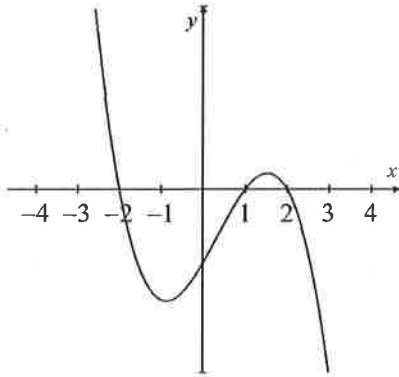


JAN 1991

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



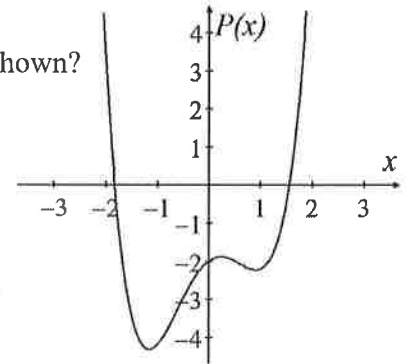
- A. $f(x) = (x - 2)(x + 1)(x + 2)$
- B. $f(x) = -(x - 2)(x + 1)(x + 2)$
- C. $f(x) = (x + 2)(x - 1)(x - 2)$
- D. $f(x) = -(x + 2)(x - 1)(x - 2)$

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

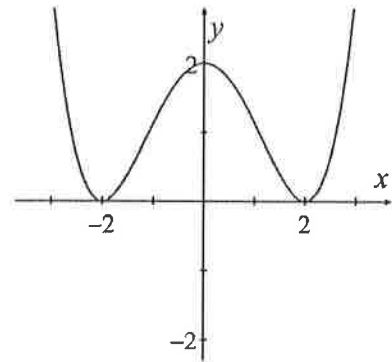


4. Which graph below illustrates the solution set for the inequality $(x + 2)(x - 3)^2 \geq 0$?

- A.
- B.
- C.
- D.

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. $P(x) = -2$

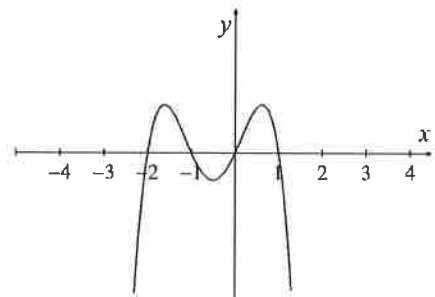
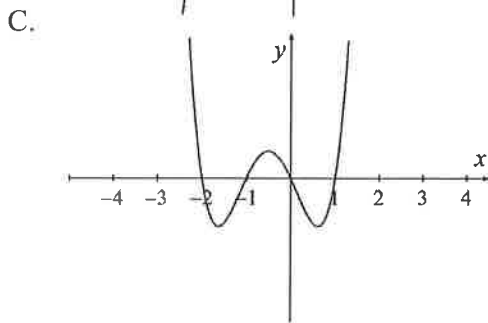
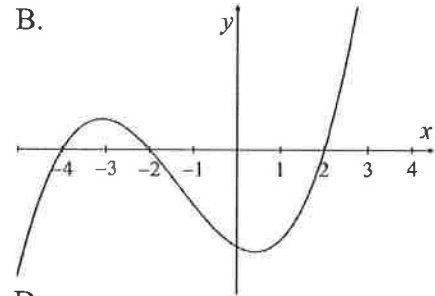
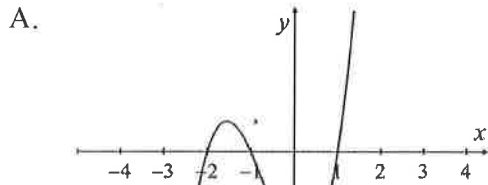
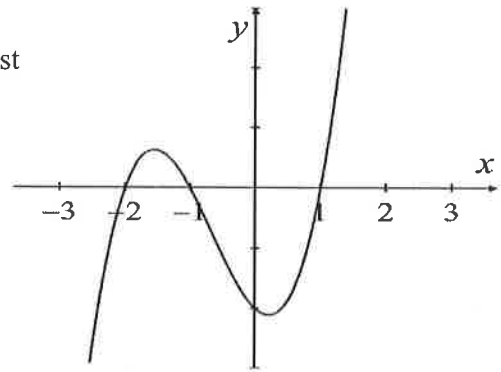
9. What is the quotient when $5x^3 - 6x^2 + 64$ is divided by $x + 2$?

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 $y = xP(x)$?



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 $2x^3 + x^2 - 5x + 3 = 0$.

