

Chapter 3 Factors and Products, page 132

### 3.1 Factors and Multiples of Whole Numbers, page 140



- 14.** The greatest common factor of the two numbers is 1.  
37                          17

15. a)  $\frac{57}{17}$

- 65 19

- c)  $\frac{13}{}$

- 18

- e)  $\frac{49}{110}$

- c)  $\frac{13}{18}$       d)  $\frac{42}{61}$   
 e)  $\frac{49}{110}$       f)  $\frac{33}{17}$

- 16. a)**  $\frac{149}{112}$

**b)**  $\frac{65}{60}$ , or  $\frac{13}{12}$

**c)**  $\frac{43}{264}$

**d)**  $\frac{304}{210}$ , or  $\frac{152}{105}$

**e)**  $\frac{121}{600}$

**f)**  $\frac{239}{90}$

**g)**  $\frac{27}{20}$

**h)**  $\frac{77}{12}$

- 17.** 800 m

**18.** No; 1 does not have any prime factors.

**19. a)** 72 cm by 72 cm      **b)** Yes

**20. a)** Yes      **b)** Yes  
**c)** 660 feet

**21.** Yes

**22.** 30 cm

### 3.2 Perfect Squares, Perfect Cubes, and Their Roots, page 146

16. Edge length: 6 units

17. a)  $11x^2y$

18.  $1^3 + 12^3, 9^3 + 10^3$

**Chapter 3: Checkpoint 1, page 149**

1. a)  $2^2 \cdot 3^2 \cdot 5 \cdot 7$

c)  $2^3 \cdot 3^2 \cdot 5 \cdot 17$

e)  $2^4 \cdot 3^3 \cdot 7$

2. a)  $2^3$ , or 8

c) 5

e)  $2^3$ , or 8

3. a)  $2^2 \cdot 3 \cdot 5 \cdot 7$ , or 420

b)  $2^5 \cdot 3 \cdot 5$ , or 480

c)  $2^3 \cdot 3^2 \cdot 5$ , or 360

d)  $2^5 \cdot 3 \cdot 5$ , or 480

e)  $2^6 \cdot 7^2$ , or 3136

f)  $2 \cdot 3 \cdot 5^2 \cdot 11$ , or 1650

4. a)  $\frac{103}{33}$

c)  $\frac{27}{70}$

5. 18 980 days; 52 years

6. a) 20

c) 24

e) 39

7. a) 12

c) 20

e) 22

8. a) Neither

b) Perfect square

c) Perfect square and perfect cube

d) Perfect square

e) Perfect cube

f) Neither

9. a) Perfect squares: 400, 441, 484

b) Perfect squares: 900, 961; perfect cube: 1000

c) Perfect square: 1156

10. 26 cans

**3.3 Common Factors of a Polynomial, page 155**

Gray algebra tiles represent positive tiles and black tiles represent negative tiles.

4. a)  $3x + 12$ ;  $3, x + 4$

b)  $4x^2 + 10x$ ;  $2x, 2x + 5$

c)  $12x^2 - 8x + 16$ ;  $4, 3x^2 - 2x + 4$

5. a) 3

6. a) i)  $3(2 + 5n)$

iii)  $3(5n - 2)$

b) i)  $m(4 + m)$

iii)  $m(4 - m)$

b)  $m$

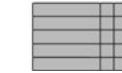
ii)  $3(2 - 5n)$

iv)  $3(-5n + 2)$

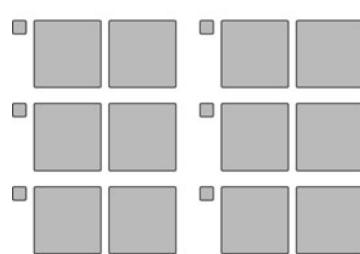
ii)  $m(m + 4)$

iv)  $m(m - 4)$

7. a)  $5(y + 2)$



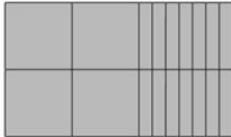
b)  $6(1 + 2x^2)$



c)  $3(3k + 2)$



d)  $2s(2s + 7)$



e)  $y(1 + y)$



f)  $h(3 + 7h)$



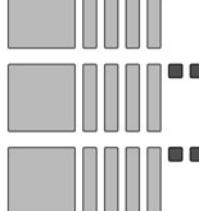
8. a)  $3b^2(3 - 4b)$

c)  $-a^2(1 + a)$

e)  $4y(2y^2 - 3)$

f)  $-7d(1 + 2d^3)$

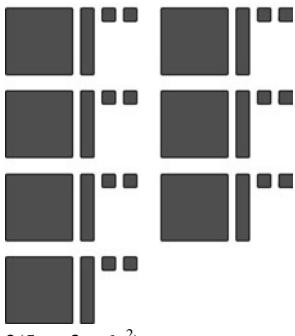
9. a)  $3(x^2 + 4x - 2)$



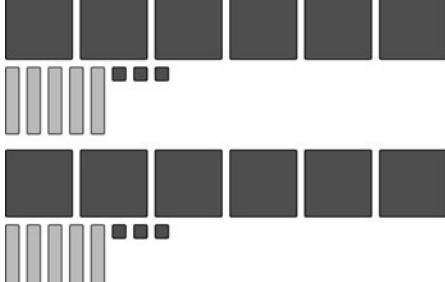
b)  $2(2 - 3y - 4y^2)$



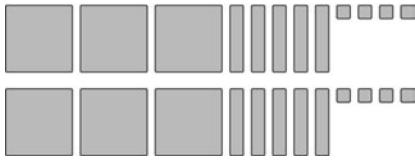
c)  $-7(m + m^2 + 2)$



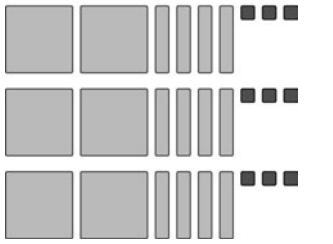
d)  $2(5n - 3 - 6n^2)$



e)  $2(4 + 5x + 3x^2)$



f)  $-3(3 - 4b - 2b^2)$



10. a)  $5(1 + 3m^2 - 2m^3)$

c)  $v(6v^3 + 7 - 8v^2)$

e)  $6x(4 + 5x - 2x^3)$

b)  $9(3n + 4 - 2n^3)$

d)  $-c^2(3 + 13c^2 + 12c)$

f)  $s(s^3 + s - 4)$

11. a)  $-12x^2 + 20x$

b)  $4x$  and  $(-3x + 5)$

c) The factors are the dimensions of the rectangle.

12. a) i)  $3m(m + 3m^2 - 1)$

ii)  $-4(4 - 2n + n^3)$

b) Expanded his solutions

13. The monomial is 1 when the term is the common factor.

The monomial is  $-1$  when the term has the opposite sign of the common factor.

