4, -1, 2$ B. $-4, 1, 2$ C. $-2, 1, 4$ D. $-1, 2, 4$

107. Solve the inequality: $(x + 5)(x - 2)(6 - x) > 0$

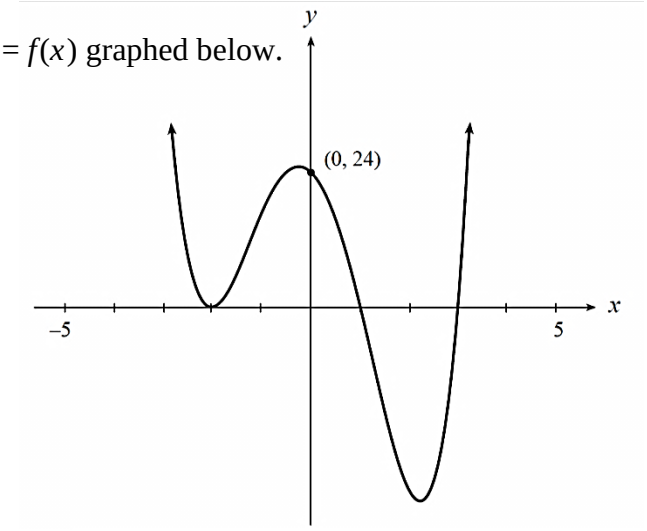
A. $x < -5$ or $x > 6$

B. $x < -5$ or $x > 2$

C. $-5 < x < 2$ or $x > 6$

D. $x < -5$ or $2 < x < 6$

108. Determine an equation of the polynomial function $y = f(x)$ graphed below.




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

B. $f(x) = 4(x + 2)^2(x - 1)(x - 3)$

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

D. $f(x) = 4(x + 2)(x - 1)(x - 3)$

## JUNE 1998

109. According to the Rational Root Theorem, determine all possible rational roots of $5x^3 - 4x^2 + 15 = 0$ .

A. $\pm 1 , \pm 5$

B. $\pm 1 , \pm 3 , \pm 5 , \pm 15$

C. $\pm 1, \pm 3, \pm 5, \pm 15, \pm\frac{1}{5}, \pm\frac{3}{5}$

D. $\pm 1, \pm 5, \pm\frac{1}{3}, \pm\frac{5}{3}, \pm\frac{1}{5}, \pm\frac{1}{15}$

110. If $3x - 1$ is a factor of $p(x)$, which of the following must have a value of $0$ ?

A. $p\left(\frac{1}{3}\right)$ B. $p\left(-\frac{1}{3}\right)$ C. $p(-1)$ D. $p(1)$

111. How many real roots are there for the polynomial equation $x(x^2 - 4)(x^2 + 9) = 0$ ?

A. 1 B. 2 C. 3 D. 5

112. Factor: $x^3 - 2x^2 - 5x + 6$

A. $(x + 1)(x - 2)(x + 3)$

B. $(x + 1)(x + 2)(x - 3)$

C. $(x - 1)(x - 2)(x + 3)$

D. $(x - 1)(x + 2)(x - 3)$

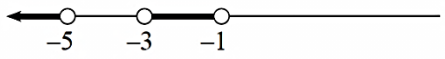
113. Determine the quotient when $2x^3 - 5x^2 + 7x + 3$ is divided by $2x + 1$ .

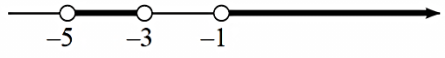
A. $x^2 - 3x + 4$ B. $x^2 - 3x + 5$ C. $x^2 - 2x - 2$ D. $x^2 - 2x + 2$

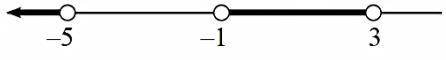
114. If the cubic polynomial function $f(x) = k(x-1)(x+2)(x-3)$ passes through the point (2, 6), determine the value of $k$.

