pp. 162-163 (#2-36, evens)

2. $h(x) = -3x^4 + 5x^{-1} - 3x^2$; $h(x)$ is the only function that is not a polynomial.

4. polynomial function; $p(x) = 6x^4 - 4x^3 + \frac{1}{2}x^2 + 3x - 1$; degree: 4 (quartic), leading coefficient: 6

6. polynomial function; $g(x) = 13x^2 - 12x + \sqrt{3}$; degree: 2 (quadratic), leading coefficient: 13

8. not a polynomial function

10. The function is not a polynomial function; f is not a polynomial function. The term $-9\sqrt{x}$ has an exponent that is not a whole number.

12. $f(-7) = 16{,}193$

14. $g(-12) = 2101$

16. $h\left(-\frac{1}{3}\right) = \frac{76}{27}$

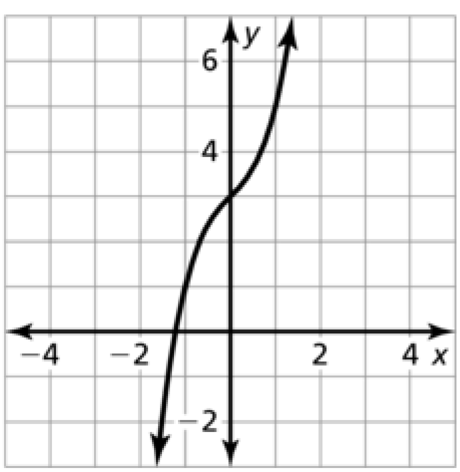
18. $g(x) \to -\infty$ as $x \to -\infty$ and $g(x) \to \infty$ as $x \to \infty$

20. $f(x) \to \infty$ as $x \to -\infty$ and $f(x) \to -\infty$ as $x \to \infty$

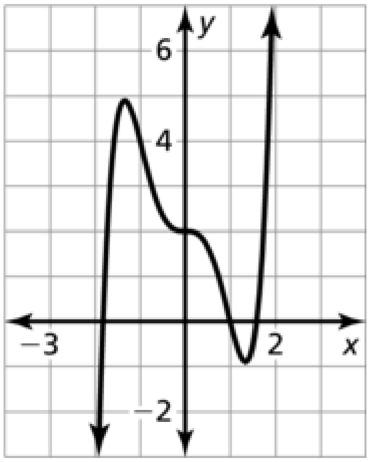
22. The degree of the function is even and the leading coefficient is positive.

24. The function f has degree 0 (constant) because it can also be written as $f(x) = 13x^0$. The leading coefficient is 13; $f(x) \to 13$ as $x \to -\infty$ and $f(x) \to 13$ as $x \to \infty$ because the y-values are always 13.

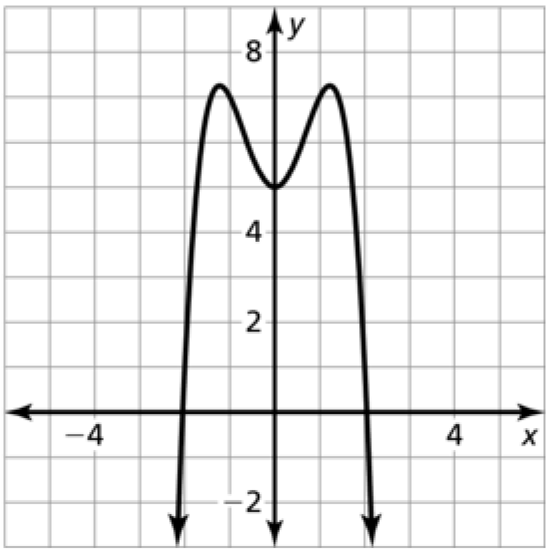
26.



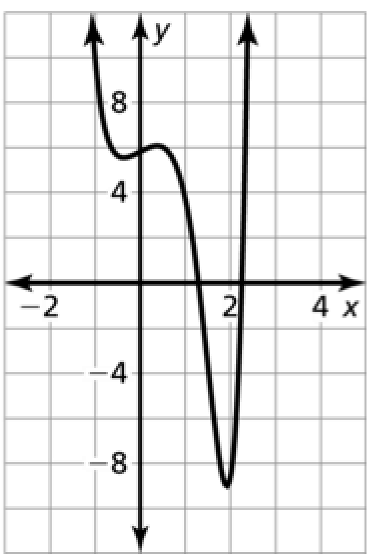
28.



30.



32.



34. **a.** The function is increasing when $x < -4$ and decreasing when $x > -4$.

b. $-6 < x < -2$

c. $x < -6$ and $x > -2$

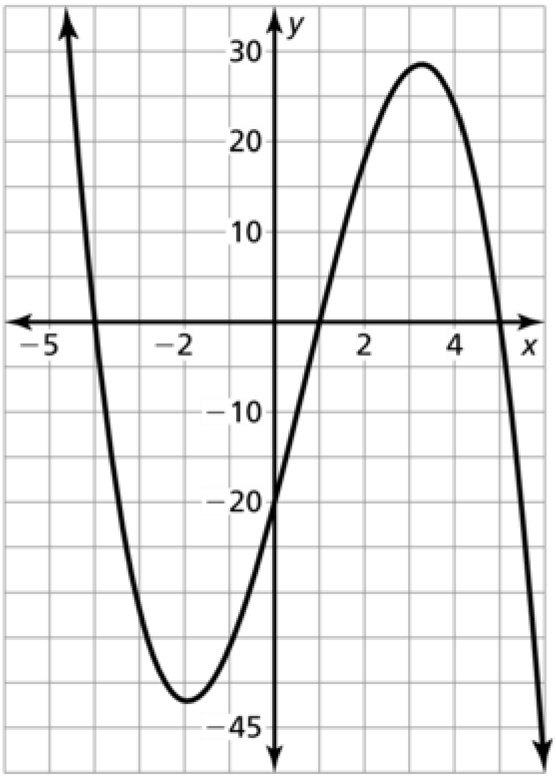
36. **a.** The function is increasing when $x < -1$ and $x > 1$ and decreasing when $-1 < x < 1$.

b. $x > 2$

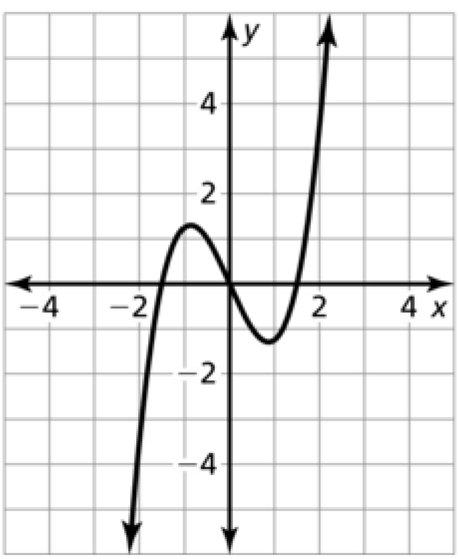
c. $x < -1$ and $-1 < x < 2$

pp. 163-164 (#38-42 evens; #43-50)

38. The degree is odd and the leading coefficient is negative.



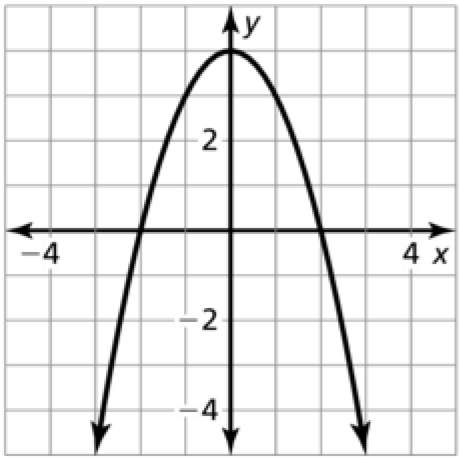
40. The degree is odd and the leading coefficient is positive.



42. $w \approx 8.53$ carats

43. Because the graph of g is a reflection of the graph of f in the y-axis, the end behavior would be opposite; $g(x) \to -\infty$ as $x \to -\infty$ and $g(x) \to \infty$ as $x \to \infty$.