14. a)  $4x - 4 = 4(x - 1)$

b)  $16m^2 - 24m - 16 = 8(2m^2 - 3m - 2)$

c)  $-8n^3 - 6n^2 - 10n = -2n(4n^2 + 3n + 5)$

15. a) i)  $2 \cdot 2 \cdot s \cdot t \cdot t$ , or  $4st^2$

ii)  $a \cdot a \cdot b$ , or  $a^2b$

iii)  $2 \cdot 2 \cdot 3 \cdot x \cdot x \cdot y \cdot y$ , or  $12x^2y^2$

b) i)  $4st^2(s + 3st + 9)$

ii)  $4st^2(3st - s - 9)$

iii)  $-a^2b(3a + 9a^2 - 8)$

iv)  $a^2b(9a^2 + 3a - 8)$

v)  $12x^2y^2(3y^2 + x + x^2y)$

vi)  $-12x^2y^2(3y^2 + x^2y + x)$

16. a)  $5x(5y + 3x - 6xy^2)$

b)  $3mn(17m + 13n - 24)$

c)  $3p^2q^2(3p^2 - 2pq + 4q^2)$

d)  $a^2b^2(10a + 12b^2 - 5)$

e)  $4cd(3d - 2 - 5c)$

f)  $7rs^2(r^2s + 2r - 3)$

17. a)  $SA = 2\pi r(r + h)$

b) Approximately  $2639 \text{ cm}^2$

18. a)  $SA = \pi r(r + s)$

b) Approximately  $679 \text{ cm}^2$

19. a) Assume the area of the base of the silo is not included in the surface area.  $SA = 2\pi rh + 2\pi r^2$ ;  $SA = 2\pi r(h + r)$ ; approximately  $603 \text{ m}^2$

b)  $V = \pi r^2 h + \frac{2}{3}\pi r^3$ ;  $V = \pi r^2 \left(h + \frac{2}{3}r\right)$ ; approximately  $1583 \text{ m}^3$

20. Yes

21. a)  $\frac{2\pi rh}{2\pi r^2 + 2\pi rh}$

b)  $\frac{h}{r+h}$

22. a) 2; 3

b)  $n - 3$

c)  $\frac{n^2}{2} - \frac{3n}{2} = \frac{n}{2}(n - 3)$

**3.4 Math Lab: Modelling Trinomials as Binomial Products, page 158**

1. a) Can be represented



- b) Can be represented



- c) Cannot be represented  
d) Cannot be represented  
e) Cannot be represented  
f) Cannot be represented

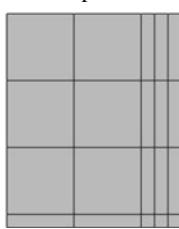
2. a) Can be represented



- b) Can be represented



- c) Cannot be represented  
d) Cannot be represented  
e) Cannot be represented  
f) Can be represented



3. 7, 8, 13

4. 4, 7, 9, 10

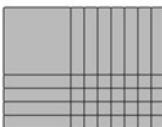
**3.5 Polynomials of the Form  $x^2 + bx + c$ , page 166**

4. a)  $(x+1)(x+3) = x^2 + 4x + 3$   
b)  $(x+2)(x+4) = x^2 + 6x + 8$   
c)  $(x+5)(x+5) = x^2 + 10x + 25$   
d)  $(x+3)(x+6) = x^2 + 9x + 18$

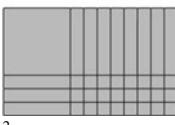
5. a)  $b^2 + 7b + 10$



b)  $n^2 + 11n + 28$



c)  $h^2 + 11h + 24$

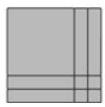


d)  $k^2 + 7k + 6$



6. a) i)  $x^2 + 4x + 4$

ii)



iii)  $(x+2)(x+2)$

b) i)  $x^2 + 5x + 4$

ii)



iii)  $(x+1)(x+4)$

c) i)  $x^2 + 6x + 8$

ii)



iii)  $(x+2)(x+4)$

d) i)  $x^2 + 7x + 12$

ii)



iii)  $(x+3)(x+4)$

- 7.** a) i) 1, 2      ii) 2, 3  
 iii) 1, 9      iv) 2, 5  
 v) 3, 4      vi) 3, 5  
 b) i)  $(v+1)(v+2)$       ii)  $(w+2)(w+3)$   
 iii)  $(s+1)(s+9)$       iv)  $(t+2)(t+5)$   
 v)  $(y+3)(y+4)$       vi)  $(h+3)(h+5)$

- 8. a)** i)  $(v+1)(v+1)$



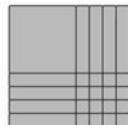
ii)  $(v+2)(v+2)$



iii)  $(v+3)(v+3)$



iv)  $(v+4)(v+4)$



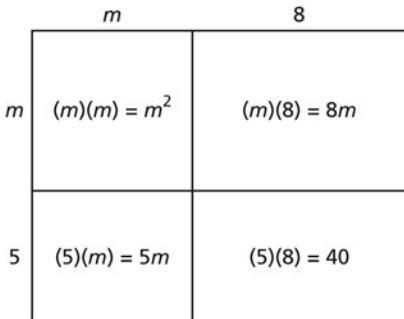
b) The rectangles are squares; the binomial factors are the same.

c)  $v^2 + 10v + 25 = (v+5)(v+5);$   
 $v^2 + 12v + 36 = (v+6)(v+6);$   
 $v^2 + 14v + 49 = (v+7)(v+7)$

- 9.** Area models and/or rectangle diagrams may vary.

For example:

a)  $m^2 + 13m + 40$



b)  $y^2 + 12y + 27$

$y$	$(y)(y) = y^2$	$(y)(3) = 3y$
9	$(9)(y) = 9y$	$(9)(3) = 27$

c)  $w^2 + 18w + 32$

$w$	$(w)(w) = w^2$	$(w)(16) = 16w$
2	$(2)(w) = 2w$	$(2)(16) = 32$

d)  $k^2 + 14k + 13$

$k$	$(k)(k) = k^2$	$(k)(1) = k$
13	$(13)(k) = 13k$	$(13)(1) = 13$

10. a)  $(w+3)(w+2) = w^2 + 5w + 6$

b)  $(x+5)(x+2) = x^2 + 7x + 10$

c)  $(y+10)(y+2) = y^2 + 12y + 20$

11. a)  $(x+4)(x+6)$

b)  $(m+2)(m+8)$

c)  $(p+1)(p+12)$

d)  $(s+2)(s+10)$

e)  $(n+1)(n+11)$

f)  $(h+2)(h+6)$

g)  $(q+1)(q+6)$

h)  $(b+2)(b+9)$

**12. a)**  $g^2 + 4g - 21$

$g$	7
$(g)(g) = g^2$	$(g)(7) = 7g$
$(-3)(g) = -3g$	$(-3)(7) = -21$

**b)**  $h^2 - 5h - 14$

$h$	-7
$(h)(h) = h^2$	$(h)(-7) = -7h$
$(2)(h) = 2h$	$(2)(-7) = -14$

**c)**  $22 - 13j + j^2$

2	-j
$(11)(2) = 22$	$(11)(-j) = -11j$
$(-j)(2) = -2j$	$(-j)(-j) = j^2$

**d)**  $k^2 + 8k - 33$

$k$	11
$(k)(k) = k^2$	$(k)(11) = 11k$
$(-3)(k) = -3k$	$(-3)(11) = -33$

**e)**  $84 - 5h - h^2$

7	-h
$(12)(7) = 84$	$(12)(-h) = -12h$
$(h)(7) = 7h$	$(h)(-h) = -h^2$

**f)**  $m^2 - 81$

$m$	9
$(m)(m) = m^2$	$(m)(9) = 9m$
$(-9)(m) = -9m$	$(-9)(9) = -81$

**g)**  $n^2 - 18n + 56$

$n$	-4
$(n)(n) = n^2$	$(n)(-4) = -4n$
$(-14)(n) = -14n$	$(-14)(-4) = 56$

**h)**  $p^2 - 11p - 102$

$p$	-17
$(p)(p) = p^2$	$(p)(-17) = -17p$
$(6)(p) = 6p$	$(6)(-17) = -102$

**13. a)**  $r^2 - 9r - 52$

**b)**  $s^2 - 20s + 75$

**14. a)**  $(b - 1)(b + 20)$

**b)**  $(t - 3)(t + 18)$

**c)**  $(x - 2)(x + 14)$

**d)**  $(n + 3)(n - 8)$

**e)**  $(a + 4)(a - 5)$

**f)**  $(y + 6)(y - 8)$

**g)**  $(m - 5)(m - 10)$

**h)**  $(a - 6)(a - 6)$

**15. a)**  $(1 + k)(12 + k)$

**b)**  $(2 + g)(-8 + g)$

**c)**  $(5 + y)(12 + y)$

**d)**  $(9 + z)(8 - z)$

**16. a) i)**  $x^2 + 3x + 2; 132$

**ii)**  $x^2 + 4x + 3; 143$

**b)** The coefficients of the terms of the polynomial are the digits in the product of integers.

**17. a)**  $(m + 5)(m - 12)$

**b)**  $(w - 5)(w - 9)$

**c)**  $(b - 3)(b + 12)$

**18. a) i)**  $t^2 + 11t + 28$

**ii)**  $t^2 - 11t + 28$

**iii)**  $t^2 + 3t - 28$

**iv)**  $t^2 - 3t - 28$

**b) i)** Because the constant terms in the binomials have the same sign

**ii)** Because the constant terms in the binomials have opposite signs

**iii)** Add the constant terms in the binomials

**19. a)**  $\pm 7, \pm 11; 4$  integers

**b)**  $0, \pm 8; 3$  integers

**c)**  $\pm 6, \pm 9; 4$  integers

**d)**  $\pm 1, \pm 4, \pm 11; 6$  integers

**e)**  $\pm 9, \pm 11, \pm 19; 6$  integers

**f)**  $0, \pm 6, \pm 15; 5$  integers

20. Infinitely many integers are possible. For example:

a)  $0, -2, -6, -12, -20, -30, \dots$

b)  $0, -2, -6, -12, -20, -30, \dots$

c)  $1, 0, -3, -8, -15, -24, -35, \dots$

d)  $1, 0, -3, -8, -15, -24, -35, \dots$

e)  $2, 0, -4, -10, -18, -28, -40, \dots$

f)  $2, 0, -4, -10, -18, -28, -40, \dots$

21. a)  $4(y-7)(y+2)$

b)  $-3(m+2)(m+4)$

c)  $4(x-3)(x+4)$

d)  $10(x+2)(x+6)$

e)  $-5(n-1)(n-7)$

f)  $7(c-2)(c-3)$

23. a) i)  $(h+2)(h-12)$

ii)  $(h-2)(h+12)$

iii)  $(h-4)(h-6)$

iv)  $(h+4)(h+6)$

b) The first 6 are:

$$h^2 \pm 13h \pm 30, h^2 \pm 15h \pm 54, h^2 \pm 17h \pm 60,$$

$$h^2 \pm 25h \pm 84, h^2 \pm 20h \pm 96, h^2 \pm 26h \pm 120$$

### 3.6 Polynomials of the Form $ax^2 + bx + c$ , page 177

5. a)  $(2m+1)(m+3) = 2m^2 + 7m + 3$

b)  $(3p+2)(p+4) = 3p^2 + 14p + 8$

c)  $(3w+1)(2w+1) = 6w^2 + 5w + 1$

d)  $(4v+3)(3v+2) = 12v^2 + 17v + 6$

6. a)  $2r^2 + 7r + 6$

b)  $3r^2 + 13r + 4$

c)  $6g^2 + 13g + 6$

d)  $8z^2 + 26z + 15$

e)  $9t^2 + 24t + 16$

f)  $4r^2 + 12r + 9$

7. a) i)  $2x^2 + 5x + 2$

ii)



iii)  $(2x+1)(x+2)$

b) i)  $3x^2 + 11x + 6$

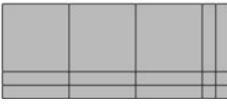
ii)



iii)  $(x+3)(3x+2)$

c) i)  $3x^2 + 8x + 4$

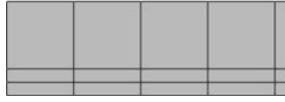
ii)



iii)  $(x+2)(3x+2)$

d) i)  $4x^2 + 9x + 2$

ii)



iii)  $(x+2)(4x+1)$

8. a)  $(2w+1)(w+6) = 2w^2 + 13w + 6$

b)  $(2g-5)(3g-3) = 6g^2 - 21g + 15$

c)  $(-4v-3)(-2v-7) = 8v^2 + 34v + 21$

9. a)  $15 + 23f + 4f^2$

b)  $15 - 29t + 12t^2$

c)  $90 + 11r - 2r^2$

d)  $36 - 24m + 4m^2$

e)  $-24 + 50x + 14x^2$

f)  $-36 + 60n - 25n^2$

10. a)  $6c^2 + 23c + 20$

b)  $-21t^2 - 32t + 5$

c)  $32r^2 + 48r - 14$

d)  $5t^2 + 46t + 9$

e)  $35h^2 + 29h - 30$

f)  $-36y^2 + 84y - 49$

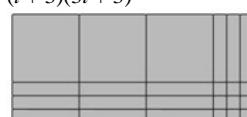
11. a) i)  $(t+1)(3t+1)$



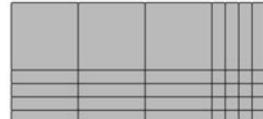
ii)  $(t+2)(3t+2)$



iii)  $(t+3)(3t+3)$



iv)  $(t+4)(3t+4)$



b) The side lengths increase by 1 each time; the constant terms in the binomial factors increase by 1 each time.

c)  $3t^2 + 20t + 25 = (t+5)(3t+5);$

$3t^2 + 24t + 36 = (t+6)(3t+6);$

$3t^2 + 28t + 49 = (t+7)(3t+7)$

12. a) i)  $(n+6)(2n+1)$

ii)  $(n-6)(2n-1)$

b) i)  $(n+6)(2n-1)$

ii)  $(n-6)(2n+1)$

c) i)  $(n+2)(2n+3)$

ii)  $(n-2)(2n-3)$

The trinomials in each pair have middle terms with the same value, but opposite signs. The constant terms in the binomial factors have opposite signs.