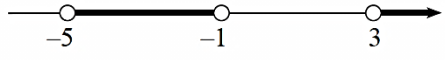
A. $-\frac{3}{2}$ B. $-\frac{2}{3}$ C. $\frac{2}{3}$ D. $\frac{3}{2}$

115. Solve: $(x+5)(x+1)(3-x) < 0$

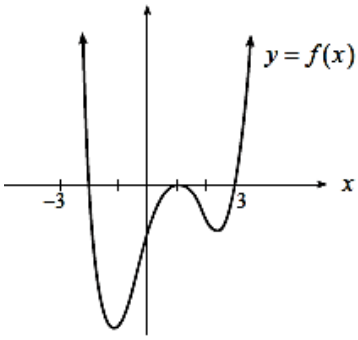
A. 

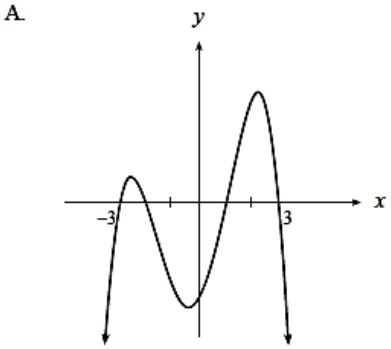

B. 

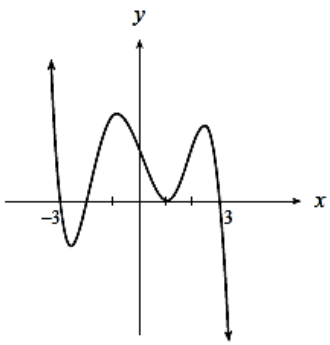

C. 

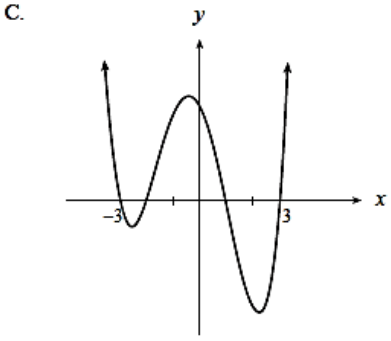

D. 

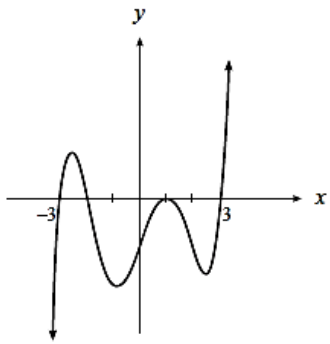

116. Given the graph of $y = f(x)$, which of the following best represents the graph of $y = (x+3)\,f(x)$ ?




A. 


B. 


C. 


D. 

## JAN 1999

117. If 5 is a zero of the polynomial $P(x)$, then which of the following must be true?

A. $P(x) = 5$ B. $P(5) = 0$ C. $P(0) = 5$ D. $P(-5) = 0$

118. According to the Rational Root Theorem, determine all possible rational roots of $4x^5 - 3x^3 + 6x - 2 = 0$.

A. $\pm 1, \pm 2$

B. $\pm 1, \pm 2, \pm 4, \pm \frac{1}{2}$

C. $\pm 1, \pm 2, \pm \frac{1}{2}, \pm \frac{1}{4}$

D. $\pm 1, \pm 2, \pm 4, \pm \frac{1}{2}, \pm \frac{1}{4}$

119. Determine the remainder when $x^{12} - 2x^7 + 6x^2 - 4$ is divided by $x + 1$.

A. 0 B. 1 C. 4 D. 5

120. Which of the following is a real zero of the polynomial function $f(x) = x^3 - 3x + 3$ ?

A. –2.10 B. –2.00 C. 0.82 D. 3.00

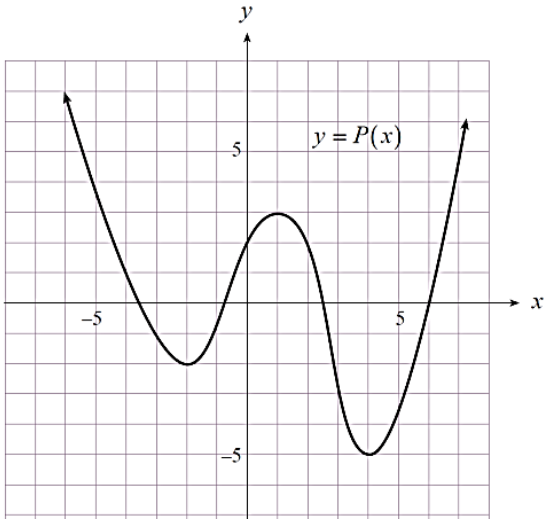
121. The graph of a polynomial function $y = P(x)$ is shown below. If $f(x) = P(x) + k$, determine all values of $k$ such that $f(x)$ will have two unequal real zeros and no other real zeros.

