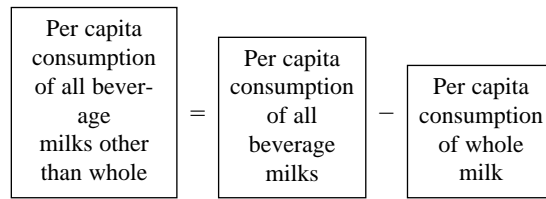


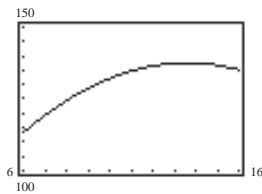
107. (a) Verbal model:



Equation:

$$\begin{aligned}
 y &= (231.06 + 0.009t - 0.095t^2) - (171.17 - 11.415t + 0.325t^2) \\
 y &= 231.06 + 0.009t - 0.095t^2 + (-171.17 + 11.415t - 0.325t^2) \\
 &= (231.06 - 171.17) + (0.009t + 11.415t) + (-0.095t^2 - 0.325t^2) \\
 &= 59.89 + 11.424t - 0.42t^2 \\
 &= -0.42t^2 + 11.424t + 59.89
 \end{aligned}$$

(b) Keystrokes:

 $\boxed{Y=}$ 59.89 $\boxed{+}$ 11.4141 $\boxed{X,T,\theta}$ $\boxed{-}$.42 $\boxed{X,T,\theta}$ $\boxed{x^2}$ $\boxed{\text{GRAPH}}$
No, this model was increasing over the interval $6 \leq t \leq 13.6$.109. The degree of the term ax^k is k . The term of highest degree in a polynomial has the same degree as the polynomial.

111. $8x^2 - 3x^2 = (8 - 3)x^2 = 5x^2$

113. No, not every trinomial is a second-degree polynomial. For example, $x^3 + 2x + 3$ is a trinomial of third-degree.

Section 3.2 Multiplying Polynomials

1. $t^3 \cdot t^4 = (t \cdot t \cdot t)(t \cdot t \cdot t \cdot t) = t^{3+4} = t^7$

$$\begin{aligned}
 3. \quad (-5x)^5 &= -5x \cdot -5x \cdot -5x \cdot -5x \cdot -5x \\
 &= -5 \cdot -5 \cdot -5 \cdot -5 \cdot -5 \cdot x \cdot x \cdot x \cdot x \cdot x \\
 &= (-5)^5 x^5 = -3125x^5
 \end{aligned}$$

$$\begin{aligned}
 5. \quad (u^4)^2 &= u^4 \cdot u^4 \\
 &= u^{4+4} \\
 &= u^8
 \end{aligned}$$

7. $\frac{x^6}{x^4} = \frac{x \cdot x \cdot x \cdot x \cdot x \cdot x}{x \cdot x \cdot x \cdot x} = x^{6-4} = x^2$

9. $\left(\frac{y}{5}\right)^4 = \frac{y}{5} \cdot \frac{y}{5} \cdot \frac{y}{5} \cdot \frac{y}{5} = \frac{y \cdot y \cdot y \cdot y}{5 \cdot 5 \cdot 5 \cdot 5} = \frac{y^4}{5^4} = \frac{y^4}{625}$

11. (a) $-3x^3 \cdot x^5 = -3(x^3 \cdot x^5) = -3x^{3+5} = -3x^8$

(b) $(-3x)^2 \cdot x^5 = 9x^2 \cdot x^5 = 9x^{2+5} = 9x^7$

13. (a) $(-5z^2)^3 = (-5)^3 \cdot (z^2)^3 = -125z^{2 \cdot 3} = -125z^6$

(b) $(-5z^4)^2 = (-5)^2(z^4)^2 = 25z^{4 \cdot 2} = 25z^8$

15. (a) $(u^3v)(2v^2) = 2 \cdot u^3 \cdot v^{1+2} = 2u^3v^3$

(b) $(-4u^4)(u^5v) = -4 \cdot u^{4+5} \cdot v = -4u^9v$

17. (a) $5u^2 \cdot (-3u^6) = 5 \cdot -3 \cdot u^2 \cdot u^6 = -15u^{2+6} = -15u^8$