- 13.** a)  $(y+2)(2y+1)$   
 b)  $(a+4)(2a+3)$   
 c)  $(k+5)(2k+3)$   
 d)  $(m-4)(2m-3)$   
 e)  $(k-3)(2k-5)$   
 f)  $(m+7)(2m+1)$   
 g)  $(g+6)(2g+3)$   
 h)  $(n+6)(2n-3)$
- 14.** a) i) 1, 15  
 ii) 3, 5  
 iii) 1, 12  
 iv) 3, 4  
 v) 3, 8  
 vi) 1, 15  
 b) i)  $(v+5)(3v+1)$   
 ii)  $(m+4)(3m+2)$   
 iii)  $(b+1)(3b+5)$   
 iv)  $(a+1)(4a+3)$   
 v)  $(d+3)(4d+1)$   
 vi)  $(v+2)(4v+3)$
- 15.** a)  $(a-2)(5a+3)$   
 b)  $(y-5)(3y+2)$   
 c)  $(s+4)(5s-1)$   
 d)  $(2c-3)(7c+1)$   
 e)  $(2a+5)(4a-1)$   
 f)  $(2r-3)(4r-1)$   
 g)  $(d+1)(6d-5)$   
 h)  $(3e-2)(5e+1)$
- 16.** a)  $(2u+7)(3u-2)$   
 b)  $(3k-10)(k+3)$   
 c)  $(4v-5)(v-4)$
- 17.**  $(3g+7)(5g-6)$
- 18.** a)  $10(r+2)(2r+3)$   
 b)  $5(a-4)(3a-1)$   
 c)  $3(2h+3)(3h-2)$   
 d)  $6(2u-3)(2u-3)$   
 e)  $4(m-5)(3m+2)$   
 f)  $2(3g+5)(4g-7)$
- 19.** a)  $(2y-1)(7y-3)$   
 b)  $(p-2)(10p+3)$   
 c)  $(2r-7)(5r+1)$   
 d)  $(3g+1)(5g-2)$   
 e)  $(2x-3)(2x+5)$   
 f)  $(3d-4)(3d-4)$   
 g)  $(3t+2)(3t+2)$   
 h)  $(5y+2)(8y-3)$   
 i)  $(2c+3)(12c-5)$   
 j)  $(2x+5)(4x-3)$
- 20.** These answers do not include cases where there is a common constant factor among the terms of the polynomial.  
 a)  $\pm 7, \pm 8, \pm 13$ ; 6 integers  
 b)  $\pm 20, \pm 25, \pm 29, \pm 52, \pm 101$ ; 10 integers  
 c)  $\pm 3, \pm 15, \pm 25, \pm 53$ ; 8 integers  
 d)  $\pm 22, \pm 23, \pm 26, \pm 29, \pm 34, \pm 43, \pm 62, \pm 121$ ; 16 integers  
 e)  $\pm 6, \pm 10$ ; 4 integers  
 f)  $\pm 1$ ; 2 integers
- 21.** a) i)  $(r+1)(4r-5)$   
 ii) Cannot be factored  
 iii) Cannot be factored  
 iv)  $(w-2)(2w-1)$   
 v)  $(h-3)(3h+1)$   
 vi) Cannot be factored

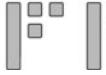
- 22.** a) i)  $(n+2)(3n+5)$   
 ii)  $(n-2)(3n-5)$   
 iii)  $(n+1)(3n+10)$   
 iv)  $(n-1)(3n-10)$   
 v)  $(n+5)(3n+2)$   
 vi)  $(n-5)(3n-2)$   
 b) Yes;  $3n^2 + 31n + 10$  and  $3n^2 - 31n + 10$
- 23.**  $9m^2 \pm 24m + 16, 9m^2 \pm 25m + 16, 9m^2 \pm 26m + 16,$   
 $9m^2 \pm 30m + 16, 9m^2 \pm 40m + 16, 9m^2 \pm 51m + 16,$   
 $9m^2 \pm 74m + 16, 9m^2 \pm 145m + 16$

### Chapter 3: Checkpoint 2, page 180

- 1.** a)  $6x+15$ ; 3 and  $(2x+5)$



- b)  $4x+12$ ; 4 and  $(x+3)$



2. a) i)  $4(a+2)$



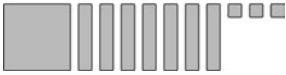
- ii)  $3(c-2)$



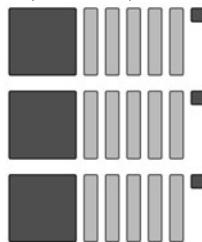
- iii)  $-v(2v+5)$



- iv)  $2(x^2 + 7x + 3)$

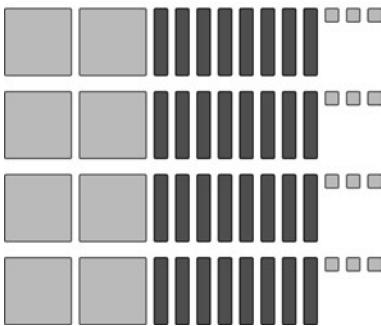


v)  $-3(r^2 - 5r + 1)$



vi)  $3a(5a^2 - ab - 2b^2)$

vii)  $4(3 - 8x + 2x^2)$



viii)  $4y(3x^2 - 2x - 4)$

b) The polynomials in part vi and part viii

3. Answers will vary. For example:

$$x^2 + 5x + 6 = (x + 3)(x + 2)$$



4. Answers will vary. For example:

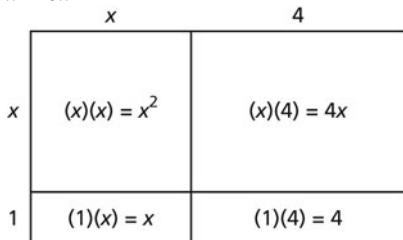
$$3x^2 + 10x + 8 = (x + 2)(3x + 4)$$



5. Area models and rectangle diagrams may vary.

For example:

a)  $x^2 + 5x + 4$



b)  $d^2 + d - 6$

$d$	3
$(d)(d) = d^2$	$(d)(3) = 3d$
$(-2)(d) = -2d$	$(-2)(3) = -6$

c)  $x^2 - 6x + 8$

$x$	-2
$(x)(x) = x^2$	$(x)(-2) = -2x$
$(-4)(x) = -4x$	$(-4)(-2) = 8$

d)  $30 - r - r^2$

6	$r$
$(5)(6) = 30$	$(5)(r) = 5r$
$(-r)(6) = -6r$	$(-r)(r) = -r^2$

e)  $g^2 + 4g - 5$

$g$	-1
$(g)(g) = g^2$	$(g)(-1) = -g$
$(5)(g) = 5g$	$(5)(-1) = -5$

f)  $20 - 12t + t^2$

10	$-t$
$(2)(10) = 20$	$(2)(-t) = -2t$
$(-t)(10) = -10t$	$(-t)(-t) = t^2$

6. a)  $(s + 5)(s + 6)$

c)  $(4 - b)(5 - b)$

e)  $(z + 3)(z + 10)$

7. a)  $3(x - 2)(x + 7)$

c)  $-(3 + m)(8 + m)$

8. a)  $2c^2 + 7c + 3$

c)  $9f^2 - 9f - 4$

e)  $30 - 8r - 6r^2$

9. a)  $(j + 4)(2j + 5)$

c)  $(k - 4)(5k - 3)$

e)  $(2y - 1)(4y + 1)$

b)  $(n + 5)(n - 6)$

d)  $-(1 + t)(11 - t)$

f)  $-(k - 3)(k - 6)$

b)  $-2(y - 3)(y - 8)$

d)  $(2 - y)(25 + y)$

b)  $-4m^2 + 21m - 5$

d)  $12z^2 - 20z + 3$

f)  $8 + 20h + 8h^2$

b)  $(v + 2)(3v - 5)$

d)  $(3h + 2)(3h + 4)$

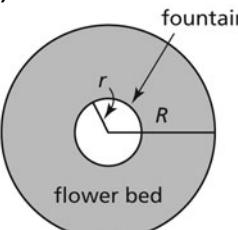
f)  $(3 - 4u)(2 - 5u)$

### 3.7 Multiplying Polynomials, page 186

4. a)  $g^3 + 3g^2 + 5g + 3$   
 b)  $2 + 7t + 6t^2 + 4t^3 + t^4$   
 c)  $2w^3 + 11w^2 + 26w + 21$   
 d)  $12 + 29n + 22n^2 + 8n^3 + n^4$
5. a)  $6z^2 + 5zy + y^2$   
 b)  $12f^2 + 4f - 25fg - 3g + 12g^2$   
 c)  $8a^2 + 22ab + 15b^2$   
 d)  $12a^2 + 4a - 31ab - 5b + 20b^2$   
 e)  $4r^2 + 4rs + s^2$   
 f)  $9t^2 - 12tu + 4u^2$
6. a) i)  $4x^2 + 4xy + y^2$   
 ii)  $25r^2 + 20rs + 4s^2$   
 iii)  $36c^2 + 60cd + 25d^2$   
 iv)  $25v^2 + 70vw + 49w^2$   
 v)  $4x^2 - 4xy + y^2$   
 vi)  $25r^2 - 20rs + 4s^2$   
 vii)  $36c^2 - 60cd + 25d^2$   
 viii)  $25v^2 - 70vw + 49w^2$   
 b) i)  $p^2 + 6pq + 9q^2$   
 ii)  $4s^2 - 28st + 49t^2$   
 iii)  $25g^2 + 40gh + 16h^2$   
 iv)  $100h^2 - 140hk + 49k^2$
7. a) i)  $x^2 - 4y^2$   
 ii)  $9r^2 - 16s^2$   
 iii)  $25c^2 - 9d^2$   
 iv)  $4v^2 - 49w^2$   
 b) i)  $121g^2 - 25h^2$   
 ii)  $625m^2 - 49n^2$
8. a)  $3y^3 + y^2 - 26y + 16$   
 b)  $4r^3 - 7r^2 - 14r - 3$   
 c)  $2b^3 + 17b^2 - 13b + 2$   
 d)  $3x^3 + 11x^2 - 39x - 7$
9. a)  $x^2 + 3x + 2xy + 3y + y^2$   
 b)  $x^2 + 3x + xy + 2y + 2$   
 c)  $a^2 + 2ab + b^2 + ac + bc$   
 d)  $3s + st + 5t + t^2 + 6$
10. a)  $x^2 - x - 2y - 4y^2$   
 b)  $2c^2 + 2c - cd - 3d - 3d^2$   
 c)  $a^2 - 4a - 3ab + 20b - 10b^2$   
 d)  $p^2 + 2pq - 8q^2 - pr + 2qr$
11.  $2r^2 - 13rs + 12r + 15s^2 - 18s$
12.  $x^3 + 10x^2 + 23x + 14$
13. a)  $4r^4 + 13r^3 + 12r^2 + 5r + 2$   
 b)  $2d^4 + 14d^3 + 19d^2 + 12d + 3$   
 c)  $-4c^4 + 26c^3 - c^2 - 22c - 6$   
 d)  $8n^4 - 18n^3 - 7n^2 + 16n - 3$
14.  $-3g^4 - 7g^3 + 10g^2 + 18g - 8$
15. a)  $9s^2 + 41s + 52$   
 b)  $13x^2 + 4x + 40$   
 c)  $18m^2 - 2m - 42mn - 4n$   
 d) 0  
 e)  $3x^2 - 28x + 10$   
 f)  $7a^2 + 2a - 7$
16. a)  $20 - 2x$   
 b)  $10 - 2x$   
 c)  $4x^2 - 60x + 200$   
 d)  $4x^3 - 60x^2 + 200x$
17. a)  $27x^2 + 43x + 16$   
 b)  $x^2 + 2x - 2$
18. a)  $x^3 - 6x^2 + 12x - 8$   
 b)  $8y^3 + 60y^2 + 150y + 125$   
 c)  $64a^3 - 144a^2b + 108ab^2 - 27b^3$   
 d)  $c^3 + 3c^2d + 3cd^2 + d^3$
19. a)  $12a^3 + 2a^2 - 4a$   
 b)  $-6r^3 + 3r^2 + 3r$   
 c)  $40x^4 - 50x^3 + 15x^2$   
 d)  $-8x^3y - 10x^2y + 25xy$   
 e)  $4b^3 + 2b^2c - 2bc^2$   
 f)  $y^6 - y^2$
20. a)  $(2x + 3)^3 = 8x^3 + 36x^2 + 54x + 27$   
 b)  $6(2x + 3)^2 = 24x^2 + 72x + 54$
21. a)  $6x^3 + 2x^2 - 128x - 160$   
 b)  $3b^3 - b^2 - 172b + 224$   
 c)  $18x^3 + 3x^2 - 88x - 80$   
 d)  $50a^3 - 235a^2 + 228a - 63$   
 e)  $8k^3 + 12k^2 - 18k - 27$
22. a)  $x^3 + 3x^2y + 3xy^2 + y^3 + 3x^2 + 6xy + 3y^2 + 3x + 3y + 1$   
 b)  $x^3 - 3x^2y + 3xy^2 - y^3 - 3x^2 + 6xy - 3y^2 + 3x - 3y - 1$   
 c)  $x^3 + 3x^2y + 3xy^2 + y^3 + 3x^2z + 6xyz + 3y^2z + 3xz^2 + 3yz^2 + z^3$   
 d)  $x^3 - 3x^2y + 3xy^2 - y^3 - 3x^2z + 6xyz - 3y^2z + 3xz^2 - 3yz^2 - z^3$