A. $k < -3$ or $k > 2$

B. $2 < k < 5$

C. $-2 < k < 5$

D. $2 < k < 5$ or $k < -3$




122. Solve: $x^3 - 8x^2 \geq -4x + 20$

## JUNE 1999

123. When the polynomial $p(x)$ is divided by $x - 4$, the remainder is 6. Which of the following must be true?

A. $p(4) = 6$ B. $p(-4) = 6$ C. $p(6) = 4$ D. $p(-6) = 4$

124. Solve: $x^3 - 7x - 6 = 0$

A. –1, –2, 3 B. –1, 2, –3 C. 1, –2, 3 D. 1, 2, –3

125. Determine the largest root of $x^3 - 30x^2 + 235x - 430 = 0$.

A. 2.64 B. 8.74 C. 18.62 D. 18.75

126. According to the Rational Root Theorem, which of the following equations has possible rational roots of $\pm 1, \pm 2, \pm\frac{1}{3}, \pm\frac{2}{3}$?

A. $3x^3 - 4x^2 + 5x + 1 = 0$ B. $6x^3 - 4x^2 + 5x + 1 = 0$

C. $2x^3 - 4x^2 + 5x + 3 = 0$ D. $3x^3 - 4x^2 + 5x + 2 = 0$

127. Which of the following is a polynomial function with zeros of $-\sqrt{2}, \sqrt{2}$ and –1 ?

A. $P(x) = x^3 - x^2 - 2x + 2$ B. $P(x) = x^3 + x^2 - 2x - 2$

C. $P(x) = x^3 - x^2 - 4x + 4$ D. $P(x) = x^3 + x^2 - 4x - 4$

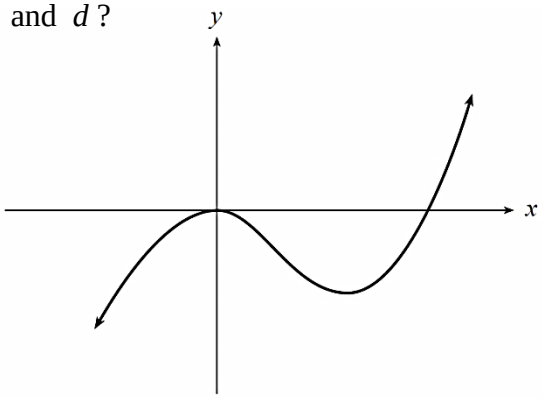
128. The graph of the polynomial function $P(x) = ax^3 + bx^2 + cx + d$, where $a$, $b$, $c$ and $d$ are constants, is shown. What are the conditions on $c$ and $d$ ?