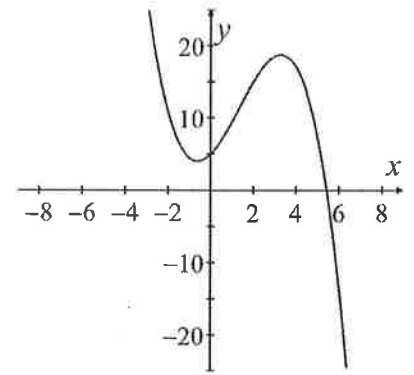
A. $\pm 1, \pm 2$ B. $\pm 1, \pm 2, \pm 3$ C. $\pm 1, \pm \frac{1}{2}, \pm \frac{3}{2}, \pm 3$ D. $\pm 1, \pm \frac{1}{3}, \pm \frac{2}{3}, \pm 2$

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?

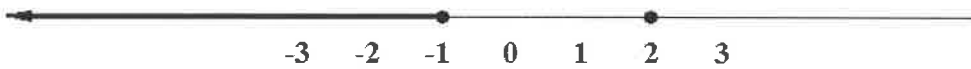
- A. 1 B. 2 C. 3 D. 4



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

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 $p(x)$?

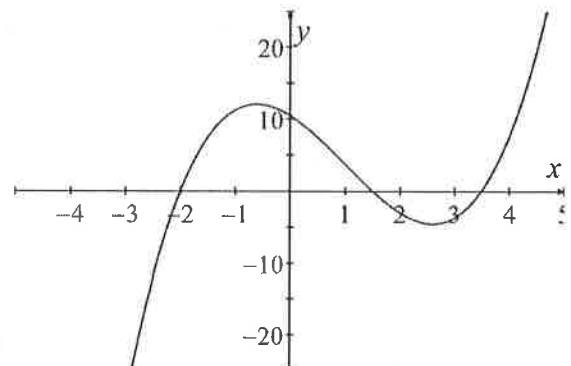
- A. x B. $x - 3$ C. $x + 3$ D. $x^2 - 9$

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



29. Determine a polynomial equation that has roots ± 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 $x(x^2 - 4)(x + 3)(x^2 + 5) = 0$?

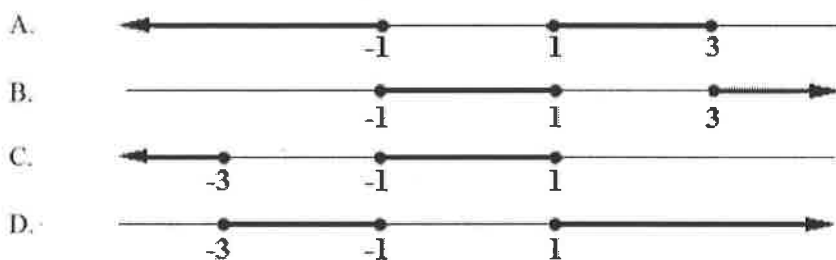
A. 3

B. 4

C. 5

D. 6

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



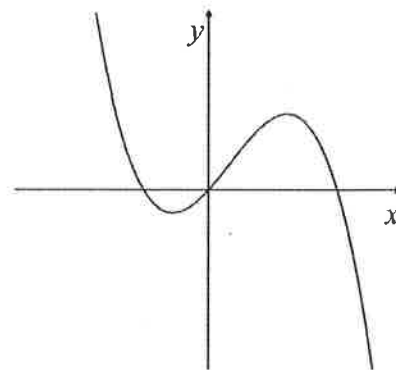
32. If the graph of the polynomial function shown is of the form $y = ax^3 + bx^2 + cx + d$ (where a , b , c , and d are constants), what are the conditions on a and d ?

A. $a > 0, d \neq 0$

B. $a > 0, d = 0$

C. $a < 0, d \neq 0$

D. $a < 0, d = 0$



JUNE 1993

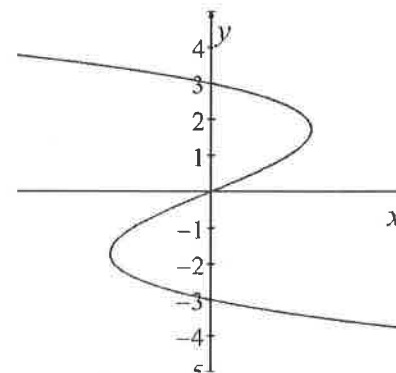
33. Determine a possible equation of the inverse of the relation shown.

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. $p(-5)$

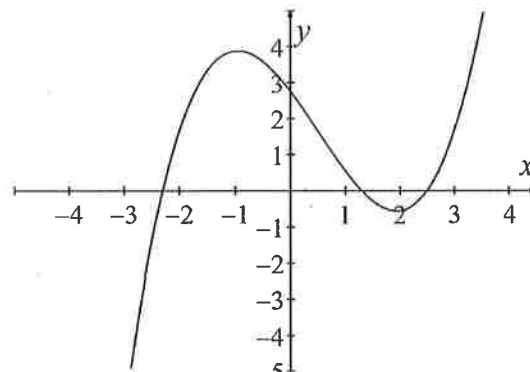
B. $p(5)$

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



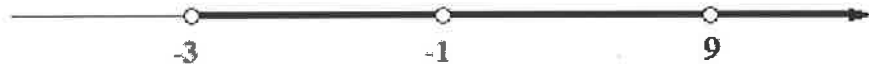
36. Determine a polynomial equation that has roots $\sqrt{2}$, $-\sqrt{2}$ and 1.