### 3.8 Factoring Special Polynomials, page 194

4. a)  $x^2 + 4x + 4$   
 b)  $9 - 6y + y^2$   
 c)  $25 + 10d + d^2$   
 d)  $49 - 14f + f^2$   
 e)  $x^2 - 4$   
 f)  $9 - y^2$   
 g)  $25 - d^2$   
 h)  $49 - f^2$
5. a) Difference of squares  
 b) Neither  
 c) Neither  
 d) Perfect square trinomial

- 6. a)**  $(x+7)(x-7)$       **b)**  $(b+11)(b-11)$   
**c)**  $(1+q)(1-q)$       **d)**  $(6+c)(6-c)$
- 7. a)** i)  $(a+5)^2$       ii)  $(b-6)^2$   
iii)  $(c+7)^2$       iv)  $(d-8)^2$   
v)  $(e+9)^2$       vi)  $(f-10)^2$
- b)**  $g^2 + 22g + 121 = (g+11)^2$ ;  
 $h^2 - 24h + 144 = (h-12)^2$ ;  
 $i^2 + 26i + 169 = (i+13)^2$ ;  
 $j^2 - 28j + 196 = (j-14)^2$
- 8. a)**  $(2x-3)^2$       **b)**  $(3+5n)^2$   
**c)**  $(9-2v)^2$       **d)**  $(5+4h)^2$   
**e)**  $(3g+8)^2$       **f)**  $(7r-2)^2$
- 9. a)**  $x^2; y^2; x^2-y^2$   
**b)**  $(x-y)$  and  $(x+y)$ ;  $(x-y)(x+y)$
- 10. a)**  $(3d+4f)(3d-4f)$   
**b)**  $(5s+8t)(5s-8t)$   
**c)**  $(12a+3b)(12a-3b)$ , or  $9(4a+b)(4a-b)$   
**d)**  $(11m+n)(11m-n)$   
**e)**  $(9k+7m)(9k-7m)$   
**f)**  $(10y+9z)(10y-9z)$   
**g)**  $(v+6t)(v-6t)$   
**h)**  $(2j+15h)(2j-15h)$
- 11. a)**  $(y+2z)(y+5z)$       **b)**  $(2w+3x)(2w-7x)$   
**c)**  $(3s-u)(4s-u)$       **d)**  $(t-v)(3t-4v)$   
**e)**  $(2r+3s)(5r-3s)$       **f)**  $(2p+7q)(4p-5q)$
- 12.** Trinomials in parts a, c, and d are perfect squares.  
**a)**  $(2x+7y)^2$       **b)**  $(3m-n)(5m+4n)$   
**c)**  $(4r+t)^2$       **d)**  $(3a-7b)^2$   
**e)**  $(3h+4k)(4h+3k)$       **f)**  $(3f-5g)(5f-2g)$
- 13. a)**  $8(m+3n)(m-3n)$   
**b)**  $2(2z+y)^2$   
**c)**  $3(2x+3y)(2x-3y)$   
**d)**  $2(2p+5q)^2$   
**e)**  $-3(2u-v)(4u+3v)$   
**f)**  $-2(3b+8c)(3b-8c)$
- 14. a)**
- 
- b)**  $\pi R^2 - \pi r^2 = \pi(R+r)(R-r)$   
**c)** Approximately 314 159 cm<sup>2</sup>
- 15. a)** i)  $\pm 14$       ii) 25  
iii) 9  
**b)** i) 2 integers      ii) 1 integer  
iii) 1 integer
- 16.**  $-2, -1, 0; -1, 0, 1; 2$  possibilities
- 17.** 39 999
- 18.**  $5x^2 + 34x + 24$
- 19. a)** i) Neither  
ii) Difference of squares  
iii) Difference of squares  
iv) Perfect square trinomial  
**b)** ii)  $(-10+r)(10+r)$   
iii)  $(9ab+1)(9ab-1)$   
iv)  $(4s^2+1)^2$
- 20. a)**  $(x+2)(x-2)(x+3)(x-3)$   
**b)**  $(a+1)(a-1)(a+4)(a-4)$   
**c)**  $(y+1)(y-1)(y+2)(y-2)$
- 21. a)**  $8(d+2e)(d-2e)$   
**b)**  $\frac{1}{4}(10m+n)(10m-n)$ , or  $\left(5m+\frac{1}{2}n\right)\left(5m-\frac{1}{2}n\right)$   
**c)**  $2y^2(3x+5y)(3x-5y)$   
**d)** Cannot be factored  
**e)** Cannot be factored  
**f)**  $\frac{1}{196}(7x+2y)(7x-2y)$ , or  $\left(\frac{x}{4}+\frac{y}{7}\right)\left(\frac{x}{4}-\frac{y}{7}\right)$

### Chapter 3: Review, page 198

- 1. a)** 2, 3, 11;  $2 \cdot 3^3 \cdot 11$   
**b)** 2, 3, 5, 7;  $2^2 \cdot 3 \cdot 5^2 \cdot 7$   
**c)** 3, 5, 13;  $3 \cdot 5^3 \cdot 13$   
**d)** 3, 7, 11, 13;  $3^2 \cdot 7 \cdot 11 \cdot 13$
- 2. a)**  $2^2 \cdot 5$ , or 20      **b)**  $5 \cdot 7$ , or 35  
**c)**  $2^4$ , or 16      **d)**  $2^2$ , or 4
- 3. a)**  $2^2 \cdot 3^2 \cdot 5 \cdot 7$ , or 1260  
**b)**  $2^3 \cdot 3 \cdot 5 \cdot 13 \cdot 103$ , or 160 680  
**c)**  $2^3 \cdot 5^3$ , or 1000  
**d)**  $2^4 \cdot 3^2 \cdot 5 \cdot 17$ , or 12 240
- 4.** 61 beads
- 5. a)**  $\frac{7}{9}$       **b)**  $\frac{11}{17}$   
**c)**  $\frac{13}{15}$       **d)**  $\frac{247}{576}$   
**e)**  $\frac{20}{27}$       **f)**  $\frac{23}{160}$
- 6. a)** 28 in.      **b)** 32 cm

7. a) 12 cm      b) 14 ft.