A. $c = 0, d = 0$

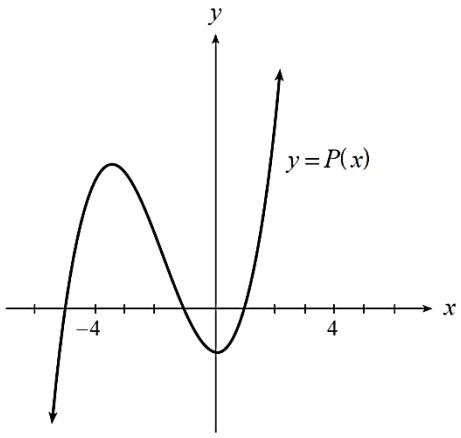
B. $c = 0, d > 0$

C. $c > 0, d = 0$

D. $c \neq 0, d = 0$



129. The graph of the cubic polynomial function $y = P(x)$ is shown below. Determine the zeros of $y = xP(-x)$.




A. $-5, -1, 0, 1$

B. $-5, -1, 1$

C. $-1, 0, 1, 5$

D. $-1, 1, 5$

130. Solve: $x^3 - 8x^2 > 18x - 20$

## JAN 2000

131. According to the Rational Root Theorem, determine all possible rational roots of $5x^3 - 3x^2 + x - 2 = 0$.

A. $\pm 1, \pm 2$

B. $\pm 1, \pm 5$

C. $\pm 1, \pm 2, \pm\frac{1}{2}, \pm\frac{5}{2}$

D. $\pm 1, \pm 2, \pm\frac{1}{5}, \pm\frac{2}{5}$

132. How many different real roots are there for the polynomial equation $x(x - 3)(x^2 + 6) = 0$ ?

A. 1 B. 2 C. 3 D. 4

133. Determine the remainder when $3t^3 - 7t^2 - 11t + 20$ is divided by $t^2 + 2t - 4$

A. $3t - 13$ B. $-25t + 24$ C. $-25t + 72$ D. $27t - 32$

134. A cubic polynomial function that passes through the point $(3, 24)$ has zeros at 5, –1 and –3. Determine an equation of this function.

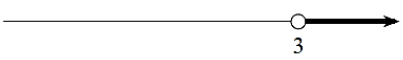
A. $y = -2(x - 5)(x + 1)(x + 3)$

B. $y = -\frac{1}{2}(x - 5)(x + 1)(x + 3)$

C. $y = \frac{1}{2}(x - 5)(x + 1)(x + 3)$

D. $y = 2(x - 5)(x + 1)(x + 3)$

135. Solve the inequality: $-(x-3)(x+2)^2 < 0$

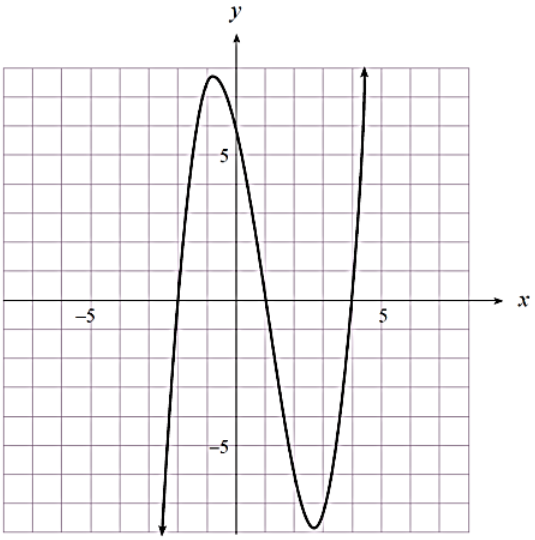
A. 


B. 


C. 


D. 


136. The graph of the polynomial function $y = f(x)$ is shown. Find the remainder when $f(x)$is divided by $(x-2)$.




A. –6

B. 0

C. 1

D. 6

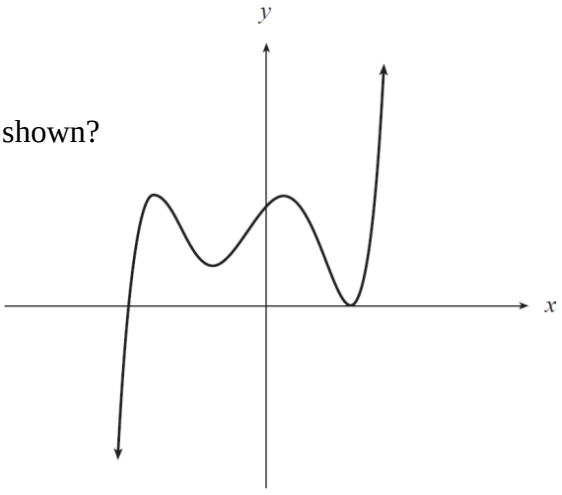
137. Solve: $x^3 + 10x^2 = 22 - 10x$

## JUNE 2000

138. According to the Rational Root Theorem, determine all possible rational roots of $4x^3 - 7x^2 + 3x - 2 = 0$ .

A. $\pm 1, \pm 2$ B. $\pm 1, \pm 2, \pm 4$ C. $\pm 1, \pm 2, \pm 4, \pm \frac{1}{2}$ D. $\pm 1, \pm 2, \pm \frac{1}{4}, \pm \frac{1}{2}$