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

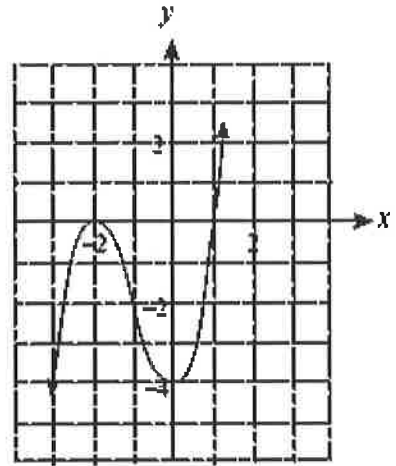
JAN 1994

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 $x - 3$.

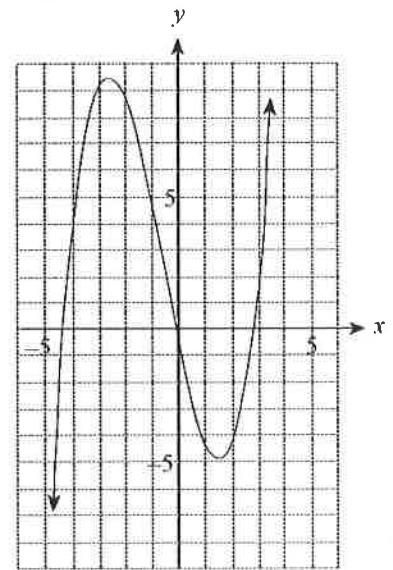
- A. $x^2 + 5x + 15$
- B. $x^2 + x - 6$
- C. $x^2 - 5x + 6$
- D. $x^2 + x + 3$

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

- A. $-2 \leq x \leq 0, x = 1$
- B. $x \leq -2, x \geq 0$
- C. $x \leq 0, x \geq 1$
- D. $0 \leq x \leq 1$

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

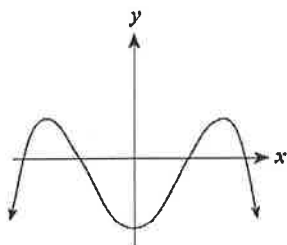
JUNE 1994

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

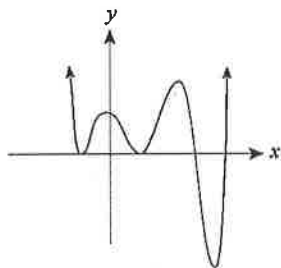
- A. 2 B. 3 C. 4 D. 8

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

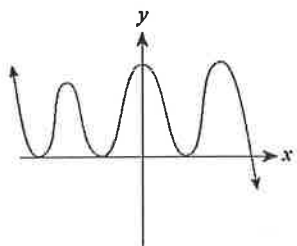
A.



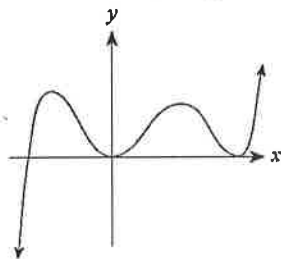
B.



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

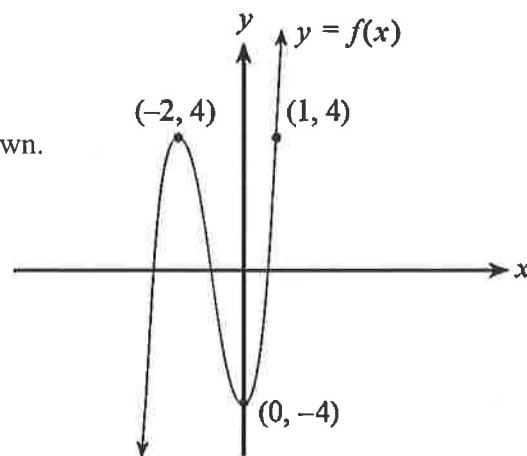
54. The graph of a cubic polynomial function, $y = f(x)$, is shown. Determine the equation of $y = f(x) - 4$.

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

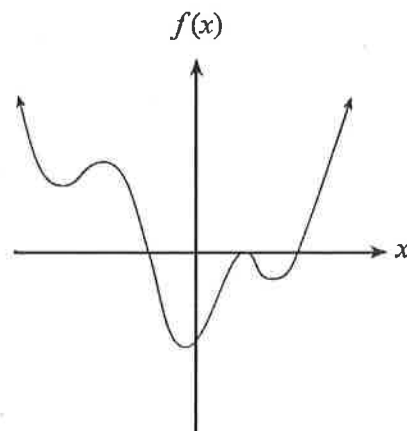
55. Determine the minimum degree of the polynomial function shown.