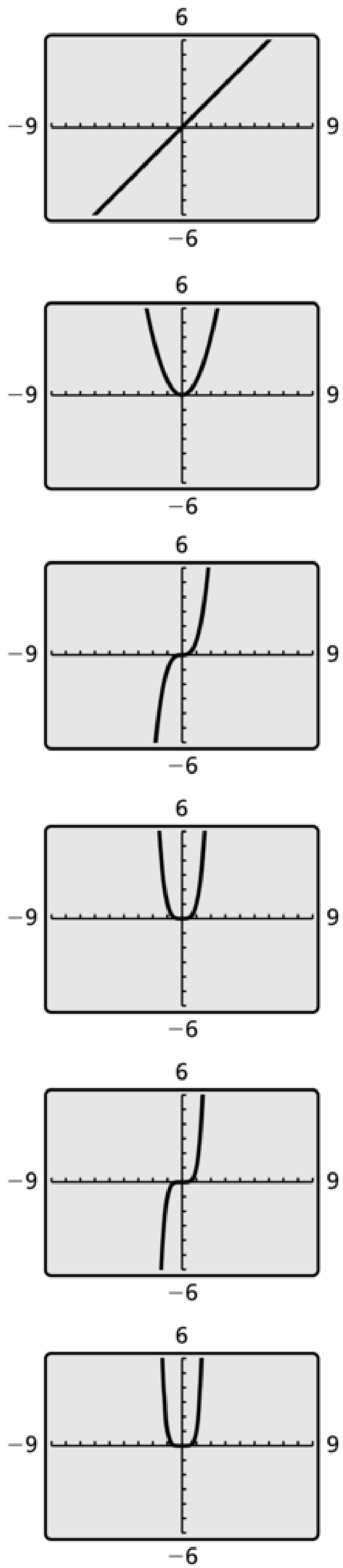
44. *Sample answer:* $y = -x^2 + 4$



45. The viewing window is appropriate if it shows the end behavior of the graph as $x \to \infty$ and $x \to -\infty$.

46. If the table is showing the end behavior of each function, then your friend is correct; $f(x) \to \infty$ as $x \to -\infty$ and as $x \to \infty$, so f is even. $g(x) \to \infty$ as $x \to -\infty$ and $g(x) \to -\infty$ as $x \to \infty$, so g is odd.

47. **a.**



$y = x$, $y = x^3$, and $y = x^5$ are all symmetric with respect to the origin.

$y = x^2$, $y = x^4$, and $y = x^6$ are all symmetric with respect to the y-axis.

b. The graph of $y = x^{10}$ will be symmetric with respect to the y-axis. The graph of $y = x^{11}$ will be symmetric with respect to the origin; The exponent is even. The exponent is odd.

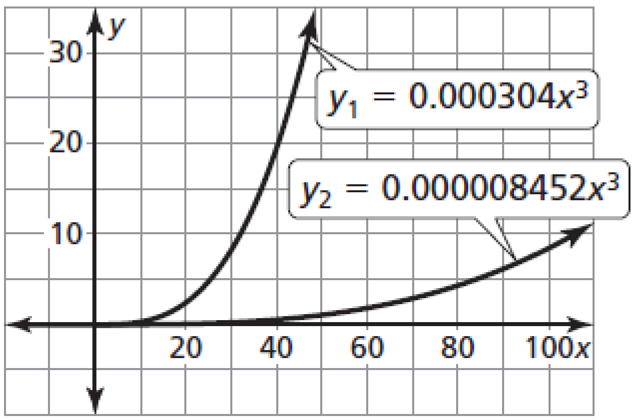
48. **a.** The degree is odd and the leading coefficient is positive.

b. The function is increasing on the intervals $(-\infty, -3)$ and $(-1, \infty)$ and decreasing on the interval $(-3, -1)$

c. 4

49. $f(-5) = -480$; Substituting the two given points into the function results in the system of equations $2 + b + c - 5 = 0$ and $16 + 4b + 2c - 5 = 3$. Solving for b and c gives $f(x) = 2x^3 - 7x^2 + 10x - 5$.

50. **a.** $y = 0.000008452x^3$

b. 

vertical shrink by a factor of about 0.0278

pp. 170-172 (#3-42, x3; #44-64 evens)

3. $x^2 + x + 1$

6. $8x^4 + 3x^3 - 3x^2 + 7x$

9. $-2x^3 - 14x^2 + 7x - 4$

12. $-10x^5 + 8x^4 - 7x^3 - 20x^2 - x + 18$

15. $P = 47.7t^2 + 678.5t + 17{,}667.4$; The constant term represents the total number of people attending degree-granting institutions at time $t = 0$.

18. $-44x^8 - 8x^7 - 36x^6 - 4x^5$

21. $x^4 - 5x^3 - 3x^2 + 22x + 20$

24. $4x^6 - 8x^5 + 10x^4 - 8x^3 - 38x^2 - 8x$

27. $x^3 + 3x^2 - 10x - 24$

30. $6x^3 + 11x^2 - 26x - 40$

33. $(a + b)(a - b) = a^2 - ab + ab - b^2 = a^2 - b^2$;

Sample answer:

$$\begin{aligned} 24 \cdot 16 &= (20 + 4)(20 - 4) \\ &= 20^2 - 4^2 \\ &= 400 - 16 \\ &= 384 \end{aligned}$$

36. $m^2 + 12m + 36$

39. $49h^2 + 56h + 16$

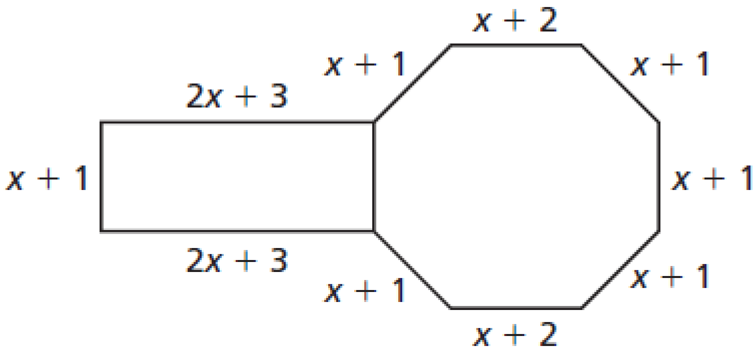
42. $64n^3 - 144n^2 - 108n - 27$

44. $36m^2 + 24m + 4$

46. $g^5 + 10g^4 + 40g^3 + 80g^2 + 80g + 32$

48. $n^4p^4 - 4n^3p^3 + 6n^2p^2 - 4np + 1$

50. *Sample answer:*



$12x + 16$

52. $\pi(3x^3 - 16x^2 + 28x - 16)$

54. $(2x + 10)^3 - \left[\frac{4}{3}\pi(x + 2)^3\right]$, or about $3.8x^3 + 94.9x^2 + 549.7x + 966.5$

56. **a.** 12 in. by 6 in.

b. $V = x(12 - 2x)(6 - 2x)$; 3

58. not equivalent; They do not produce the same graph.

60. equivalent; They produce the same graph.

62. When in standard form the function is $x^4 + (ax^3 + bx^3 + cx^3 + dx^3) + (abx^2 + bcx^2 + bdx^2 + cdx^2) + (acx + adx + abcx + abdx + acdx + bcdx) + abcd$ which can also be written as $x^4 + (a + b + c + d)x^3 + (ab + ad + ac + bc + bd + cd)x^2 + (abc + abd + acd + bcd)x + abcd$.

64. **a.** 3, 5, 7; The difference increases by 2 for each consecutive pair of square numbers.

b. The first difference is 3, given by $2(1) + 1 = 3$. The second difference is 5, given by $2(2) + 1 = 5$. The third difference is 7, given by $2(3) + 1$.

c. $(n + 1)^2 - n^2 = n^2 + 2n + 1 - n^2 = 2n + 1$

pp. 177-178 (#2-40 evens)

2. The divisor must be a linear factor such as $(x - 3)$ or $(x + 5)$. Synthetic division cannot be used when dividing by nonlinear factors such as $(x^2 + 3x - 1)$ or $(x^2 + 8)$.

4. The colored numbers represent the quotient of the synthetic division problem. The number to the right is the remainder and the other numbers are the coefficients of each term.

6. $3x + 1$

8. $7x + 1 + \dfrac{-6x - 1}{x^2 + 1}$

10. $4x^2 + 12x + 44 + \dfrac{161x + 84}{x^2 - 3x - 2}$

12. $4x - 5 - \dfrac{15}{x - 2}$

14. $x^2 - 3x + 5 - \dfrac{9}{x + 3}$

16. $3x^2 - 2x - 2 - \dfrac{4}{x - 1}$

18. $x^3 - x^2 + 5x - 9 + \dfrac{10}{x + 5}$

20. A; $(2)^2 - (2) - 3 = -1$ so the remainder must be -1.

22. B; $(2)^2 + (2) + 3 = 9$ so the remainder must be 9.

24. The coefficient of 0 for the quadratic term of the dividend was not included.

$$\begin{array}{c|cccc} 2 & 1 & 0 & -5 & 3 \\ & & 2 & 4 & -2 \\ \hline & 1 & 2 & -1 & 1 \end{array}$$

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

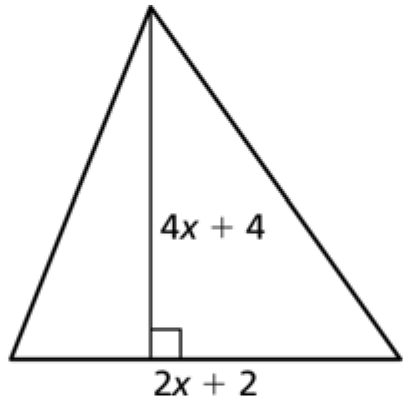
26. $f(3) = 13$

28. $f(-4) = -27$

30. $f(10) = 903$

32. $f(5) = -752$

34. *Sample answer:*



36.