(b) $(2u)^4(4u) = 2^4u^4 \cdot 4u = 16 \cdot 4 \cdot u^{4+1} = 64u^5$

19. (a) $-(m^5n)^3(-m^2n^2)^2 = -m^{5 \cdot 3}n^3 \cdot m^{2 \cdot 2}n^{2 \cdot 2}$

$$= -m^{15}n^3 \cdot m^4n^4$$

$$= -m^{15+4} \cdot n^{3+4} = -m^{19}n^7$$

(b) $(-m^5n)(m^2n^2) = -m^{5+2}n^{1+2} = -m^7n^3$

21. (a) $\frac{27m^5n^6}{9mn^3} = \frac{27}{9} \cdot \frac{m^5}{m} \cdot \frac{n^6}{n^3}$
 $= 3 \cdot m^{5-1} \cdot n^{6-3}$
 $= 3m^4n^3$

(b) $\frac{-18m^3n^6}{-6mn^3} = \frac{-18}{-6} \cdot \frac{m^3}{m} \cdot \frac{n^6}{n^3}$
 $= 3 \cdot m^{3-1} \cdot n^{6-3}$
 $= 3m^2n^3$

23. (a) $\left(\frac{3x}{4y}\right)^2 = \frac{3^2 \cdot x^2}{4^2 \cdot y^2}$
 $= \frac{9x^2}{16y^2}$

(b) $\left(\frac{5u}{3v}\right)^3 = \frac{5^3 \cdot u^3}{3^3 \cdot v^3}$
 $= \frac{125u^3}{27v^3}$

25. (a) $-\frac{(-3x^2y)^3}{9x^2y^2} = -\frac{(-3)^3(x^2)^3y^3}{9x^2y^2}$
 $= -\frac{(-27)x^6y^3}{9x^2y^2}$
 $= \frac{27x^{6-2}y^{3-2}}{9}$
 $= 3x^4y$

(b) $-\frac{(-2xy^3)^2}{6y^2} = -\frac{(-2)^2x^2(y^3)^2}{6y^2}$
 $= -\frac{4x^2y^6}{6y^2}$
 $= -\frac{2x^2y^{6-2}}{3}$
 $= -\frac{2x^2y^4}{3}$

27. (a) $\left[\frac{(-5u^3v)^2}{10u^2v}\right]^2 = \left[\frac{(-5)^2 \cdot (u^3)^2 \cdot (v)^2}{10u^2v}\right]^2$
 $= \left[\frac{25u^6v^2}{10u^2v}\right]^2$
 $= \left[\frac{25}{10} \cdot \frac{u^6}{u^2} \cdot \frac{v^2}{v}\right]^2$
 $= \left[\frac{5}{2} \cdot u^{6-2} \cdot v^{2-1}\right]^2$
 $= \left[\frac{5}{2}u^4v\right]^2$
 $= \frac{25}{4}u^8v^2$

(a) $\left[\frac{-5(u^3v)^2}{10u^2v}\right]^2 = \left[\frac{-5 \cdot (u^3)^2 \cdot (v)^2}{10u^2v}\right]^2$
 $= \left[\frac{-5u^6v^2}{10u^2v}\right]^2$
 $= \left[\frac{-5}{10} \cdot \frac{u^6}{u^2} \cdot \frac{v^2}{v}\right]^2$
 $= \left[-\frac{1}{2} \cdot u^{6-2} \cdot v^{2-1}\right]^2$
 $= \left[-\frac{1}{2}u^4v\right]^2$
 $= \frac{1}{4}u^8v^2$

$$29. \text{ (a) } \frac{x^{2n+4}y^{4n}}{x^5y^{2n+1}} = x^{2n+4-5}y^{4n-(2n+1)} = x^{2n-1}y^{4n-2n-1} = x^{2n-1}y^{2n-1}$$

$$\text{ (b) } \frac{x^{6n}y^{n-7}}{x^{4n+2}y^5} = x^{6n-(4n+2)}y^{n-7-5} = x^{6n-4n-2}y^{n-12} = x^{2n-2}y^{n-12}$$