A. 3

B. 4

C. 5

D. 6



56. If $p(x) = x^3 - 3x^2 + kx + 1$, 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. $\pm 2, 5$

C. $\pm 2, \pm 3, 5$

D. $\pm 2, \pm 3, \pm 5$

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: $30t - 20$




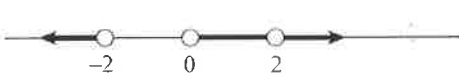
60. Find the remainder when $x^{39} - 3x^{15} - 2x + 1$ is divided by $x - 1$.

- 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. $1, -3, 2$

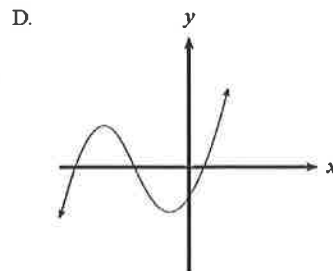
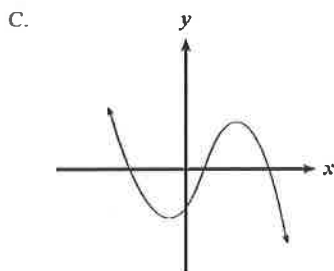
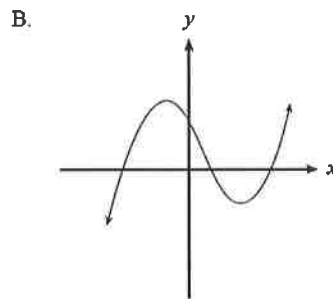
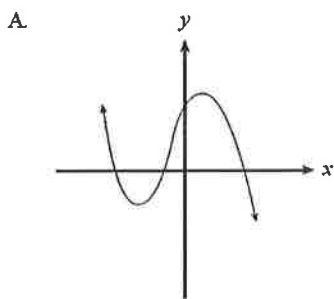
62. Solve the inequality: $x(x - 2)(x^2 - 4) < 0$

- 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 $a > 0$?



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

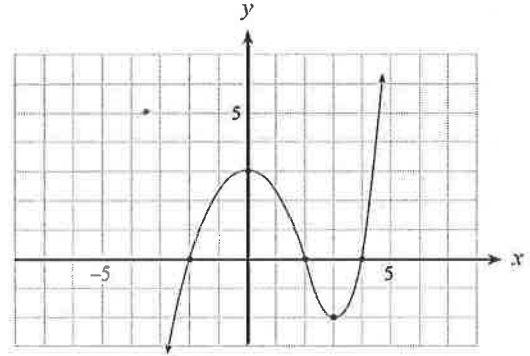
- A. $0, \pm\sqrt{2}$ B. $0, \pm 3$ C. $0, \sqrt{2}, 3$ D. $0, \pm\sqrt{2}, \pm 3$

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 $x^2 + x - 1$.

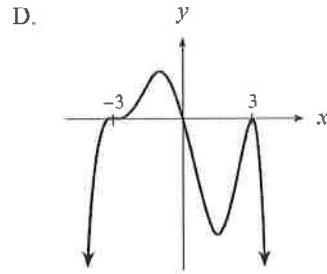
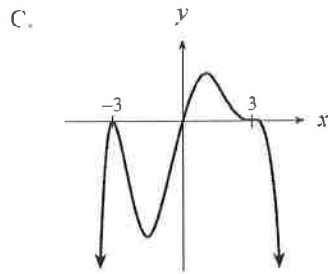
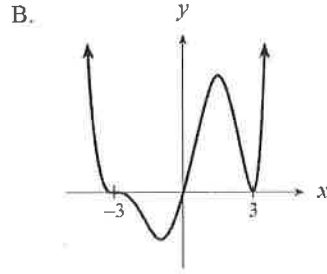
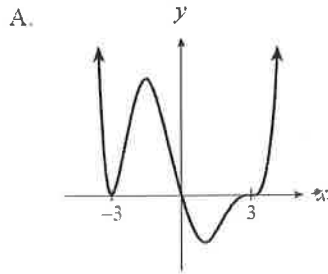
- A. 4 B. $2x + 2$ C. $2x + 4$ D. $4x + 2$

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

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

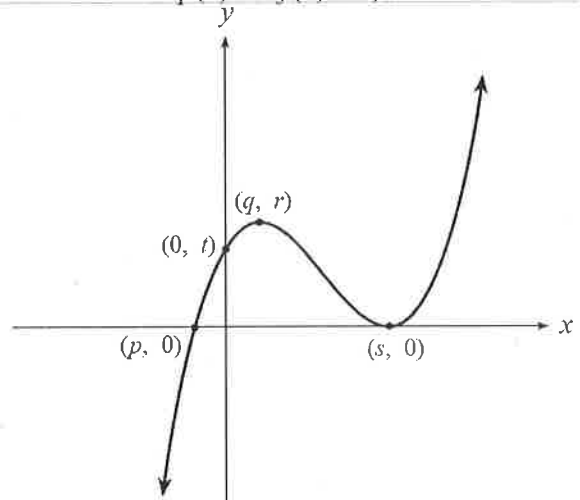
76. Determine the value of k such that $x + 2$ is a factor of the polynomial $2x^3 + 5x^2 + kx - 12$.
- A. -12 B. -4 C. 4 D. 12

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



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.