2	−6	0	72	0
		−12	−24	96
	−6	−12	48	96

Because the remainder is 96, this verifies that $P(2) = 96$; yes; An easier method would be to substitute 2 directly into the equation.

38. **a.** -4

b. The remainders are both 0 because $f(-3) = f(-1) = 0$.

40. $5x^3 - 3x^2 + 21x - 8$; *Sample answer:* Multiply by $x + 2$.

p. 184 (#6-44 evens)

6. $4k^3(k - 5)(k + 5)$

8. $2m^4(m - 8)(m - 4)$

10. $r^4(3r + 4)(r - 5)$

12. $v^7(3v + 2)(6v + 7)$

14. $(y + 8)(y^2 - 8y + 64)$

16. $(c - 3)(c^2 + 3c + 9)$

18. $9n^3(n - 9)(n^2 + 9n + 81)$

20. $135z^8(z - 2)(z^2 + 2z + 4)$

22. The polynomial is not completely factored;

$$\begin{aligned} x^9 + 8x^3 &= (x^3)^3 + (2x)^3 \\ &= (x^3 + 2x)[(x^3)^2 - (x^3)(2x) + (2x)^2] \\ &= (x^3 + 2x)(x^6 - 2x^4 + 4x^2) \\ &= x^3(x^2 + 2)(x^4 - 2x^2 + 4) \end{aligned}$$

24. $(m^2 + 7)(m - 1)$

26. $(2k^2 + 5)(k - 10)$

28. $(z - 3)(z + 3)(z - 5)$

30. $(4n - 1)(4n + 1)(n + 2)$

32. $(2m^2 - 5)(2m^2 + 5)$

34. $(y^2 - 7)(y^2 + 4)$

36. $(9a^2 + 16)(3a - 4)(3a + 4)$

38. $4n^2(n^5 - 6)(n^5 - 2)$

40. not a factor

42. not a factor

44. factor

pp. 185-186 (#46-66 evens; #67-75)

46.

5	1	−5	−9	45
		5	0	−45
	1	0	−9	0

$t(x) = (x - 5)(x - 3)(x + 3)$

48.

−4	1	4	0	−64	−256
		−4	0	0	256
	1	0	0	−64	0

$s(x) = (x + 4)(x - 4)(x^2 + 4x + 16)$

50.

−2	1	−1	−24	−36
		−2	6	36
	1	−3	−18	0

$h(x) = (x + 2)(x - 6)(x + 3)$

52. C; The x-intercepts of the graph are 0, −2, −1, and 2.

54. B; The x-intercepts of the graph are 0, 2, 1, and −2.

56. The model makes sense for $x > 3$; When factored completely, the volume is $V = (x - 1)(x - 3)(3x - 5)$. For all three dimensions of the cage to have positive lengths, the value of x must be greater than 3.

58. $(2m - 7)(4m^2 + 14m + 49)$; The difference of two cubes pattern can be used because the expression is of the form $a^3 - b^3$.

60. $2p^2(p^3 - 2)(p^3 - 4)$; A common monomial can be factored out to obtain a factorable trinomial in quadratic form where $u = p^3$.

62. $5x^3(x - 4)(x + 2)$; A common monomial can be factored out to obtain a factorable trinomial in quadratic form.

64. $(3k^2 + 1)(3k - 8)$; Factoring by grouping can be used because the expression contains pairs of monomials that have a common factor.

66. 1 million

67. 0.7 million

68. *Sample answer:* 4; $\dfrac{x^3 - 3x^2 - 4x}{x - 4} = x^2 + x$

69. *Sample answer:* Factor Theorem and synthetic division; Calculations without a calculator are easier with this method because the values are lesser.

70. no; $f(x)$ may be factorable by factors other than $x - a$.

71. $k = 22$

$$\begin{array}{r|rrrr} 7 & 2 & -13 & -22 & 105 \\ & & 14 & 7 & -105 \\ \hline & 2 & 1 & -15 & 0 \end{array}$$

72. $y = x(x + 2)(x - 2)$; Because 0, -2, and 2 are the x-intercepts, $(x - 0)$, $(x + 2)$, and $(x - 2)$ must be factors.

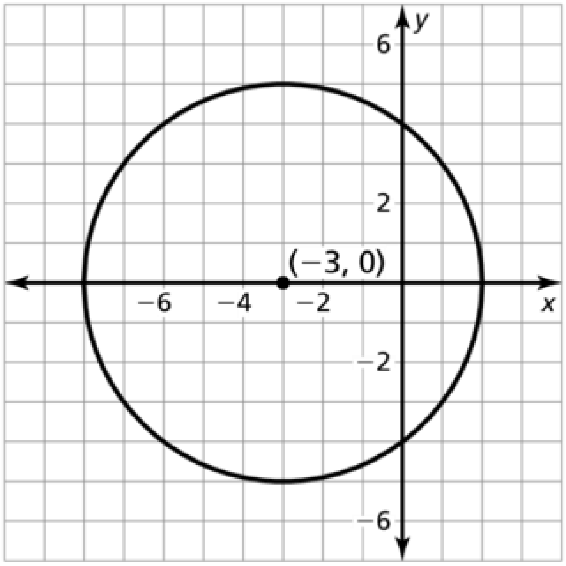
73. **a.** $(c - d)(c + d)(7a + b)$

b. $(x^n - 1)(x^n - 1)$

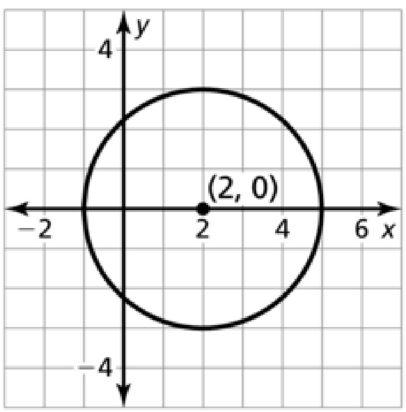
c. $(a^3 - b^2)(ab + 1)^2$

74. no; The function shows no x-intercepts. At least one x-intercept is needed to determine the factor used in synthetic division.

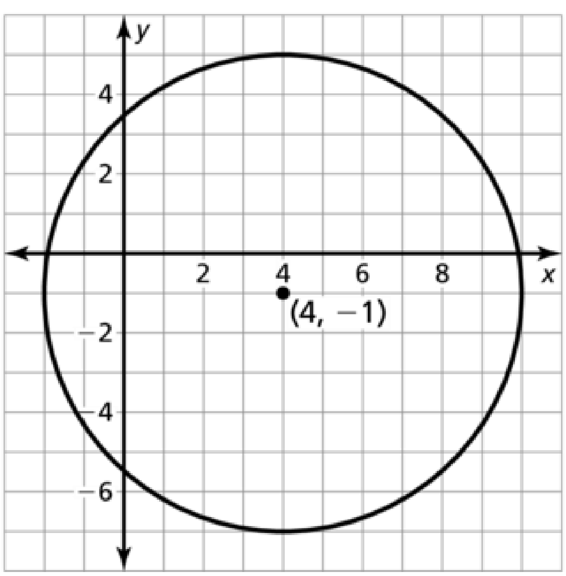
75. **a.** $(x + 3)^2 + y^2 = 5^2$; The center of the circle is $(-3, 0)$ and the radius is 5.



b. $(x - 2)^2 + y^2 = 3^2$; The center of the circle is $(2, 0)$ and the radius is 3.



c. $(x - 4)^2 + (y + 1)^2 = 6^2$; The center of the circle is $(4, -1)$ and the radius is 6.



p. 188 (#1-17)

1. polynomial function; $f(x) = -3x^4 - x^3 + 2x^2 - 2x + 5$; degree: 4 (quartic), leading coefficient: -3

2. polynomial function; $g(x) = \frac{1}{4}x^3 - 3x^2 + 2x + 1$; degree: 3 (cubic), leading coefficient: $\frac{1}{4}$

3. not a polynomial function

4. **a.** The function is increasing when $x < 2$ and decreasing when $x > 2$.

   b. $1 < x < 3$

   c. $x < 1$ and $x > 3$

5. The area is $3x^2 + 7x + 3$ and the perimeter is $8x + 8$.

6. $4x^2 + 5x - 5$

7. $3x^3 - 10x^2 + 9x - 2$

8. $x^3 - 2x^2 - 11x + 12$

9. $x^5 + 10x^4 + 40x^3 + 80x^2 + 80x + 32$

10. $4x^2 + 6x + 17 + \dfrac{35x + 25}{x^2 - 2x - 1}$

11. $a(a - 4)(a + 2)$

12. $(2m + 3)(4m^2 - 6m + 9)$

13. $(z - 2)(z + 2)(z + 1)$

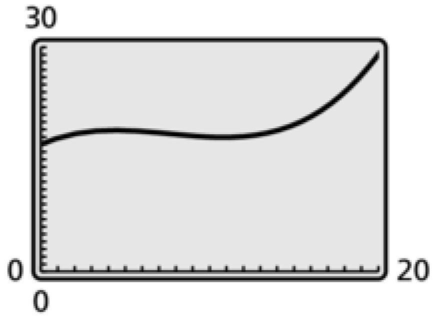
14. $(7b^2 - 8)(7b^2 + 8)$

15.