$$31. (-2a^2)(-8a) = (-2)(-8)a^2 \cdot a = 16a^{2+1} = 16a^3$$

$$33. 2y(5 - y) = (2y)(5) - (2y)(y) = 10y - 2y^2$$

$$35. 4x(2x^2 - 3x + 5) = (4x)(2x^2) - (4x)(3x) + (4x)(5) = 8x^3 - 12x^2 + 20x$$

$$37. -2x^2(5 + 3x^2 - 7x^3) = (-2x^2)(5) + (-2x^2)(3x^2) - (-2x^2)(7x^3) = -10x^2 - 6x^4 + 14x^5$$

$$39. -x^3(x^4 - 2x^3 + 5x - 6) = -x^3(x^4) - x^3(-2x^3) - x^3(5x) - x^3(-6) = -x^7 + 2x^6 - 5x^4 + 6x^3$$

$$41. -3x(-5x)(5x + 2) = (-3x)(-5x)(5x + 2) = 15x^2(5x + 2) = 15x^2(5x) + 15x^2(2) = 75x^3 + 30x^2$$

$$43. u^2v(3u^4 - 5u^2 + 6uv^3) = u^2v(3u^4) + u^2v(-5u^2) + u^2v(6uv^3) = 3u^6v - 5u^4v + 6u^3v^4$$

$$45. (x + 2)(x + 4) = x^2 + 4x + 2x + 8 = x^2 + 6x + 8$$

$$47. (x - 6)(x + 5) = x^2 + 5x - 6x - 30 = x^2 - x - 30$$

$$49. (x - 4)(x - 4) = x^2 - 4x - 4x + 16 = x^2 - 8x + 16$$

$$51. (2x - 3)(x + 5) = 2x^2 + 10x - 3x - 15 = 2x^2 + 7x - 15$$

$$53. (5x - 2)(2x - 6) = 10x^2 - 30x - 4x + 12 = 10x^2 - 34x + 12$$

$$55. (8 - 3x^2)(4x + 1) = 32x + 8 - 12x^3 - 3x^2 = -12x^3 - 3x^2 + 32x + 8$$

$$57. \left(4y - \frac{1}{3}\right)(12y + 9) = 48y^2 + 36y - 4y - 3 = 48y^2 + 32y - 3$$

$$59. (2x + y)(3x + 2y) = 6x^2 + 4xy + 3xy + 2y^2 = 6x^2 + 7xy + 2y^2$$

$$61. (2t - 1)(t + 1) + 1(2t - 5)(t - 1) = 2t^2 + 2t - t - 1 + 2t^2 - 2t - 5t + 5 = 4t^2 - 6t + 4$$

$$\begin{aligned} 63. (x - 1)(x^2 - 4x + 6) &= (x - 1)(x^2) + (x - 1)(-4x) + (x - 1)(6) \\ &= x^3 - x^2 - 4x^2 + 4x + 6x - 6 \\ &= x^3 - 5x^2 + 10x - 6 \end{aligned}$$

$$\begin{aligned} 65. (3a + 2)(a^2 + 3a + 1) &= (3a + 2)(a^2) + (3a + 2)(3a) + (3a + 2)(1) \\ &= 3a^3 + 2a^2 + 9a^2 + 6a + 3a + 2 \\ &= 3a^3 + 11a^2 + 9a + 2 \end{aligned}$$

$$103. (2x + 5)^2 = (2x)^2 + 2(2x)(5) + (5)^2 = 4x^2 + 20x + 25 \quad 105. (6x - 1)^2 = (6x)^2 - 2(6x)(1) + (1)^2 = 36x^2 - 12x + 1$$

$$107. (2x - 7y)^2 = (2x)^2 - 2(2x)(7y) + (7y)^2 = 4x^2 - 28xy + 49y^2$$

$$109. [(x + 2) + y]^2 = (x + 2)^2 + 2(x + 2)y + y^2 = (x^2 + 2(x)(2) + (2)^2) + 2xy + 4y + y^2 = x^2 + 4x + 4 + 2xy + 4y + y^2$$

$$111. [u - (v - 3)][u + (v - 3)] = (u)^2 - (v - 3)^2 = u^2 - [v^2 - 2(v)(3) + (3)^2] = u^2 - (v^2 - 6v + 9) = u^2 - v^2 + 6v - 9$$

$$113. (x + 3)^3 = (x + 3)(x + 3)(x + 3) \\ = (x^2 + 3x + 3x + 9)(x + 3) \\ = (x^2 + 6x + 9)(x + 3)$$

$$\begin{array}{r} x^2 + 6x + 9 \\ \underline{ x + 3} \\ 3x^2 + 18x + 27 \\ \underline{ x^3 + 6x^2 + 9x} \\ x^3 + 9x^2 + 27x + 27 \end{array}$$