139. What is the minimum degree of the polynomial function shown?




A. 2 B. 3 C. 4 D. 5

140. Solve: $2x^3 + 5 = 5x^2 + 5x$

A. –1.88 B. –0.58 C. –1.22, 0.67, 3.05 D. –1.00, 0.60, 3.00

141. Solve the following inequality for $x$, given that $a$, $b$ and $c$ are constants such that $a < b < c$.

$$(x - a)^3(x - b)^2 (x - c) > 0$$

A. $x > c$ B. $x < a$ or $x > c$ C. $x < c\ ,\ x \neq a\ ,\ x \neq b$ D. $a < x < c\ ,\ x \neq b$

142. Determine all values for $k$ such that $y = 2x^3 + 3x^2 - 12x + k$ has only one real zero.

A. $k < -20$ B. $k > 7$ C. $-20 < k < 7$ D. $k < -20$ or $k > 7$

143. When $2x^3 - 8x^2 + kx + 18$ is divided by $x + 2$, the remainder is $-14$. Find $k$, then find all real roots of $2x^3 - 8x^2 + kx + 18 = 0$.

## JAN 2001

144. Which expression represents the remainder when the polynomial $P(x)$ is divided by $x - 9$ ?

A. $P(9)$ B. $P(-9)$ C. $P(0)$ D. $P(x - 9)$

145. According to the Rational Root Theorem, which of the following is a possible root of the equation $5x^3 + mx^2 + nx + 20 = 0$, where $m$ and $n$ are integers?

A. $\frac{1}{10}$ B. $\frac{1}{5}$ C. $\frac{1}{4}$ D. $\frac{1}{2}$

146. Determine the quotient when $x^4 - 8x^2 + 2x - 7$ is divided by $x + 3$.

A. $x^2 - 5x - 13$ B. $x^2 - 11x + 35$ C. $x^3 - 3x^2 + x - 1$ D. $x^3 + 3x^2 + x + 5$

147. Determine the value of $k$ if $x - 2$ is a factor of the polynomial $x^3 - 4x^2 + kx + 6$.

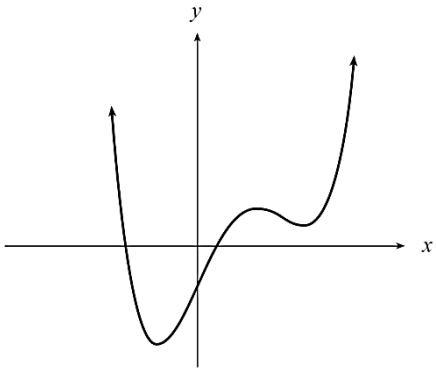
A. –9 B. –1 C. 1 D. 9

148. Solve $(x + a)^2 (x + b)(x + c) < 0$, where $a, b, c$ are real number constants and $0 < a < b < c$.

A. $b < x < c$ B. $-b < x < -c$ C. $-c < x < -b$ D. $-b < x < -a$ , $x < -c$

149. Solve: $x^3 - 15x^2 = -10x - 30$

## JUNE 2001




150. Determine the number of real zeros of the function shown.

A. 1 B. 2 C. 3 D. 4

151. Find the quotient when $2x^3 - 3x^2 + 2x - 8$ is divided by $x + 1$.

A. $x^2 - 2x$ B. $x^2 - 4x + 6$ C. $2x^2 - x + 1$ D. $2x^2 - 5x + 7$

152. The polynomial equation $mx^3 + 7x^2 - 3x + n = 0$, where $m$ and $n$ are integers, has a root of $\frac{4}{9}$. According to the Rational Root Theorem, which of the following could be a value for $m$ ?