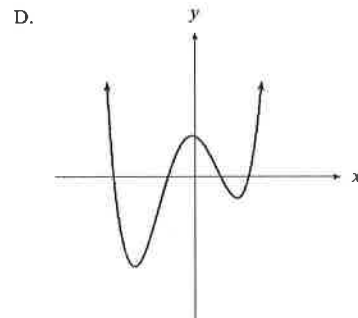
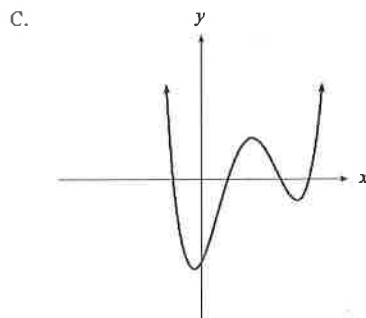
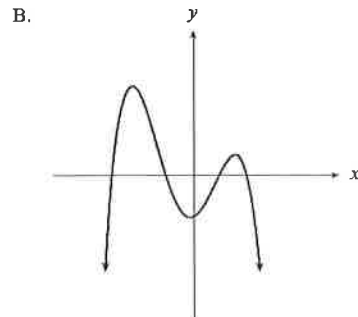
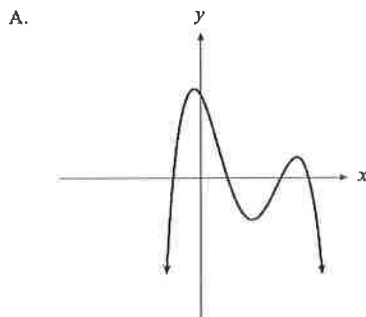
- A. p
 B. t
 C. r
 D. s



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?



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. $x^3 + 2x^2 + 5x + 10 = 0$

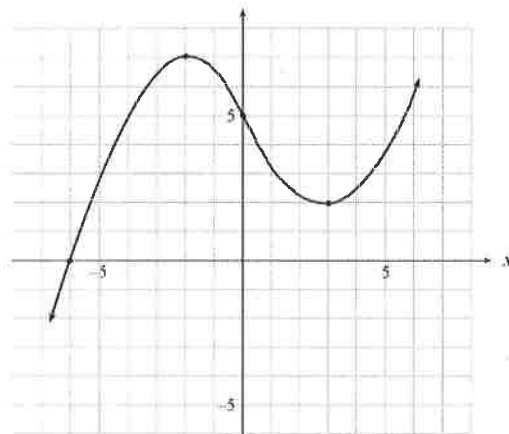
86. The graph of the cubic polynomial function $p(x)$ is given below. Which of the following functions must have 3 unequal real zeros?

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. $\frac{3}{2}$

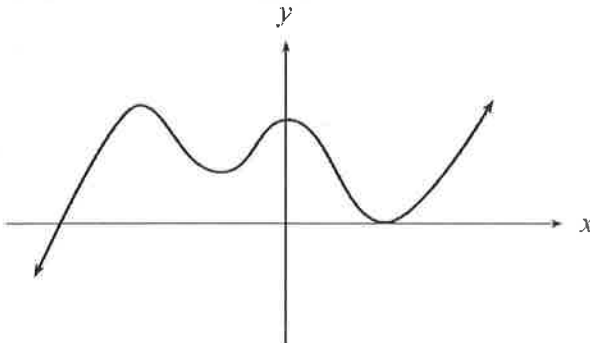
89. What is the minimum degree of the polynomial function graphed below?