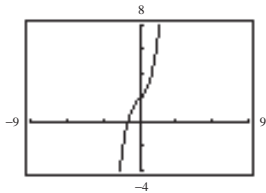
$$115. (u + v)^3 = (u + v)(u + v)(u + v) \\ = (u^2 + uv + uv + v^2)(u + v) \\ = (u^2 + 2uv + v^2)(u + v)$$

$$\begin{array}{r} u^2 + 2uv + v^2 \\ \underline{ u + v} \\ u^2v + 2uv^2 + v^3 \\ \underline{ u^3 + 2u^2v + uv^2} \\ u^3 + 3u^2v + 3uv^2 + v^3 \end{array}$$

117. Keystrokes:

$$y_1 \text{ [Y=] [C] [X,T,\theta] [+ 1] [)] [C] [X,T,\theta] [x^2] [-] [X,T,\theta] [+ 2] [)] [ENTER]$$

$$y_2 \text{ [X,T,\theta] [^] 3 [+] [X,T,\theta] [+ 2] [GRAPH]}$$

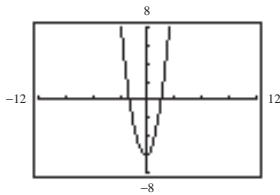


$$y_1 = y_2 \text{ because } (x + 1)(x^2 - x + 2) = x^3 - x^2 + 2x + x^2 - x + 2 = x^3 + x + 2$$

119. Keystrokes:

$$y_1 \text{ [Y=] [C] 2 [X,T,\theta] [-] 3 [)] [C] [X,T,\theta] [+ 2] [)] [ENTER]$$

$$y_2 \text{ 2 [X,T,\theta] [x^2] [+] [X,T,\theta] [-] 6 [GRAPH]}$$



$$y_1 = y_2 \text{ because } (2x - 3)(x + 2) = 2x^2 + 4x - 3x - 6 = 2x^2 + x - 6$$

$$121. (a) f(t - 3) = (t - 3)^2 - 2(t - 3) \\ = t^2 - 6t + 9 - 2t + 6 \\ = t^2 - 8t + 15$$

$$(b) f(2 + h) - f(2) = [(2 + h)^2 - 2(2 + h)] - [2^2 - 2(2)] \\ = (4 + 4h + h^2 - 4 - 2h) - (0) \\ = 2h + h^2$$

123. (a) Verbal model: $\boxed{\text{Volume}} = \boxed{\text{Length}} \cdot \boxed{\text{Width}} \cdot \boxed{\text{Height}}$

Function:
$$\begin{aligned} V(n) &= n \cdot (n + 2) \cdot (n + 4) \\ &= n(n^2 + 6n + 8) \\ &= n^3 + 6n^2 + 8n \end{aligned}$$

(b)
$$\begin{aligned} V(2) &= 2 \cdot (2 + 2) \cdot (2 + 4) \\ &= 2(4)(6) \\ &= 48 \text{ cubic inches} \end{aligned}$$

(c) Verbal model: $\boxed{\text{Area}} = \boxed{\text{Length}} \cdot \boxed{\text{Width}}$

Function:
$$\begin{aligned} A(n) &= n \cdot (n + 2) \\ &= n^2 + 2n \end{aligned}$$

(d) Function:
$$\begin{aligned} \text{Area} &= (n + 4)(n + 2 + 4) \\ &= (n + 4)(n + 6) \\ &= n^2 + 6n + 4n + 24 \\ &= n^2 + 10n + 24 = A(n + 4) \\ A(n + 4) &= (n + 4)(n + 4 + 2) \\ &= (n + 4)(n + 6) \\ &= n^2 + 10n + 24 \end{aligned}$$

125. Verbal model:

$$\boxed{\text{Area of Shaded Region}} = \boxed{\text{Area of Outside Rectangle}} - \boxed{\text{Area of Inside Rectangle}}$$

Function:
$$\begin{aligned} A(x) &= 3x(3x + 10) - x(x + 4) \\ &= 9x^2 + 30x - x^2 - 4x \\ &= 8x^2 + 26x \end{aligned}$$