8. a) Perfect square;  $\sqrt{256} = 16$

b) Perfect square;  $\sqrt{324} = 18$

c) Perfect square and perfect cube;  
 $\sqrt{729} = 27$ ;  $\sqrt[3]{729} = 9$

d) Neither

e) Perfect square;  $\sqrt{1936} = 44$

f) Perfect cube;  $\sqrt[3]{9261} = 21$

9. 540 ft.

10. 44 cm

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

b)  $-3(1 - 3g^2)$

c)  $7a^2(4 - a)$

d)  $3a^2b^2c(2b - 5c)$

e)  $-6mn(4m + n)$

f)  $7b^2(2bc^2 - 3a^3)$

Algebra tiles could be used to factor the binomials in parts a and b

12. a)  $3(4 + 2g - g^2)$

b)  $d(3c^2 - 10c - 2)$

c)  $4mn(2n - 3 - 4m)$

d)  $y(y^2 - 12y + 24)$

e)  $10x^2y(3 - 2y + xy)$

f)  $-4b(2b^2 - 5b + 1)$

13. a)  $4x(2x - 3)$

b)  $3y(y^2 - 4y + 5)$

c)  $2b(2b^2 - 1 - 3b)$

d)  $6m(m^2 - 2 - 4m)$

14. a)  $5q(3p^2 + 5pq - 7q^2)$

b)  $-3(4mn - 5m^2 - 6n^2)$

15. a)

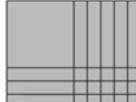


b)



c) Cannot be arranged as a rectangle

d)



16. a) Cannot be arranged as a rectangle

b)



c)



d) Cannot be arranged as a rectangle

17. 6  $x$ -tiles

18. a)  $g^2 + g - 20$

$g$	$(g)(g) = g^2$	$(g)(-4) = -4g$
5	$(5)(g) = 5g$	$(5)(-4) = -20$

b)  $h^2 + 14h + 49$

$h$	$(h)(h) = h^2$	$(h)(7) = 7h$
7	$(7)(h) = 7h$	$(7)(7) = 49$

c)  $k^2 + 7k - 44$

$k$	$(k)(k) = k^2$	$(k)(11) = 11k$
-4	$(-4)(k) = -4k$	$(-4)(11) = -44$

d)  $81 - s^2$

9	$(9)(9) = 81$	$(9)(-s) = -9s$
s	$(s)(9) = 9s$	$(s)(-s) = -s^2$

e)  $144 - 24t + t^2$

12	$(12)(12) = 144$	$(12)(-t) = -12t$
-t	$(-t)(12) = -12t$	$(-t)(-t) = t^2$

f)  $42 - r - r^2$

6	$(7)(6) = 42$	$(7)(-r) = -7r$
r	$(r)(6) = 6r$	$(r)(-r) = -r^2$

g)  $y^2 - 14y + 33$

$y$	$(y)(y) = y^2$	$(y)(-11) = -11y$
-3	$(-3)(y) = -3y$	$(-3)(-11) = 33$

h)  $x^2 - 25$

$x$	$(x)(x) = x^2$	$(x)(5) = 5x$
-5	$(-5)(x) = -5x$	$(-5)(5) = -25$

19. a)  $(q+2)(q+4)$

c)  $(6-s)(9-s)$

e)  $(x+4)(x-5)$

20. a) i)  $(m+3)(m+4)$

iii)  $(m+1)(m+12)$

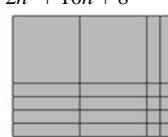
v)  $(m-2)(m-6)$

b) No

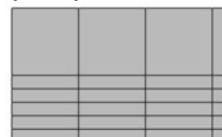
21. a)  $(u-3)(u-9)$

c)  $(w-2)(w+12)$

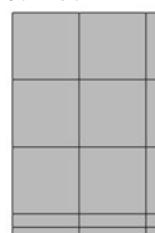
22. a)  $2h^2 + 10h + 8$



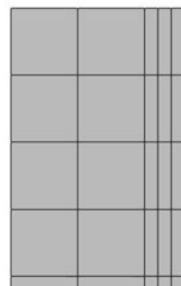
b)  $3j^2 + 16j + 5$



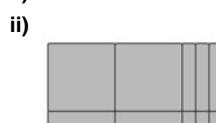
c)  $6k^2 + 7k + 2$



d)  $8m^2 + 14m + 3$



23. a) i)  $2x^2 + 5x + 3$



ii)  $(x+1)(2x+3)$

b) i)  $3x^2 + 10x + 8$



ii)  $(x+2)(3x+4)$

24. a)  $6r^2 + 31r + 35$

$2r$	$(2r)(3r) = 6r^2$	$(2r)(5) = 10r$
7	$(7)(3r) = 21r$	$(7)(5) = 35$

b)  $9y^2 - 80y - 9$

$9y$	$(9y)(y) = 9y^2$	$(9y)(-9) = -81y$
1	$(1)(y) = y$	$(1)(-9) = -9$

c)  $4a^2 - 26a + 42$

$2a$	$(2a)(2a) = 4a^2$	$(2a)(-6) = -12a$
-7	$(-7)(2a) = -14a$	$(-7)(-6) = 42$

d)  $9w^2 - 9w + 2$

$3w$	$3w$	$-1$
$(3w)(3w) = 9w^2$	$(3w)(-1) = -3w$	
$-2(-2)(3w) = -6w$	$(-2)(-1) = 2$	