−5	1	−2	−23	60
		−5	35	−60
	1	−7	12	0

$f(x) = (x + 5)(x - 3)(x - 4)$

16. **a.**



The graph remains relatively constant until the year 2002 when it begins to increase. It continues to increase each year until 2010.

b. 0.6 cents per year

17. The model makes sense for $x > 4$; In factored form, the volume is $V(x) = x(2x - 3)(x - 4)$. For all three dimensions of the crate to be positive, x must always be greater than 4.

pp. 194-195 (#2-32 evens)

2. Find the y-intercept of the graph of $y = x^3 - 2x^2 - x + 2$; 2; -1, 1, and 2

4. $a = 0$ and $a = 2$

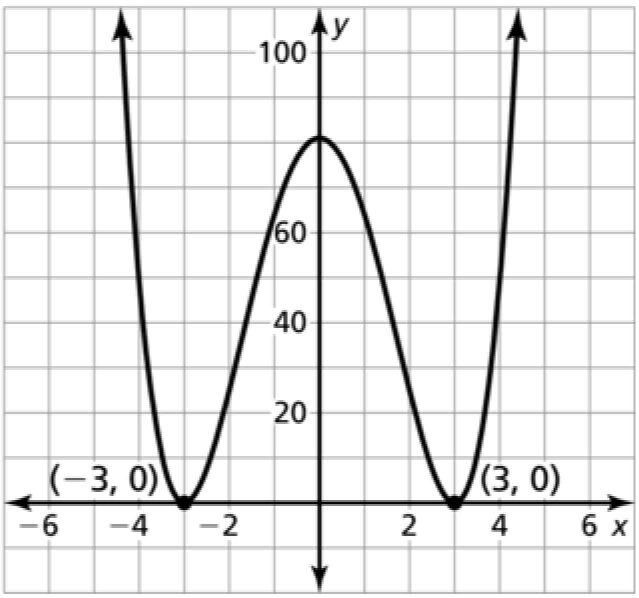
6. $v = -4$, $v = 2$, and $v = 4$

8. $m = 0$ and $m = \pm\sqrt{3} \approx \pm 1.73$

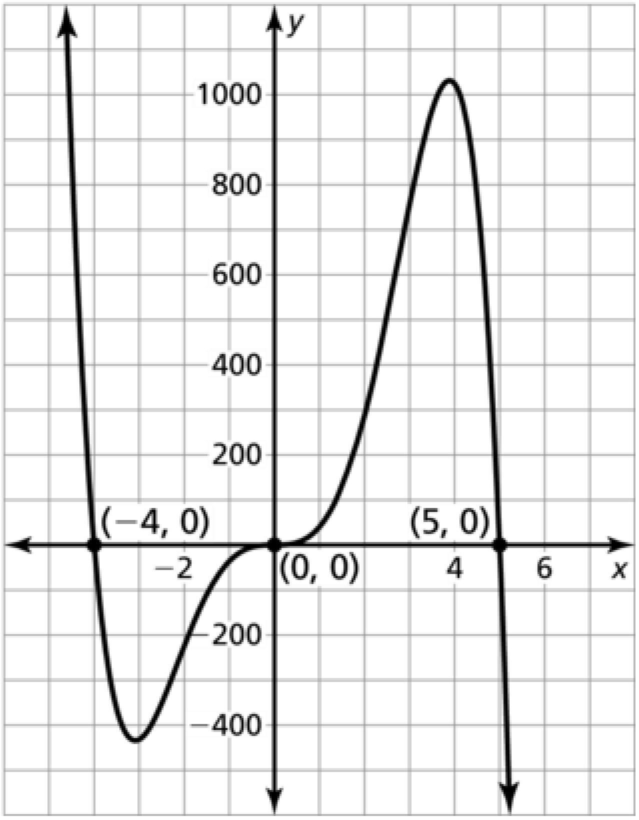
10. $p = -2$, $p = 2$, and $p = \pm\sqrt{10} \approx \pm 3.16$

12. $y = 3$

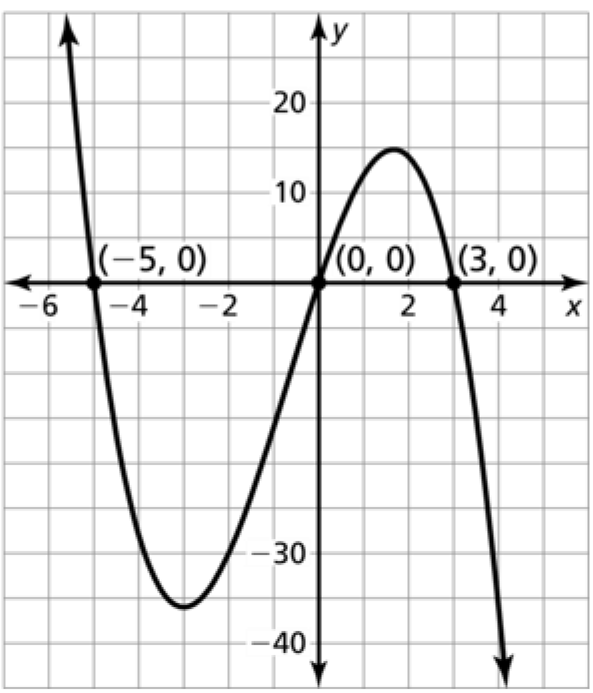
14. $x = -3$ and $x = 3$



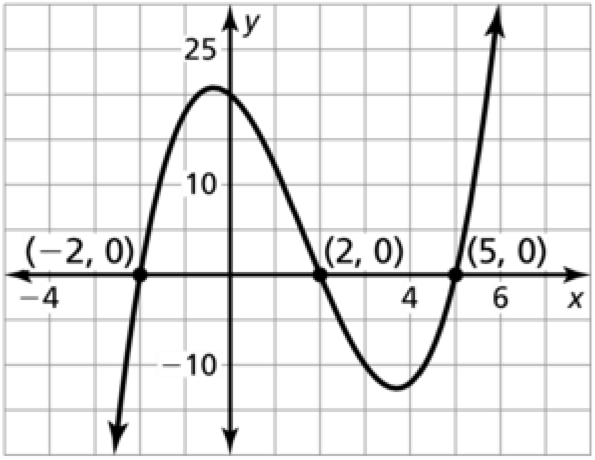
16. $x = -4$, $x = 0$, and $x = 5$



18. $x = -5$, $x = 0$, and $x = 3$



20. $x = -2$, $x = 2$, and $x = 5$



22. A

24. The factors were listed as $\frac{q}{p}$ instead of $\frac{p}{q}$; ± 1, $\pm \frac{1}{3}$, ± 2, ± 4, ± 8, $\pm \frac{2}{3}$, $\pm \frac{4}{3}$, $\pm \frac{8}{3}$

26. $x = -2$, $x = 1$, and $x = 3$

28. $x = -5$, $x = -2$, and $x = 3$

30. $x = -1$, $x = 8$, and $x = 9$

32. $x = -4$, $x = \frac{2}{3}$, and $x = 3$

pp. 195-196 (#34-54 evens; #55-58; #60-64 evens)

34. $-4, -2$, and 6

36. 1, 6, and 7

38. $\frac{4}{3}$, 2, and 5

40. 4, $-\frac{3}{2}$, and $-\frac{5}{2}$

42. $f(x) = x^3 + x^2 - 22x - 40$

44. $f(x) = x^3 - 16x^2 + 77x - 116$

46. $f(x) = x^4 + 5x^3 - 33x^2 - 85x$

48. no; The number of zeros for a function is always equal to its degree. A cubic function can have three real zeros.

50. **a.** $x^3 - 9x^2 + 27x - 35 = 0$

b. $\pm 1, \pm 5, \pm 7, \pm 35$

c.

$$\begin{array}{r|rrrr} 5 & 1 & -9 & 27 & -35 \\ & & 5 & -20 & 35 \\ \hline & 1 & -4 & 7 & 0 \end{array}$$

Dividing by $(x - 5)$ results in a remainder of 0, so 5 is a solution. The resulting equation, $x^2 - 4x + 7$, has solutions $x = 2 \pm i\sqrt{3}$, so 5 is the only real solution.

d. 2 cm by 2 cm by 2 cm

52. yes; The denominator of each possible rational zero is 1 or -1.