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. $x^2 + 2x - 4 \overline{) x^4 + 2x^3 - 3x^2 + 2x - 6}$

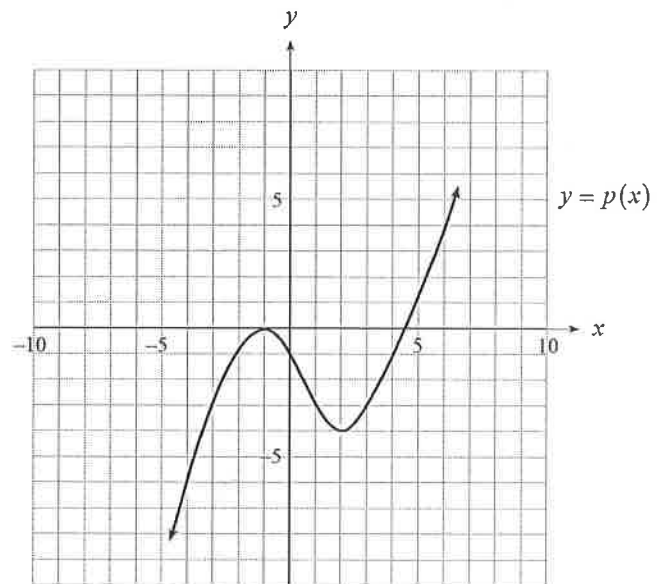
- A. 2 B. 10 C. $4x + 2$ D. $16x - 22$

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 $2x^8 - 5x^3 + 6x^2 - 4 = 0$.

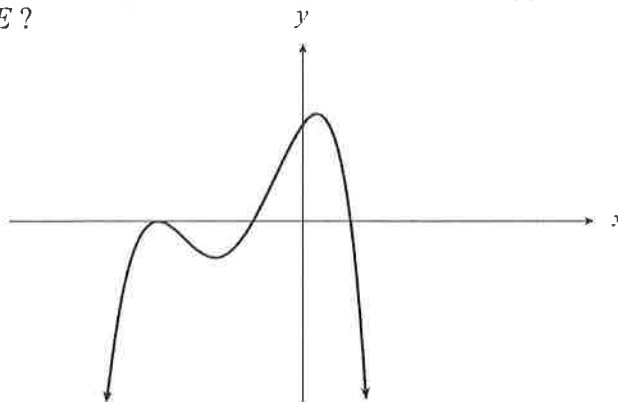
- A. $\pm 1, \pm 2, \pm 4$ B. $\pm \frac{1}{2}, \pm 1, \pm 2, \pm 4$ C. $\pm \frac{1}{4}, \pm \frac{1}{2}, \pm 1, \pm 2$ D. $\pm \frac{1}{2}, \pm 1, \pm 2, \pm 4, \pm 8$

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

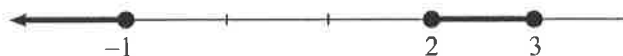
- A. $-107x - 53$ B. $-107x + 43$ C. $40x - 20$ D. 20

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, *which is not a possible root?*
 $2x^3 - 5x^2 + 12x - 6 = 0$.

- A. $x = -6$ B. $x = \frac{1}{2}$
C. $x = \frac{2}{3}$ D. $x = -2$

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 $2 < x < 6$

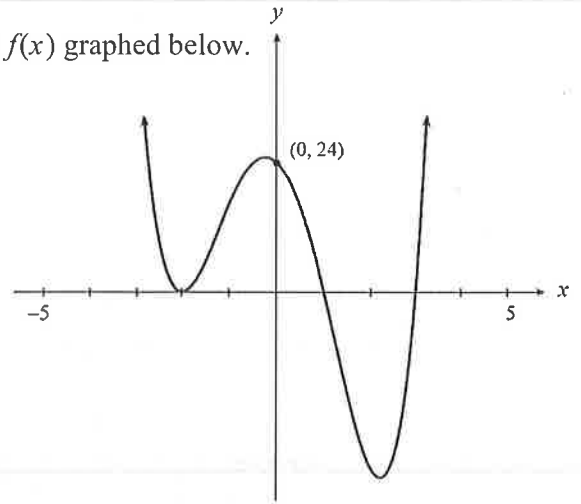
108. Determine an equation of the polynomial function $y = f(x)$ graphed below.

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. $-\frac{2}{3}$

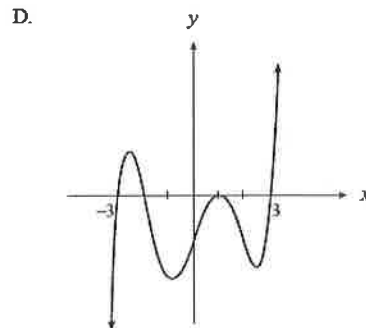
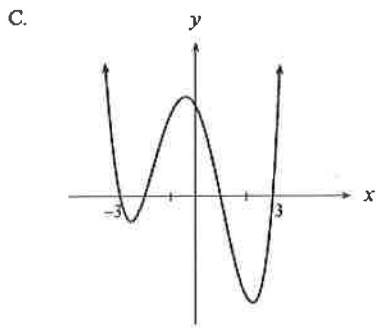
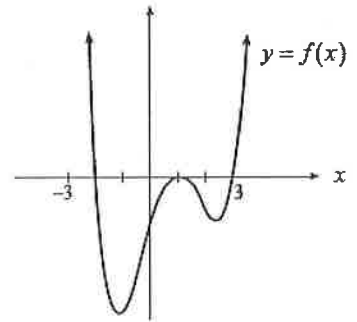
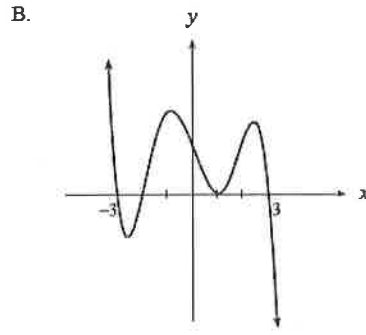
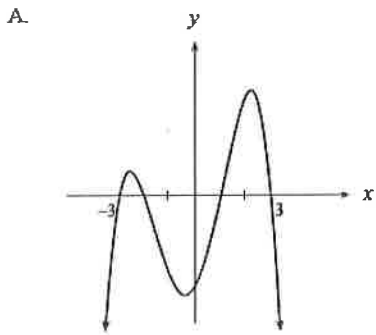
C. $\frac{2}{3}$