e)  $16p^2 + 40p + 25$

$4p$	$5$
$(4p)(4p) = 16p^2$	$(4p)(5) = 20p$
$5(5)(4p) = 20p$	$(5)(5) = 25$

f)  $3y^2 - 2y - 1$

$-3y$	$-1$
$(-y)(-3y) = 3y^2$	$(-y)(-1) = y$
$1(1)(-3y) = -3y$	$(1)(-1) = -1$

25. a)  $(k - 1)(4k - 3)$

b)  $(3c + 1)(2c - 5)$

c)  $(b - 2)(4b + 3)$

d)  $(a - 5)(6a - 1)$

e)  $(4x - 1)(7x + 4)$

f)  $(3x + 2)(7x - 2)$

26. a)  $(2m - 3)(3m + 7)$

b)  $(4n + 1)(3n - 5)$

c)  $(4p - 5)(5p + 4)$

27. a)  $c^3 + 4c^2 + 5c + 2$

b)  $8r^3 - 22r^2 - 9r + 30$

c)  $-2j^3 - 5j^2 + 35j + 11$

d)  $6x^3 + 5x^2 - 17x - 6$

28. a)  $16m^2 - 8mp + p^2$

b)  $9g^2 - 24gh + 16h^2$

c)  $y^2 - yz - 2z^2 - 2y + 4z$

d)  $-18c^2 + 39cd - 20d^2 + 21c - 28d$

29. a)  $2m^4 + 7m^3 + 12m^2 + 17m + 10$

b)  $5 - 11x - 3x^2 + 11x^3 - 2x^4$

c)  $-6k^4 + 25k^3 + 10k^2 - 33k - 18$

d)  $3 + 2h - 10h^2 - 3h^3 + 2h^4$

30. a)  $22a^2 + 3a + 7$

b)  $23c^2 - 10c - 53$

31. a)  $n + 2, n + 4$

b)  $n(n + 2)(n + 4) = n^3 + 6n^2 + 8n$

32. a)  $(9 + 2b)(9 - 2b)$

b)  $(4v + 7)(4v - 7)$

c)  $16(2g + h)(2g - h)$

d)  $2(3m + n)(3m - n)$

33. a)  $(m - 7)^2$

b)  $(n + 5)^2$

c)  $(2p + 3)^2$

d)  $(4 - 5q)^2$

34. a)  $(g + 3h)^2$

b)  $(4j - 3k)^2$

c)  $(5t + 2u)^2$

d)  $(3v - 8w)^2$

35.  $3x^2 + 14x + 16$

### Chapter 3: Practice Test, page 201

1. A

2. C

3. 900; 5

4. a) i)  $20: 5, 20, 45, 80, 125, \dots$

45: 5, 20, 45, 80, 125, ...

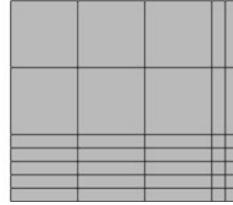
50: 2, 8, 18, 32, 50, ...

ii) 20: 50, 400, 1350, 3200, 6250, ...

45: 75, 600, 2025, 4800, 9375, ...

50: 20, 160, 540, 1280, 2500, ...

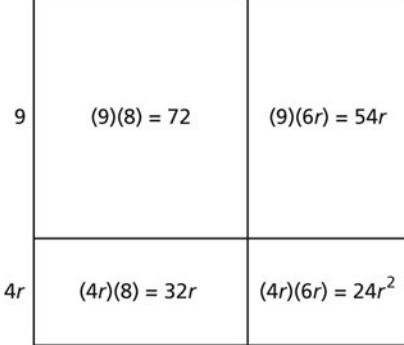
5. a)  $6c^2 + 19c + 10$



b)  $72 + 86r + 24r^2$

8

6r



c)  $12t^2 + 13t - 35$

$3t$	7	
$4t$	$(4t)(3t) = 12t^2$	$(4t)(7) = 28t$
-5	$(-5)(3t) = -15t$	$(-5)(7) = -35$

6. a)  $2p^3 + 3p^2 - 16p + 7$

b)  $3e^3 + 6e^2f + 2ef^2 + 4f^3 + 5ef + 10f^2$

c)  $-7y^2 + 60yz - 16z^2$

7. a)  $(f+1)(f+16)$

b)  $(c-2)(c-11)$

c)  $(t+4)(4t-7)$

d)  $(2r+5s)^2$

e)  $(2x-5y)(3x-y)$

f)  $(h+5j)(h-5j)$

8.  $6r^3 + 11r^2 + 6r + 1$

9.  $8t^2 \pm 25t + 3; 8t^2 \pm 14t + 3; 8t^2 \pm 11t + 3; 8t^2 \pm 10t + 3$

## Chapter 4 Roots and Powers, page 202

### 4.1 Math Lab: Estimating Roots, page 206

1. Answers will vary. For example:

a)  $\sqrt{25}, \sqrt[3]{19}, \sqrt[4]{37}, \sqrt[5]{3}$

b) For  $\sqrt{25}$ , the radicand is 25 and the index is 2.

For  $\sqrt[3]{19}$ , the radicand is 19 and the index is 3.

For  $\sqrt[4]{37}$ , the radicand is 37 and the index is 4.

For  $\sqrt[5]{3}$ , the radicand is 3 and the index is 5.

c) The index tells which root to take.

2. a)  $6; 36 = (6)(6)$

b)  $2; 8 = (2)(2)(2)$

c)  $10; 1000 = (10)(10)(10)(10)$

d)  $-2; (-2)(-2)(-2)(-2)(-2) = -32$

d)  $\frac{3}{5}; \left(\frac{3}{5}\right)\left(\frac{3}{5}\right)\left(\frac{3}{5}\right) = \frac{27}{125}$

e)  $1.5; (1.5)(1.5) = 2.25$

f)  $0.5; (0.5)(0.5)(0.5) = 0.125$

g)  $5; (5)(5)(5)(5) = 625$

3. a) 2.8

b) 2.1

c) 1.8

d) 3.6

e) 2.5

f) 2.0

g) 4.4

h) 2.7

4. a) The calculator returns an error message; the square of a real number will always be positive.

b) Any non-zero even index

c) i) Any odd index

ii) Any even index

5. a) i)  $\sqrt{4}$

ii)  $\sqrt[3]{8}$

iii)  $\sqrt[4]{16}$

b) i)  $\sqrt{9}$

ii)  $\sqrt[3]{27}$

iii)  $\sqrt[4]{81}$

c) i)  $\sqrt{16}$

ii)  $\sqrt[3]{64}$

iii)  $\sqrt[4]{256}$

d) i)  $\sqrt{100}$

ii)  $\sqrt[3]{1000}$

iii)  $\sqrt[4]{10\,000}$

e) i)  $\sqrt{0.81}$

ii)  $\sqrt[3]{0.729}$

iii)  $\sqrt[4]{0.6561}$

f) i)  $\sqrt{0.04}$

ii)  $\sqrt[3]{0.008}$

iii)  $\sqrt[4]{0.0016}$

6. Answers will vary. For example:

a)  $\sqrt[3]{216} = 6$

b)  $\sqrt[3]{-343} = -7$

c)  $\sqrt[4]{\frac{81}{16}} = \frac{3}{2}$

d)  $\sqrt{17} \approx 4.1$

### 4.2 Irrational Numbers, page 211

3. a) Irrational

b) Rational

c) Irrational

d) Rational

e) Irrational

f) Rational

4. a)  $7, \sqrt[3]{27}$

b)  $-5, 7, \sqrt[3]{27}$

c)  $\frac{4}{3}, 0.\overline{34}, -5, -2.1538, \sqrt[3]{27}, 7$

d)  $\sqrt[4]{9}$

5. a)  $\sqrt{49} = 7; \sqrt[4]{16} = 2$

b)  $\sqrt{21}$  and  $\sqrt[3]{36}$  cannot be written as a terminating or repeating decimals.

6. a) Rational

b) Irrational