A. 2 B. 4 C. 6 D. 18

153. Solve: $x^3 < x$

A. $x < 0,\ x > 1$ B. $-1 < x < 1$ C. $-1 < x < 0, x > 1$ D. $x < -1, 0 < x < 1$

154. Solve: $x^3 + 2x^2 - 104x + 192 = 30$

A. 1.65, 8.24 B. 2.37, 7.73 C. −12.11, 2.37, 7.73 D. −11.89, 1.65, 8.24

155. The points $(-2, 0)$ , $(0, 5)$ and $(2, -4)$ are on the graph of a third degree polynomial function, $y = P(x)$. If $P(x)$ is divided by $x - 2$, determine the remainder.

A. −4 B. 0 C. 4 D. 5

156. A cubic polynomial function has a double zero at $-2$ and a single zero at $3$. If this function passes through the point $(4, -24)$, determine an equation of the function. Answer may be left in factored form.

## ADDITIONAL QUESTIONS

157. What numbers should replace $p$ and $q$ in the incomplete synthetic division shown below?

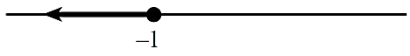
$$\begin{array}{r|cccc} \square & 2 & p & q & 2 \\ & & \square & \square & \square \\ \hline & 2 & -7 & 4 & -2 \end{array}$$

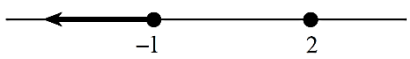
A. $p = -5,\ q = -3$ B. $p = -5,\ q = 3$ C. $p = 5,\ q = -3$ D. $p = 5,\ q = 3$

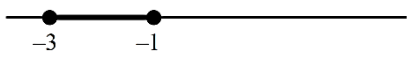
158. Determine the coefficient of $x$ in the quotient when $2x^4 - 7x^3 + 9x^2 + 2x - 8$ is divided by $x^2 - 3x + 4$.

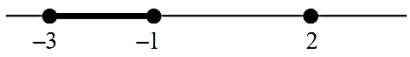
A. $-13$ B. $-1$ C. $1$ D. $13$

159. Graph the solution to $(x + 1)(x - 2)^2(x + 3)^3 \le 0$.

A.



B.



C.



D.



160. Find a polynomial equation of lowest degree with integral coefficients such that one root of $f(x) = 0$ is $\sqrt{2} + \sqrt{3}$.

161. Given the following table of values for the polynomial function $y = f(x)$, determine the minimum number of zeros for $f(x)$.

| $x$ | $y$ |
|---|---|
| $-3$ | $-15$ |
| $-2$ | $-12$ |
| $-1$ | $2$ |
| $0$ | $3$ |
| $1$ | $5$ |
| $2$ | $-7$ |
| $3$ | $-19$ |

A. 1

B. 2

C. 3

D. 4

162. When $x^4 + kx^2 - 5$ is divided by $x^2 + 1$, the remainder is $-6$. Find the value of $k$.

A. $-2$ B. 0 C. 1 D. 2

163. A polynomial function of degree 3 has zeros $-2$, 2, 4, and passes through the point $(3, -25)$. Determine an equation of the function. (Answer may be left in factored form.)

164. Determine the cubic polynomial function which has zeros of $-1$, 2 and 3, and goes through the point (4, 6).

A. $f(x) = (x+1)(x-2)(x-3)$ B. $f(x) = \frac{3}{5}(x+1)(x-2)(x-3)$

C. $f(x) = (x-1)(x+2)(x+3)$ D. $f(x) = \frac{1}{21}(x-1)(x+2)(x+3)$

165. If $p(x) = (x-2)q(x) + r$, determine $p(2)$.

A. $q(2)$ B. $q(-2)$ C. $-r$ D. $r$

166. A polynomial function of degree 3 has zeros 5, 3, $-1$, and passes through the point $(2, -6)$. Determine an equation of this function. (Answer may be left in factored form.)

167. Determine a factor of degree 2 of the polynomial $p(x)$ if $p(3) = 0$ and $p(-4) = 0$ .

A. $x^2 + x - 12$ B. $x^2 - x + 12$ C. $x^2 - x - 12$ D. $x^2 + x + 12$

168. Determine the values of $k$ for which $\frac{1}{3}$ is a zero of $p(x) = -9x^3 + 3x^2 - 3kx + k^3$ .

A. $-2, -1, 0$ B. $-2, 0, 1$ C. $-1, 0, 1$ D. $-1, 0, 2$

169. Determine the polynomial function of degree 3, with zeros of $-2$, 0, and 3, that passes through the point (2, 5). Answer may be left in factored form.