54. *Sample answer:* $f(x) = 16x^3 - 9x$; Factoring gives you $f(x) = x(4x - 3)(4x + 3)$, so the zeros are $x = 0$ and $x = \pm\frac{3}{4}$.

55. The length should be 8 feet, the width should be 4 feet, and the height should be 4 feet.

56. **a.** $x = -2$ and $x = 1$

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

57. **a.** $k = 60$

b. $k = 33$

c. $k = 6$

58. $g(x) = x^4 - 2x^3 - 20x^2 + 46x - 21$

60. $x = 2$ and $x = 4$

62. $x = -3$

64. Each side of the base is to be 2 feet and the height is to be 3 feet.

pp. 202-203 (#3-18, x3; #20-32 evens)

3. 4

6. 4

9. $-1, 1, 2$, and 4

12. $-5, -2$, and 2

15. $-4, -1, 2, i\sqrt{2}$, and $-i\sqrt{2}$

18. 4; The graph shows 1 real zero, so the remaining zeros must be imaginary.

20. 0; The graph shows 3 real zeros, so all of the zeros are real.

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

24. $f(x) = x^3 - 12x^2 + 46x - 52$

26. $f(x) = x^4 - 4x^3 + 14x^2 - 36x + 45$

28. $f(x) = x^5 - 13x^4 + 60x^3 - 82x^2 - 144x + 360$

30. In the second factor, the same zero is being added, instead of subtracting the conjugate of the zero.

$$\begin{aligned} f(x) &= [x - (2 + i)][x - (2 - i)] \\ &= [(x - 2) - i][(x - 2) + i] \\ &= (x - 2)^2 - i^2 \\ &= (x^2 - 4x + 4) - (-1) \\ &= x^2 - 4x + 5 \end{aligned}$$

32. The function has degree 3, so it must have three solutions. Because the imaginary solutions come in conjugate pairs, there must be an even number of imaginary solutions. Given that the first two are real, the third must also be real.

pp. 202-203 (#34-42 evens; #43-47, #49-52)

34.

Positive real zeros	Negative real zeros	Imaginary zeros	Total zeros
1	0	2	3

36.

Positive real zeros	Negative real zeros	Imaginary zeros	Total zeros
2	3	0	5
2	1	2	5
0	3	2	5
0	1	4	5

38.

Positive real zeros	Negative real zeros	Imaginary zeros	Total zeros
3	2	0	5
3	0	2	5
1	2	2	5
1	0	4	5

40.

Positive real zeros	Negative real zeros	Imaginary zeros	Total zeros
2	1	4	7
0	1	6	7

42. A

43. in the year 1958

44. in the 9th year

45. in the 3rd year and the 9th year

46. your friend; $2 - i$ is a zero of the function, but its conjugate does not need to be, because the Complex Conjugates Theorem only applies when the polynomial function has real coefficients.

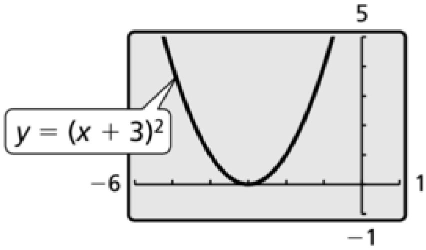
47. $x = 4.2577$

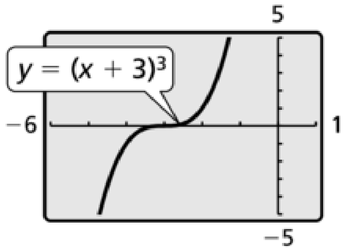
49. no; The Fundamental Theorem of Algebra applies to functions of degree greater than zero. Because the function $f(x) = 2$ is equivalent to $f(x) = 2x^0$, it has degree 0, and does not fall under the Fundamental Theorem of Algebra.

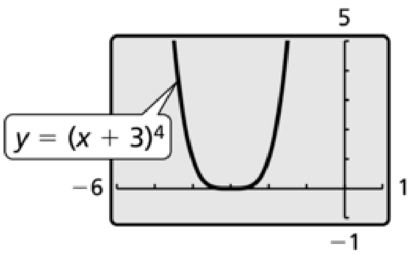
50. **a.** The function has three positive real zeros, one negative real zero, and two imaginary zeros. Or, the function has five positive real zeros, one negative zero, and zero imaginary zeros.

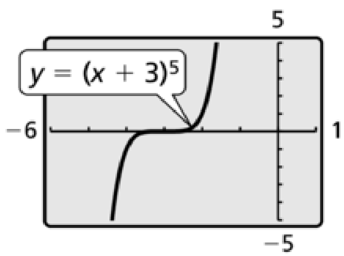
    b. $f(x)$ could change signs five times or three times

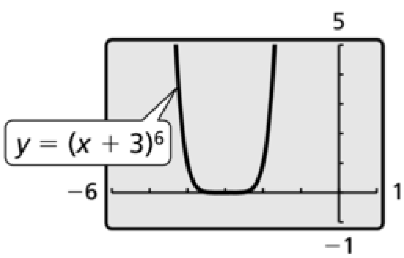
51.

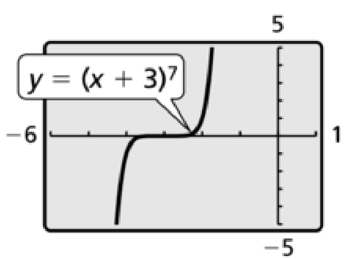












a. For all functions, $f(x) \to \infty$ as $x \to \infty$. When n is even, $f(x) \to \infty$ as $x \to -\infty$, but when n is odd, $f(x) \to -\infty$ as $x \to -\infty$.

b. As n increases, the graph becomes more flat near the zero $x = -3$.

c. The graph of g becomes more vertical and straight near $x = 4$.

52. $f(x)$: 2, 3; $g(x)$: $-3, 1, 2$; $h(x)$: $-3, 1, 2i, -2i$; $k(x)$: $-3, 2, 0,$
$2 + \sqrt{3} \approx 3.73, 2 - \sqrt{3} \approx 0.27$

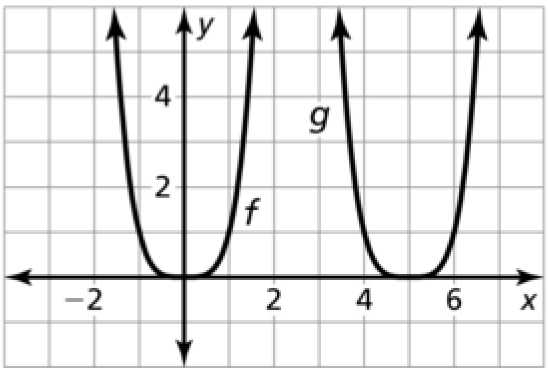
a. If the function is of degree n, the sum of the zeros is equal to the opposite of the coefficient of the $n - 1$ term.

b. The product of the zeros is equal to the constant term of the polynomial function.

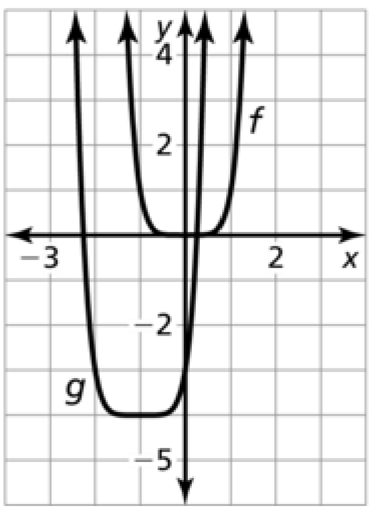
p. 209 (#2-20 evens)

2. Both functions have been translated horizontally h units and vertically k units.

4. The graph of g is a translation 5 units right of the graph of f.



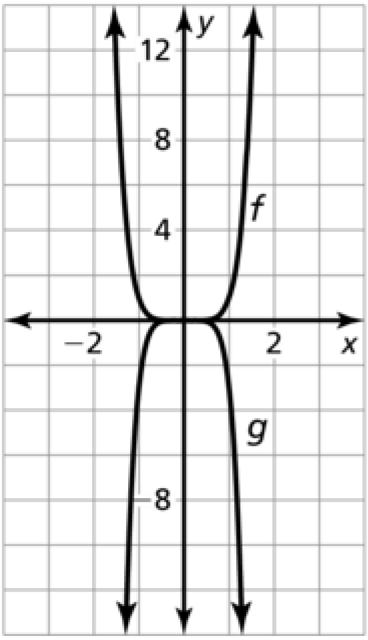
6. The graph of g is a translation 1 unit left and 4 units down of the graph of f.