D. $\frac{3}{2}$

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



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



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

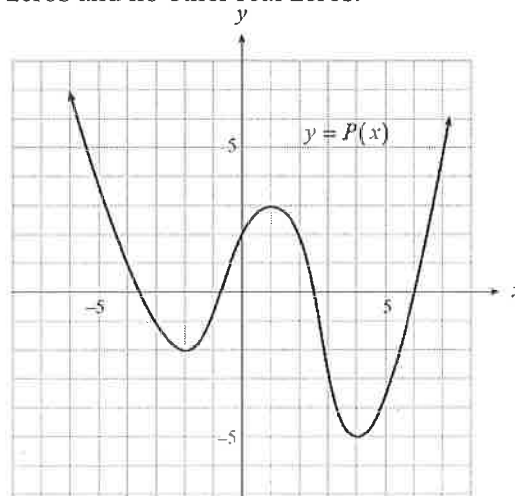


120. Which of the following is a real zero of the polynomial function $f(x) = x^3 - 3x + 3$?

- 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 $\pm 1, \pm 2, \pm \frac{1}{3}, \pm \frac{2}{3}$?

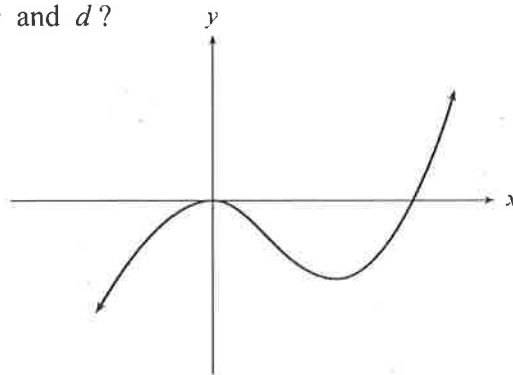
- A. $3x^3 - 4x^2 + 5x + 1 = 0$ B. $6x^3 - 4x^2 + 5x + 1 = 0$
C. $2x^3 - 4x^2 + 5x + 3 = 0$ D. $3x^3 - 4x^2 + 5x + 2 = 0$

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

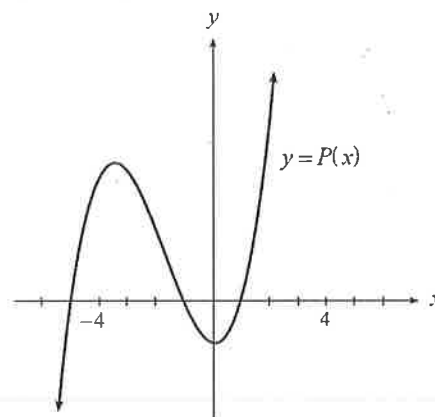
128. The graph of the polynomial function $P(x) = ax^3 + bx^2 + cx + d$, where a, b, c and d are constants, is shown. What are the conditions on c and d ?

- 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.

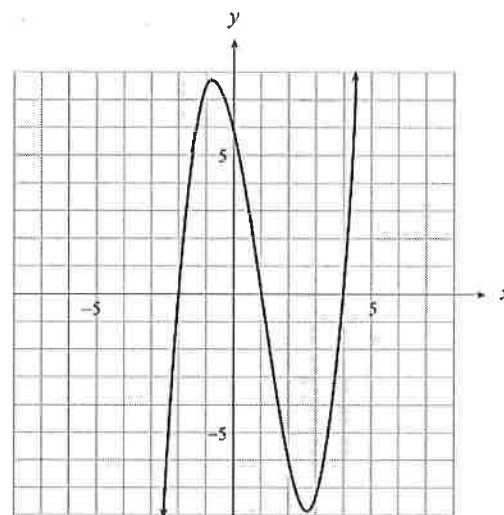
- A. $y = -2(x-5)(x+1)(x+3)$ B. $y = -\frac{1}{2}(x-5)(x+1)(x+3)$
 C. $y = \frac{1}{2}(x-5)(x+1)(x+3)$ D. $y = 2(x-5)(x+1)(x+3)$