170. Determine the number of rational roots for the equation $x^5 - 2x - 1 = 0$.

A. 1 B. 2 C. 3 D. 5

171. When a polynomial $P(x)$ is divided by $x + 4$, the remainder is 5. Which point must be on the graph of the function $y = P(x)$ ?

A. $(-4, 5)$ B. $(5, -4)$ C. $(-4, -5)$ D. $(-5, -4)$

172. A polynomial function of degree 3 has a zero of $-1$ and a double zero of 4. Determine this function if it passes through the point (1, 10). Answer may be left in factored form.

173. If $x + 2$ is a factor of the polynomial $P(x) = 2x^3 + kx^2 - 32x - 4k^2$ , determine all possible values of $k$.

174. Solve the following inequality: $x^3 - 3x^2 - x > 2x - 4$

175. Determine the range of the function $f(x) = x^4 - 3x^3 - 8$.

A. $y \geq -18.81$ B. $y \geq -16.54$ C. $y \geq -8$ D. all real numbers

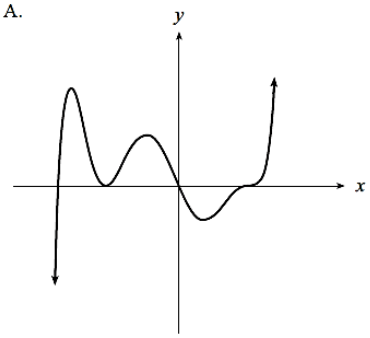
176. Determine the cubic polynomial function with zeros 1, 2, and −3 that passes through (3, −10). (Answer may be left in factored form.)

177. The function $H(x)$ is the product of a 3rd degree polynomial function and a 2nd degree polynomial function. What is the maximum number of zeros of $H(x)$ ?

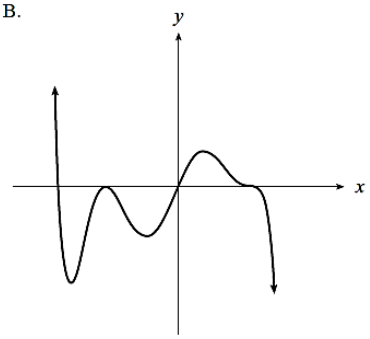
A. 2 B. 3 C. 5 D. 6

178. Which graph could represent $f(x) = x(a - x)(x - b)^2 (x - c)^3$, where $a$, $b$ and $c$ are constants?

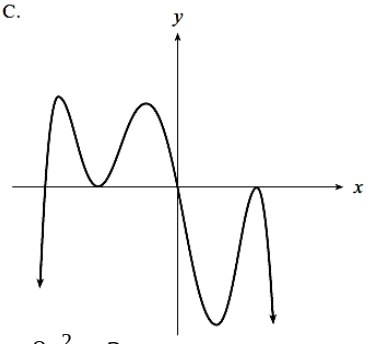
A.



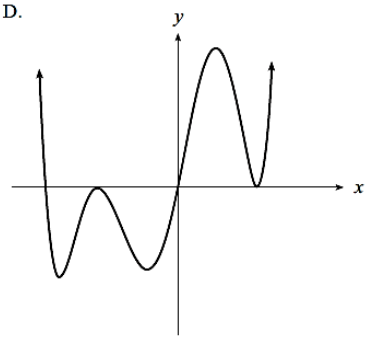

B.




C.




D.




179. Solve: $x^4 - x^3 \geq 8x^2 + 2$

180. If the polynomial $p(x) = ax^2 + bx - 6$ is divided by $(x - 1)$, the remainder is $-9$. When $p(x)$ is divided by $(x + 2)$, the remainder is 12. Find the value of $b$.