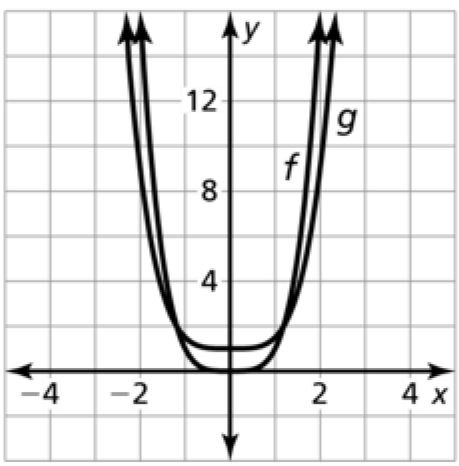
8. C; The graph has been translated 2 units left and 2 units up.

10. A; The graph has been translated 2 units down.

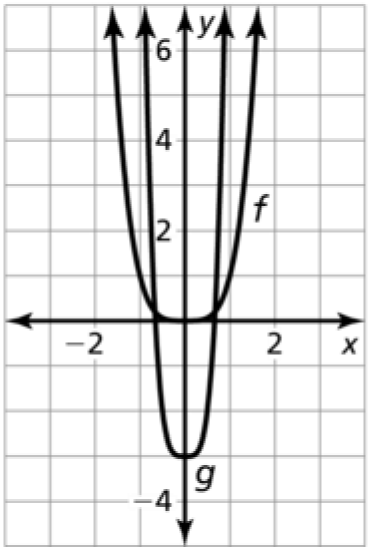
12. The graph of g is a vertical stretch by a factor of 3 followed by a reflection in the x-axis of the graph of f.



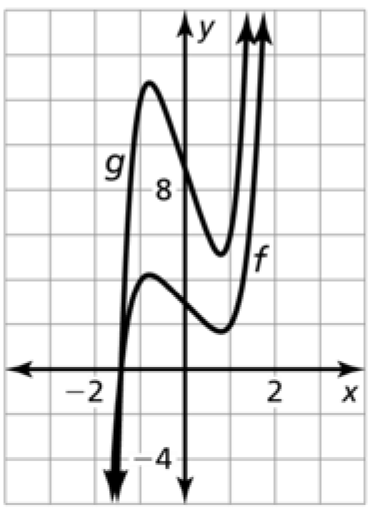
14. The graph of g is a vertical shrink by a factor of $\frac{1}{2}$ followed by a translation 1 unit up of the graph of f.



16. The graph of g is a horizontal shrink by a factor of $\frac{1}{2}$ followed by a translation 3 units down of the graph of f.

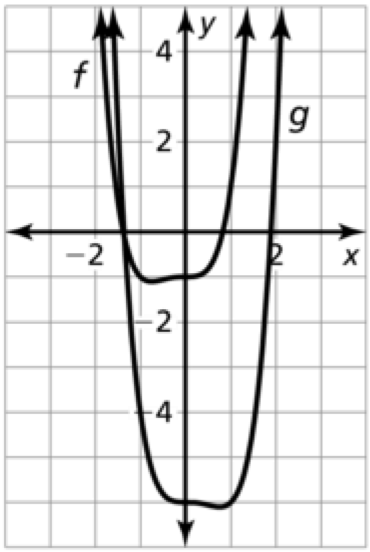


18. $g(x) = 3x^5 - 6x + 9$



The graph of g is a vertical stretch by a factor of 3 of the graph of f.

20. $g(x) = x^4 - x^3 - 6$



The graph of g is a reflection in the y-axis followed by a translation 5 units down of the graph of f.

p. 210 (#22-33)

22. The factor of the horizontal shrink is incorrect; The graph of g is a horizontal shrink by a factor of $\frac{1}{3}$, followed by a translation 4 units down of the graph of f.

23. $g(x) = -x^3 + 9x^2 - 27x + 21$

24. $g(x) = 2x^4 - 32x^3 + 192x^2 - 508x + 508$

25. $g(x) = -27x^3 - 18x^2 + 7$

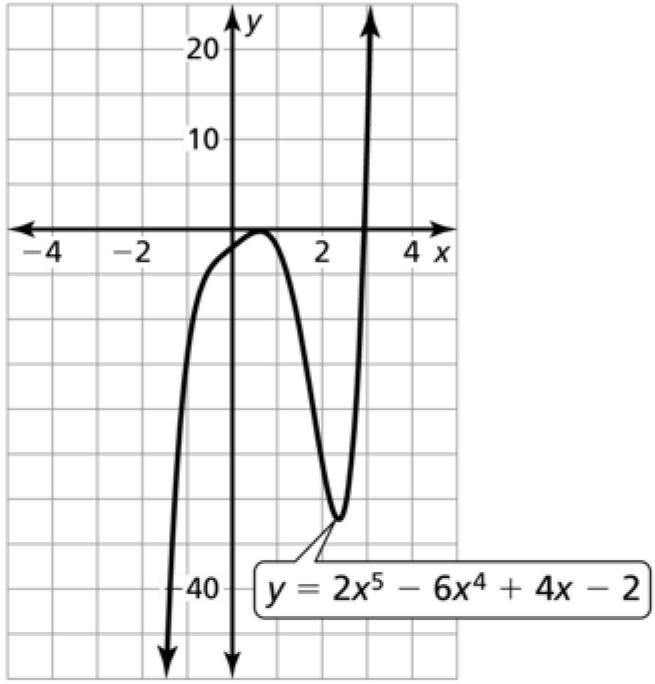
26. $g(x) = -6x^5 + 3x^3 + 3x^2 + 11$

27. $W(x) = 27x^3 - 12x$; $W(5) = 3315$; When x is 5 yards, the volume of the pyramid is 3315 cubic feet.

28. no; When each side is divided in half the new volume is $V\left(\frac{1}{2}x\right) = \left(\frac{1}{2}x\right)^3 = \frac{1}{8}x^3$ and is four times less than when the volume is divided in half.

29. *Sample answer:* If the function is translated up and then reflected in the x-axis, the order is important; If the function is translated left and then reflected in the x-axis, the order is not important; Reflecting a graph in the x-axis does not affect its x-coordinate, but it does affect its y-coordinate. So, the order is only important if the other translation is in the y.

30. *Sample answer:* $f(x) = 2x^5 - 6x^4 + 4x - 2$



31. **a.** 0 m, 4 m, and 7 m

b. $g(x) = -\frac{2}{5}(x - 2)(x - 6)^2(x - 9)$

32. The real zeros of f are -2, 0, and 2. The real zeros of g are 0, 2, and 4. Because all of the real zeros have been increased two units, the graph of g is a translation two units right of the graph of g.

33. $V(x) = 3\pi x^2(x + 3)$; $W(x) = \frac{\pi}{3}x^2\left(\frac{1}{3}x + 3\right)$;

$W(3) = 12\pi \approx 37.70$; When x is 3 feet, the volume of the cone is about 37.70 cubic yards.

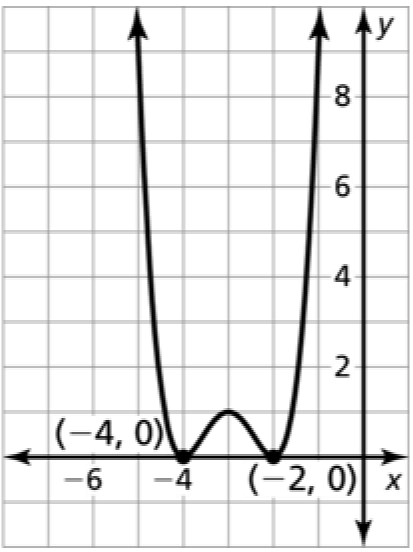
p. 216 (#2-22 evens)

2. A local maximum is a turning point of a graph where the *y*-coordinate is higher than all nearby points. It is different from the maximum value of a function because it may not be the highest point on the entire graph.