127. Verbal model:

$$\boxed{\text{Area of Shaded Region}} = \boxed{\text{Area of Larger Triangle}} - \boxed{\text{Area of Smaller Triangle}}$$

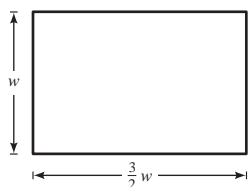
Function:
$$\begin{aligned} A(x) &= \frac{1}{2}(2x)(1.6x) - \frac{1}{2}(x)(0.8x) \\ &= 1.6x^2 - 0.4x^2 \\ &= 1.2x^2 \end{aligned}$$

129. (a) Verbal model:

$$\boxed{\text{Perimeter}} = 2 \boxed{\text{Length}} + 2 \boxed{\text{Width}}$$

$$\begin{aligned} P &= 2\left(\frac{3}{2}w\right) + 2w \\ &= 3w + 2w \end{aligned}$$

$$P = 5w$$



(b) Verbal model:

$$\boxed{\text{Area}} = \boxed{\text{Length}} \cdot \boxed{\text{Width}}$$

$$A = \left(\frac{3}{2}w\right)(w)$$

$$A = \frac{3}{2}w^2$$

$$\begin{aligned}
 131. \text{ Interest} &= 1000(1+r)^2 \\
 &= 1000(1+r)(1+r) \\
 &= 1000(1+2r+r^2) \\
 &= 1000 + 2000r + 1000r^2
 \end{aligned}$$

$$\begin{aligned}
 133. \text{ Area} &= l \cdot w \\
 &= (x+a)(x+b) \\
 &= x^2 + ax + bx + ab \\
 \text{Area} &= (x \cdot x) + (x \cdot a) + (x \cdot b) + (a \cdot b) \\
 &= x^2 + ax + bx + ab \\
 \text{Formula: } &(x+a)(x+b) = x^2 + ax + bx + ab. \\
 &\text{Distributive Property}
 \end{aligned}$$

$$\begin{aligned}
 135. \text{ (a) } &(x-1)(x+1) = x^2 - 1 \\
 \text{(b) } &(x-1)(x^2+x+1) = x^3 + x^2 + x - x^2 - x - 1 = x^3 - 1 \\
 \text{(c) } &(x-1)(x^3+x^2+x+1) = x^4 + x^3 + x^2 + x - x^3 - x^2 - x - 1 = x^4 - 1 \\
 &(x-1)(x^4+x^3+x^2+x+1) = x^5 - 1
 \end{aligned}$$

$$137. \text{ (a) Verbal model: } \boxed{\text{Volume}} = \boxed{\text{Length}} \cdot \boxed{\text{Width}} \cdot \boxed{\text{Height}}$$

$$\begin{aligned}
 \text{Labels:} \quad &\text{Volume} = V_B(x) \\
 &\text{Length} = 3x - 2 \\
 &\text{Width} = x + 5 \\
 &\text{Height} = x \\
 \text{Function:} \quad &V_B(x) = (3x - 2)(x + 5)x \\
 &= (3x^2 + 15x - 2x - 10)x \\
 &= (3x^2 + 13x - 10)x \\
 &= 3x^3 + 13x^2 - 10x
 \end{aligned}$$

$$\text{(b) Verbal model: } \boxed{\text{Volume}} = \frac{1}{3} \cdot \boxed{\text{Area of base}} \cdot \boxed{\text{Height}}$$

$$\begin{aligned}
 \text{Labels:} \quad &\text{Volume} = V_P(x) \\
 &\text{Area of base} = (2x - 6)(x - 1) \\
 &\text{Height} = x - 3 \\
 \text{Function:} \quad &V_P(x) = \frac{1}{3}(2x - 6)(x - 1)(x - 3) \\
 &= \frac{1}{3}(2x^2 - 8x + 6)(x - 3) \\
 &= \frac{1}{3}(2x^3 - 8x^2 + 6x - 6x^2 + 24x - 18) \\
 &= \frac{1}{3}(2x^3 - 14x^2 + 30x - 18) \\
 &= \frac{2}{3}x^3 - \frac{14}{3}x^2 + 10x - 6
 \end{aligned}$$