A. −5 B. −2 C. 2 D. 5

181. If 2 is a root of the polynomial equation $6x^3 + kx^2 + x + 2 = 0$, determine the other roots.

## POLYNOMIALS

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | | 91 | A | 139 | D |
| 1 | D | 46 | $x=-2,\frac{1}{2},2$ | 92 | B | 140 | C |
| 2 | D | | | 93 | B | 141 | B |
| 3 | B | 47 | B | 94 | C | 142 | D |
| 4 | A | 48 | D | 95 | B | 143 | –1.66, 1.22, 4.44 |
| 5 | C | 49 | C | 96 | C | 144 | A |
| 6 | $x=-1,-\frac{1}{3},2$ | 50 | B | 97 | B | 145 | B |
| | | 51 | D | 98 | D | 146 | C |
| 7 | C | 52 | A | 99 | A | 147 | C |
| 8 | A | 53 | B | 100 | $-2.48<x<0.83$ or $x>9.65$ | 148 | C |
| 9 | B | 54 | D | 101 | A | 149 | 1.09, 1.95, 14.14 |
| 10 | D | 55 | D | 102 | C | 150 | B |
| 11 | C | 56 | B | 103 | B | 151 | D |
| 12 | C | 57 | B | 104 | D | 152 | D |
| 13 | C | 58 | D | 105 | B | 153 | D |
| 14 | B | 59 | A | 106 | A | 154 | D |
| 15 | C | 60 | A | 107 | D | 155 | A |
| 16 | A | 61 | C | 108 | A | 156 | $y=-\frac{2}{3}(x+2)^2(x-3)$ |
| 17 | B | 62 | A | 109 | C | | |
| 18 | $-1\pm\sqrt{5}$ | 63 | $x=\frac{5}{3}cm$ | 110 | A | 157 | A |
| 19 | C | | | 111 | C | 158 | B |
| 20 | C | 64 | A | 112 | D | 159 | D |
| 21 | B | 65 | C | 113 | B | 160 | $x^4-10x^2+1=0$ |
| 22 | D | 66 | C | 114 | A | 161 | B |
| 23 | A | 67 | D | 115 | D | 162 | D |
| 24 | 240 | 68 | D | 116 | D | 163 | $f(x)=5(x-2)(x+2)(x-4)$ |
| 25 | A | 69 | A | 117 | B | 164 | B |
| 26 | D | 70 | C | 118 | C | 165 | $p(x)=-\frac{2}{3}(x-5)(x-3)(x+1)$ |
| 27 | A | 71 | A | 119 | D | | |
| 28 | C | 72 | D | 120 | A | 166 | D |
| 29 | A | 73 | B | 121 | D | 167 | A |
| 30 | B | 74 | D | 122 | $x\geq 7.82$ | 168 | C |
| 31 | B | 75 | C | 123 | A | 169 | $y=-\frac{5}{8}x(x+2)(x-3)$ |
| 32 | D | 76 | B | 124 | A | | |
| 33 | D | 77 | C | 125 | C | 170 | A |
| 34 | A | 78 | B | 126 | D | 171 | A |
| 35 | A | 79 | A | 127 | B | 172 | $y=\frac{5}{9}(x+1)(x-4)^2$ |
| 36 | D | 80 | B | 128 | A | | |
| 37 | C | 81 | B | 129 | C | 173 | D |
| 38 | C | 82 | C | 130 | $-2.48<x<0.83$ or $x>9.65$ | 174 | $-1.36<x<0.83$ or $x>3.53$ |
| 39 | $x=-3,-\frac{1}{2},2$ | 83 | C | 131 | D | 175 | B |
| | | 84 | B | 132 | B | 176 | $y=-\frac{5}{6}(x-1)(x-2)(x+3)$ |
| 40 | C | 85 | C | 133 | D | | |
| 41 | A | 86 | B | 134 | B | 177 | C |
| 42 | D | 87 | A | 135 | A | 178 | B |
| 43 | D | 88 | C | 136 | A | 179 | $x\leq -2.43$ or $x\geq 3.40$ |
| 44 | D | 89 | C | 137 | –8.52, –2.51, 1.03 | 180 | A |
| 45 | B | 90 | A | 138 | D | 181 | $x=-\frac{1}{3},\frac{1}{2}$ |