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



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: $x^3 + 10x^2 = 22 - 10x$

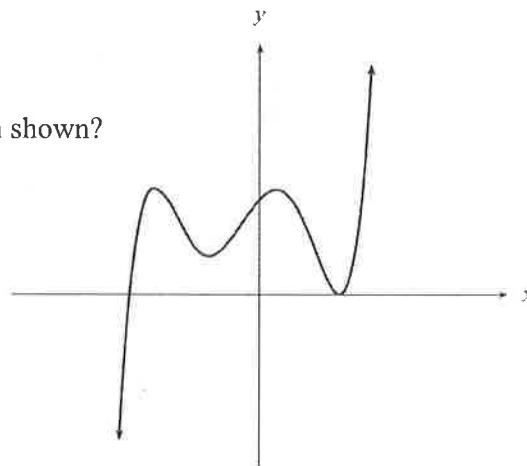
JUNE 2000

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 $0 < a < b < c$.

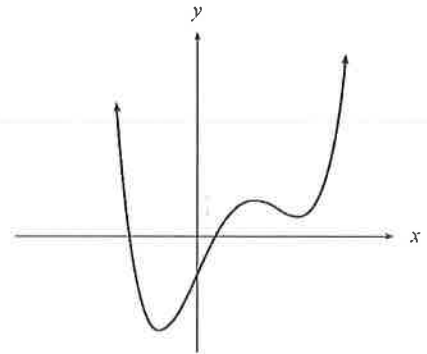
- A. $b < x < c$ B. $-b < x < -c$ C. $-c < x < -b$ D. $-b < x < -a, x < -c$

 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

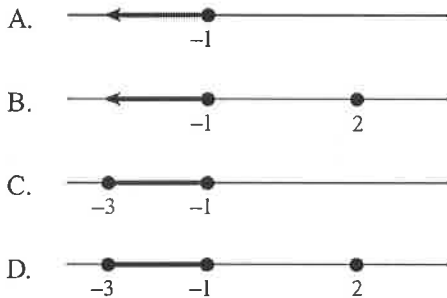
156. A cubic polynomial function has a double zero at -2 and a single zero at 3 . If this function passes through the point $(4, -24)$, determine an equation of the function. Answer may be left in factored form.

ADDITIONAL QUESTIONS

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

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

- 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 $(x + 1)(x - 2)^2(x + 3)^3 \leq 0$.



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
A. 1	-3	-15
B. 2	-2	-12
C. 3	-1	2
D. 4	0	3
	1	5
	2	-7
	3	-19

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.)

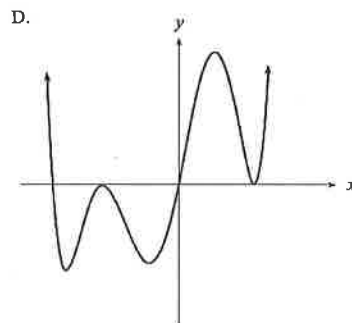
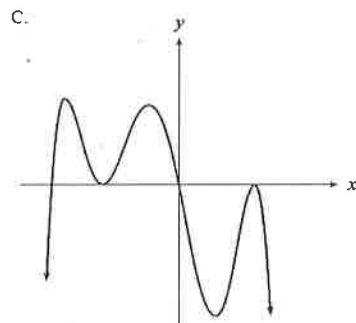
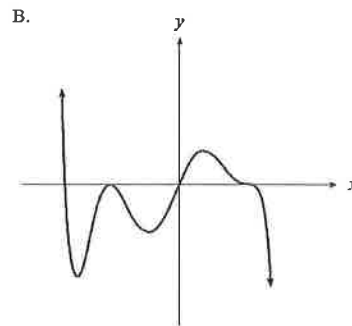
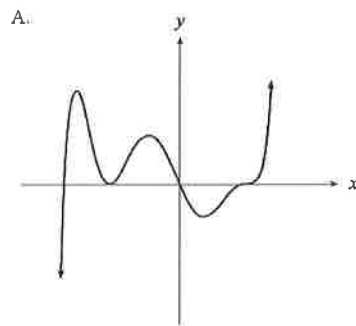
167. Determine a factor of degree 2 of the polynomial $p(x)$ if $p(3) = 0$ and $p(-4) = 0$.
- A. $x^2 + x - 12$ B. $x^2 - x + 12$ C. $x^2 - x - 12$ D. $x^2 + x + 12$
168. Determine the values of k for which $\frac{1}{3}$ is a zero of $p(x) = -9x^3 + 3x^2 - 3kx + k^3$.
- A. $-2, -1, 0$ B. $-2, 0, 1$ C. $-1, 0, 1$ 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?



 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

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