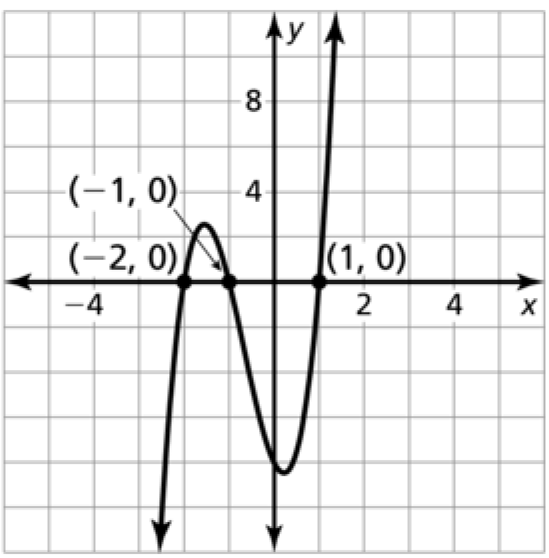
4. C

6. D

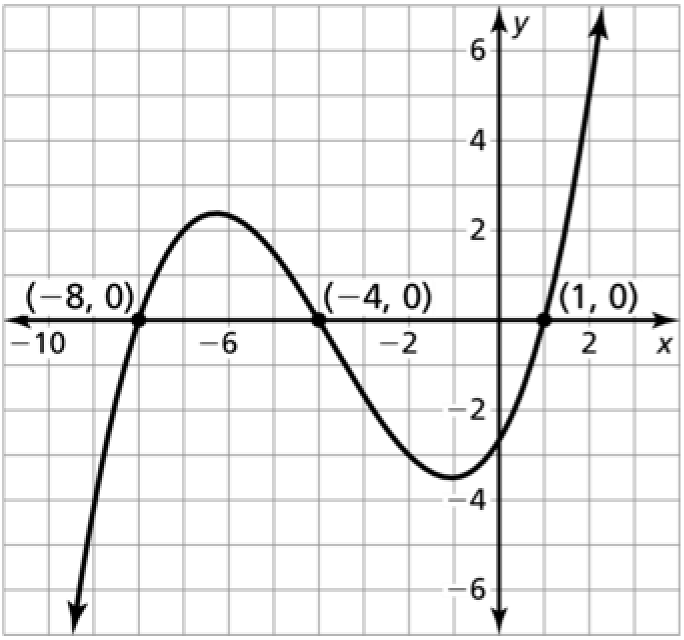
8.



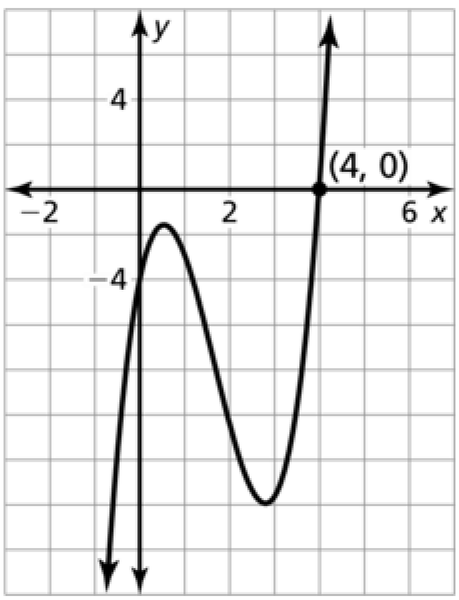
10.



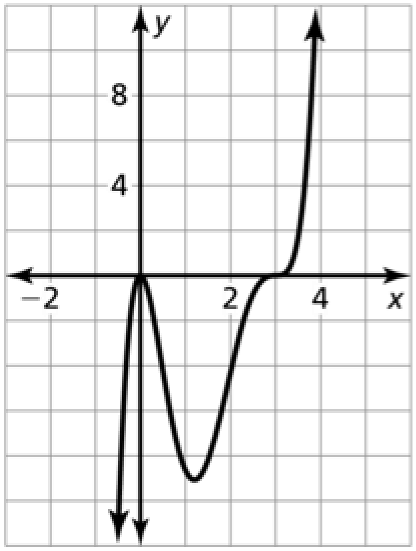
12.



14.



16. Because 0 is a repeated zero with an even power, the graph should only touch the x-axis at 0, not cross it. Because 3 is a repeated zero with an odd power, the graph should cross the x-axis at 3.



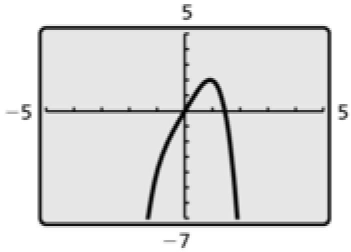
18. -2, 2, and 3

20. $-\frac{3}{2}$, -1, and 3

22. -3, $-\frac{1}{2}$, and 5

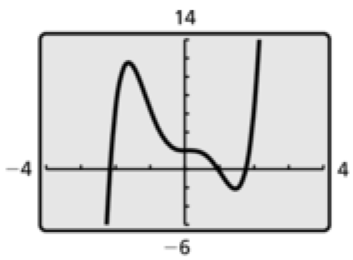
pp. 217-218 (#24-46 evens; #47-55)

24.



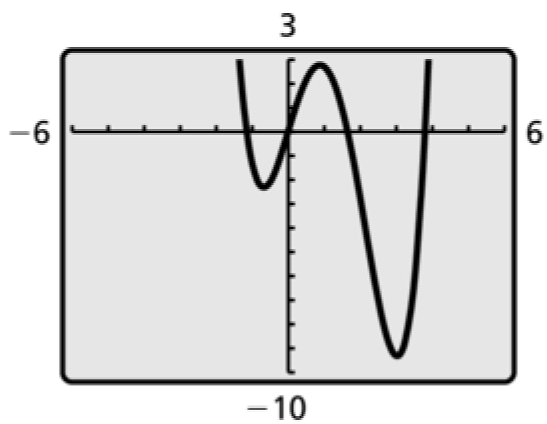
The x-intercepts of the graph are $x = 0$ and $x \approx 1.44$. The function has a local maximum at (0.91, 2.04); The function is increasing when $x < 0.91$ and is decreasing when $x > 0.91$.

26.

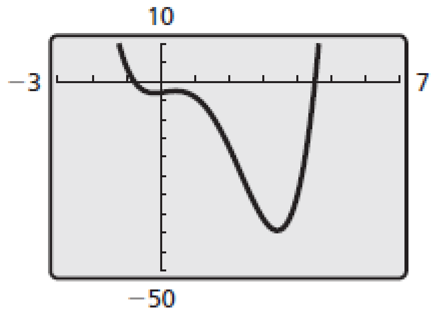


The x-intercepts of the graph are $x \approx -2.16$, $x = 1$, and $x \approx 1.75$. The function has a local maximum at $(-1.63, 10.47)$ and a local minimum at $(1.46, -1.68)$; The function is increasing when $x < -1.63$ and $x > 1.46$ and is decreasing when $-1.63 < x < 1.46$.

28.



The x-intercepts of the graph are $x \approx -1.15$, $x = 0$, $x \approx 1.64$, and $x \approx 3.79$. The function has a local maximum at $(0.87, 2.78)$ and local minimums at $(-0.68, -2.31)$ and $(3.02, -9.30)$; The function is increasing when $-0.68 < x < 0.87$ and $x > 3.02$ and is decreasing when $x < -0.68$ and $0.87 < x < 3.02$.

30. 

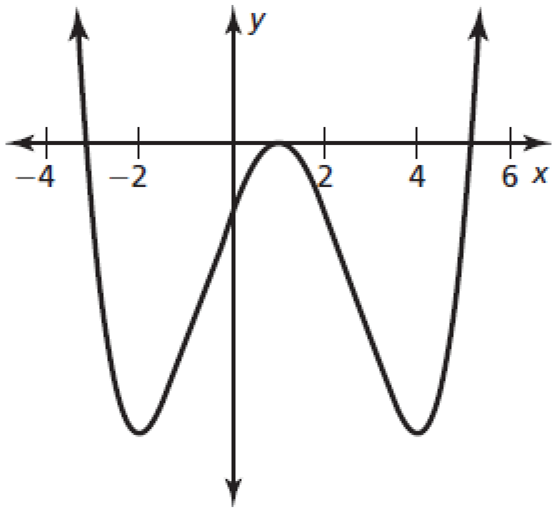
The x-intercepts of the graph are $x \approx -0.77$ and $x \approx 4.54$. The function has a local maximum at $(0.47, -2.56)$ and local minimums at $(-0.16, -3.09)$ and $(3.44, -39.40)$; The function is increasing when $-0.16 < x < 0.47$ and $x > 3.44$ and is decreasing when $x < -0.16$ and $0.47 < x < 3.44$.

32. $(-2.91, -1.36)$ and $(0.57, -6.63)$; $(-2.91, -1.36)$ corresponds to a local maximum and $(0.57, -6.63)$ corresponds to a local minimum; The real zero is 2.5. The function is of at least degree 3.

34. $(-1.22, 5.07)$, $(1.96, 7.71)$, $(0.15, -48.35)$, and $(2.79, -3.74)$; $(-1.22, 5.07)$ and $(1.96, 7.71)$ correspond to local maximums, and $(0.15, -48.35)$ and $(2.79, -3.74)$ correspond to local minimums; The real zeros are -1.4, -1, 1.5, 2.5, and 3. The function is of at least degree 5.

36. $(-1.18, -7.57)$; $(-1.18, -7.57)$ corresponds to a local minimum; The zeros are -2.45 and 2.45. The function is of at least degree 4.

38.