$$\text{(c) Verbal model: } \boxed{\text{Volume of grain}} = \boxed{\text{Volume of bin}} - \boxed{\text{Volume of pyramid}}$$

$$\begin{aligned}
 \text{Function:} \quad &V_S(x) = (3x^3 + 13x^2 - 10x) - \left(\frac{2}{3}x^3 - \frac{14}{3}x^2 + 10x - 6\right) \\
 &= 3x^3 + 13x^2 - 10x - \frac{2}{3}x^3 + \frac{14}{3}x^2 - 10x + 6 \\
 &= \frac{7}{3}x^3 + \frac{53}{3}x^2 - 20x + 6
 \end{aligned}$$

139. $(2x)^3 = 2^3 \cdot x^3 = 8x^3 \neq 2x^3$

141. F = First

O = Outer

I = Inner

L = Last

143. (a) True, the product of two monomials is a monomial.

(b) False, the product of two binomials can be a trinomial. For example, $(x + 2)(x - 3) = x^2 - x - 6$.**Section 3.3 Factoring Polynomials**

1. $48 = 2^4 \cdot 3$

$90 = 5 \cdot 2 \cdot 3^2$

$96 = 2^5 \cdot 3$

GCF = $2 \cdot 3 = 6$

3. $3x^2 = 3 \cdot x \cdot x$

$12x = 2^2 \cdot 3 \cdot x$

GCF = $3x$

5. $30z^2 = 2 \cdot 3 \cdot 5 \cdot z \cdot z$

$-12z^3 = -1 \cdot 2^2 \cdot 3 \cdot z \cdot z \cdot z$

GCF = $2 \cdot 3 \cdot z \cdot z$

$= 6z^2$

7. $28b^2 = 7 \cdot 2^2 \cdot b \cdot b$

$14b^3 = 7 \cdot 2 \cdot b \cdot b \cdot b$

$42b^5 = 7 \cdot 2 \cdot 3 \cdot b \cdot b \cdot b \cdot b \cdot b$

GCF = $7 \cdot 2 \cdot b \cdot b$

$= 14b^2$

9. $42(x + 8)^2 = 7 \cdot 3 \cdot 2 \cdot (x + 8)^2$

$63(x + 8)^3 = 7 \cdot 3^2 \cdot (x + 8)^3$

GCF = $7 \cdot 3(x + 8)^2$

$= 21(x + 8)^2$

11. $8z - 8 = 8(z - 1)$

13. $4u + 10 = 2(2u + 5)$

15. $24x^2 - 18 = 6(4x^2 - 3)$

17. $2x^2 + x = x(2x + 1)$

19. $21u^2 - 14u = 7u(3u - 2)$

21. $11u^2 + 9$ is prime (No common factor other than 1.)

23. $28x^2 + 16x - 8 = 4(7x^2 + 4x - 2)$

25. $3x^2y^2 - 15y = 3y(x^2y - 5)$

27. $15xy^2 - 3x^2y + 9xy = 3xy(5y - x + 3)$

29. $14x^4y^3 + 21x^3y^2 + 9x^2 = x^2(14x^2y^3 + 21xy^2 + 9)$

31. $10 - x = -1(-10 + x) = -1(x - 10)$

33. $7 - 14x = -7(-1 + 2x) = -7(2x - 1)$

35. $16 + 4x - 6x^2 = -1(-16 - 4x + 6x^2) = -1(6x^2 - 4x - 16) = -2(3x^2 - 2x - 8)$

37. $y - 3y^3 - 2y^2 = -1(-y + 3y^3 + 2y^2) = -1(3y^3 + 2y^2 - y) = -y(3y^2 + 2y - 1)$

39. $2y - \frac{3}{5} = \frac{1}{5}(10y - 3)$

41. $\frac{3}{2}x + \frac{5}{4} = \frac{1}{4}(6x + 5)$

43. $2y(y - 3) + 5(y - 3) = (y - 3)(2y + 5)$

45. $5x(3x + 2) - 3(3x + 2) = (3x + 2)(5x - 3)$

47. $2(7a + 6) - 3a^2(7a + 6) = (7a + 6)(2 - 3a^2)$

49. $8t^3(4t - 1)^2 + 3(4t - 1)^2 = (4t - 1)^2(8t^3 + 3)$