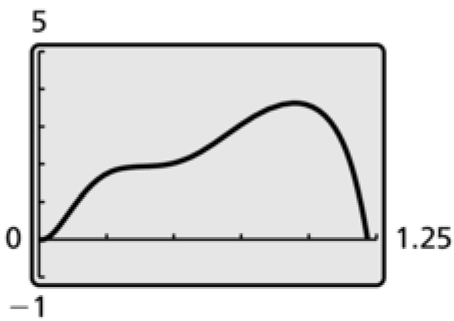
40. even

42. odd

44. neither

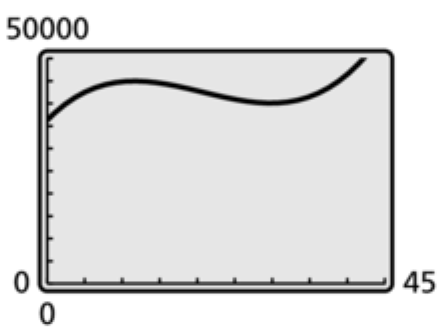
46. neither

47.



about 1 sec into the stroke

48.



Enrollment increases until approximately the 12th year to a maximum of almost 45,000 students. Then, enrollment decreases until approximately the 30th year to a minimum of about 40,000 students. Then, enrollment increases again and ends the period with about 48,000 students.

49. A quadratic function only has one turning point, and it is always the maximum or minimum value of the function.

50. a. The zeros of the function are -3 and 0. The local maximum is $(-2, 4)$ and the local minimum is $(0, 0)$.

b. The x-intercepts of the graphs of $y = f(x)$ and $y = -f(x)$ are the same.

c. The minimum value of $y = f(x)$ is the opposite of the maximum value of $y = -f(x)$ and the maximum value of $y = f(x)$ is the opposite of the minimum value of $y = -f(x)$.

51. no; When multiplying two odd functions, the exponents of each term will be added, creating an even exponent. So, the product will not be an odd function.

52. a. about 2.94 in.

b. about 420.11 $in.^3$

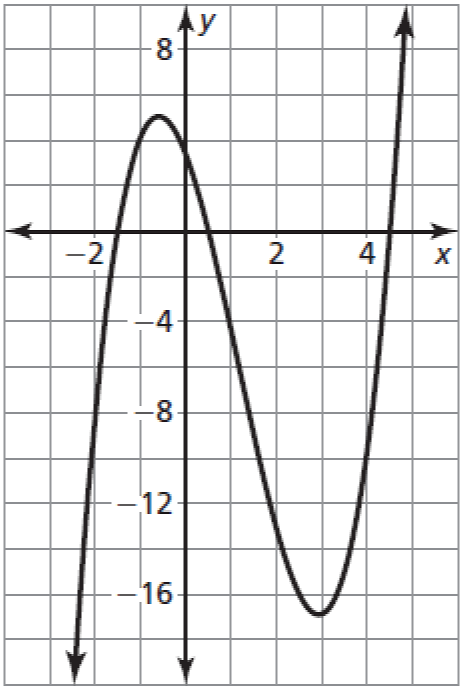
c. 2.94 in. by 14.11 in. by 10.11 in.

53. a. $\dfrac{1100 - \pi r^2}{\pi r}$

b. $V = 550r - \dfrac{\pi}{2}r^3$

c. about 10.8 ft

54. *Sample answer:* $x^3 - 3.5x^2 - 5.25x + 3.375$



There is no maximum degree; The function could have repeated zeros or infinitely many imaginary zeros.

55. $V(h) = 64\pi h - \frac{\pi}{4}h^3$; about 9.24 in.; about 1238.22 in.^{3}

pp. 223-224 (#3-12, x3; #13-23)

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

6. $f(x) = \frac{1}{6}(x + 3)(x + 6)(x - 3)$

9. $4; f(x) = -3x^4 - 5x^3 + 9x^2 + 3x - 1$

12. $4; f(x) = -x^4 + 13x^3 - 58x^2 + 104x - 58$

17. $y = 0.002x^2 + 0.60x - 2.5$; about 15.9 mph

14.

n	1	2	3	4	5
$f(n)$	1	5	12	22	35

4 7 10 13

3 3 3

15. *Sample answer:*

$$y = (x - 3)(x - 4)(x + 1),$$
$$y = 3(x - 3)(x - 4)(x - 1),$$
$$y = \frac{1}{2}(x - 3)(x - 4)(x + 4);$$
$$y = a(x - 3)(x - 4)(x - c)$$
$$6 = a(2 - 3)(2 - 4)(2 - c)$$
$$6 = 2a(2 - c)$$
$$3 = a(2 - c)$$
$$\frac{3}{2 - c} = a$$

Any combination of a and c that fit the equation will contain these points.

16. $y = -0.22x^2 + 6.4x + 10$; about 27 years old

17. $0.002x^2 + 0.601x - 2.493$; about 15.9 mph

18. **a.** a cubic function; The data rises, but not linearly. The end behavior models that of a cubic function.

b. The third set of finite differences; It appears to be a cubic function.

19. $d = \frac{1}{2}n^2 - \frac{3}{2}n$; 35

20. no; If the first order differences are given, they can be used to find the second order differences, and so on, until the differences are constant.

21. With real-life data sets, the numbers rarely fit a model perfectly. Because of this, the differences are rarely constant.

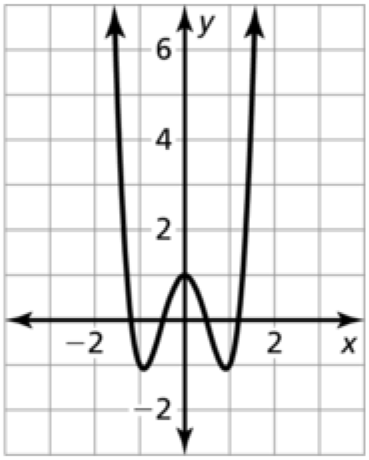
22. *Sample answer:* $A = 2, B = 1, C = 5$;
$f(x) = (x - 1)(x - 2)(x - 5)$

23. C, A, B, D

pp. 226-230 (#2-38 evens; #40-44)

2. not a polynomial

4.



6. $4x^3 - 4x^2 - 4x - 8$

8. $2x^2 + 11x + 1$

10. $8m^3 + 12m^2n + 6mn^2 + n^3$

12. $m^4 + 16m^3 + 96m^2 + 256m + 256$

14. $z^6 + 6z^5 + 15z^4 + 20z^3 + 15z^2 + 6z + 1$

16. $x^2 + 2x - 10 + \dfrac{7x + 43}{x^2 + x + 4}$

18. $g(5) = 546$

20. $2z(z^2 - 5)(z - 1)(z + 1)$

22.

−2	1	2	0	−27	−54
		−2	0	0	54
	1	0	0	−27	0

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

24. $x = -4$, $x = -3$, and $x = 2$

26. $f(x) = x^4 - 5x^3 + x^2 + 25x - 30$

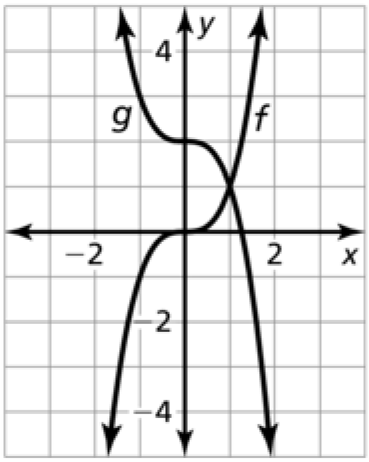
28. The length is 6 inches, the width is 2 inches, and the height is 20 inches; When $\ell(\ell - 4)(3\ell + 2) = 240$, $\ell = 6$

30. $f(x) = x^4 - x^3 + 14x^2 - 16x - 32$

32.

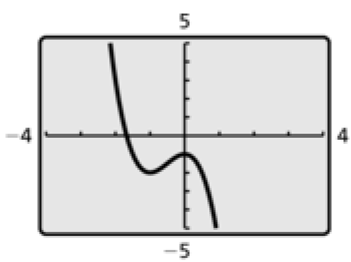
Positive real zeros	Negative real zeros	Imaginary zeros	Total zeros
2	0	2	4
0	0	4	4

34. The graph of g is a reflection in the y-axis followed by a translation 2 units up of the graph of f.



36. $g(x) = \frac{1}{1024}(x - 3)^5 + \frac{3}{4}(x - 3) - 5$

38.



The x-intercept of the graph is $x \approx -1.68$. The function has a local maximum at $(0, -1)$ and a local minimum at $(-1, -2)$; The function is increasing when $-1 < x < 0$ and decreasing when $x < 1$ and $x > 0$.

40. odd

41. even

42. neither

43. $f(x) = \frac{3}{16}(x + 4)(x - 4)(x - 2)$

44. 3; $f(x) = 2x^3 - 7x^2 - 6x$