Answers

Unit 1 Square Roots and Surface Area, page 4

1.1 Square Roots of Perfect Squares, page 11

3. **a)** 0.5 **b)** $\frac{3}{4}$ or 0.75

c) $\frac{4}{5}$ or 0.8

4. **a)** 1, 4, 9, 16, 25, 36, 49, 64, 81, 100

b) 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

5. **a)** 0.6 **b)** 0.7

c) 0.9 **d)** 0.4

e) $\frac{1}{6}$ **f)** $\frac{5}{3}$

g) $\frac{8}{10} = \frac{4}{5}$ **h)** $\frac{6}{4} = \frac{3}{2}$

6. **a)** 121, 144, 169, 196, 225, 256, 289, 324, 361, 400

b) 11, 12, 13, 14, 15, 16, 17, 18, 19, 20

7. **a)** $\frac{13}{4}$ **b)** $\frac{20}{14} = \frac{10}{7}$

c) $\frac{16}{19}$ **d)** $\frac{15}{17}$

e) 12 **f)** 0.15

g) 0.11 **h)** 1.8

i) 0.18 **j)** 0.13

8. **a)** $0.12 = \frac{12}{100}$ is not a perfect square because 12 is not a perfect square.

b) $\sqrt{0.81} = 0.9$, so 0.81 is a perfect square.

c) $\sqrt{0.25} = 0.5$, so 0.25 is a perfect square.

d) $\sqrt{1.69} = 1.3$, so 1.69 is a perfect square.

e) $\frac{9}{12}$ is not a perfect square because 12 is not a perfect square.

f) $\frac{36}{81}$ is a perfect square because both 36 and 81 are perfect squares.

g) $\frac{81}{49}$ is a perfect square because both 81 and 49 are perfect squares.

h) $\frac{75}{27} = \frac{25}{9}$ is a perfect square, because both 25 and 9 are perfect squares.

i) $0.081 = \frac{81}{1000}$ is not a perfect square because 1000 is not a perfect square.

j) $\frac{25}{10}$ is not a perfect square because 10 is not a perfect square.

k) $2.5 = \frac{25}{10}$ so it is not a perfect square.

l) $\frac{8}{50} = \frac{4}{25}$ is a perfect square because both 4 and 25 are perfect squares.

9. **a)** 0.09 **b)** 0.0144

c) 3.61 **d)** 9.61

e) $\frac{4}{9}$ **f)** $\frac{25}{36}$

g) $\frac{1}{49}$ **h)** $\frac{4}{25}$

10. **a)** 3.5 **b)** 5.5

c) 4.5 **d)** 7.5

11. **a)** **i)** $36.0 = \frac{36}{1}$ is a perfect square.

ii) $3.6 = \frac{36}{10} = \frac{18}{5}$ is not a perfect square.

iii) $0.36 = \frac{36}{100} = \frac{9}{25}$ is a perfect square.

iv) $0.036 = \frac{36}{1000} = \frac{9}{250}$ is not a perfect square.

v) $0.0036 = \frac{36}{10\,000} = \frac{9}{2500}$ is a perfect square.

vi) $0.000\,36 = \frac{36}{100\,000} = \frac{9}{25000}$ is not a perfect square.

b) **i)** $\sqrt{36.0} = 6$

ii) $\sqrt{3.6} \doteq 1.9$

iii) $\sqrt{0.36} = 0.6$

iv) $\sqrt{0.036} \doteq 0.19$

v) $\sqrt{0.0036} = 0.06$

vi) $\sqrt{0.000\,36} \doteq 0.019$

12. **a)** **i)** 300 **ii)** 30

iii) 0.3 **iv)** 0.03

b) **i)** 0.05 **ii)** 0.5

iii) 50 **iv)** 500

13. **a)** **i)** C **ii)** A

iii) E **iv)** B

v) F **vi)** D

14. **a)** 2.4 cm **b)** 9.6 cm

15. **a)** 2.5 km **b)** 3.2 km

c) 7.84 km^2

16. No. $\sqrt{0.04} = 0.2$

17. **b)** For example: (3, 4, 5), (9, 12, 15), (12, 16, 20), (5, 12, 13), (8, 15, 17)

18. Yes, the squares of all numbers between 0.8 and 0.9 are between 0.64 and 0.81.

19. **a)** 3.6 cm **b)** 1 cut

1.2 Square Roots of Non-Perfect Squares, page 18

4. **a)** 1 and 4; $\sqrt{1} = 1$ and $\sqrt{4} = 2$

b) 9 and 16; $\sqrt{9} = 3$ and $\sqrt{16} = 4$

c) 49 and 64; $\sqrt{49} = 7$ and $\sqrt{64} = 8$

d) 64 and 81; $\sqrt{64} = 8$ and $\sqrt{81} = 9$

e) 81 and 100; $\sqrt{81} = 9$ and $\sqrt{100} = 10$

f) 100 and 121; $\sqrt{100} = 10$ and $\sqrt{121} = 11$

5. **a)** $\frac{49}{100}$ and $\frac{64}{100}$; $\sqrt{0.49} = 0.7$ and $\sqrt{0.64} = 0.8$

b) 4 and 9; $\sqrt{4} = 2$ and $\sqrt{9} = 3$

c) 9 and 16; $\sqrt{9} = 3$ and $\sqrt{16} = 4$

d) 49 and 64; $\sqrt{49} = 7$ and $\sqrt{64} = 8$

e) 64 and 81; $\sqrt{64} = 8$ and $\sqrt{81} = 9$

f) 100 and 121; $\sqrt{100} = 10$ and $\sqrt{121} = 11$

6. Estimates will vary, for example:

a) $\sqrt{\frac{8}{10}} \doteq 0.9$ **b)** $\sqrt{\frac{17}{5}} \doteq \frac{9}{5}$

c) $\sqrt{\frac{7}{13}} \doteq 0.7$ **d)** $\sqrt{\frac{29}{6}} \doteq 2.2$

7. Approximations will vary, for example:

a) $\sqrt{4.5} \doteq 2.1$ **b)** $\sqrt{14.5} \doteq 3.8$

c) $\sqrt{84.5} \doteq 9.2$ **d)** $\sqrt{145.5} \doteq 12.1$

e) $\sqrt{284.5} \doteq 16.9$ **f)** $\sqrt{304.5} \doteq 17.4$

8. **a)** $\sqrt{29.5} \doteq 5.4$ **b)** $\sqrt{\frac{5}{2}} \doteq 1.6$

9. **a)** The estimate is incorrect. $\sqrt{4.4} \doteq 2.1$

b) The estimate is incorrect. $\sqrt{0.6} \doteq 0.8$

c) The estimate is correct to the nearest tenth.

d) The estimate is incorrect. $\sqrt{0.4} \doteq 0.6$

10. **a)** Any number between 9 and 16; for example 10.24 and 12.25

b) Any number between 49 and 64; for example 50.41 and 59.29

c) Any number between 144 and 169; for example 158.36 and 166.41

d) Any number between 2.25 and 6.25; for example 3.0 and 3.5

e) Any number between 20.25 and 30.25; for example 22.09 and 29.16

11. **a)** About 2.1 **b)** About 2.9

c) About 0.4 **d)** About 0.5

e) About 0.8 **f)** About 0.4

g) About 0.2 **h)** About 2.2

12. **a)** 0.6 **b)** 0.6

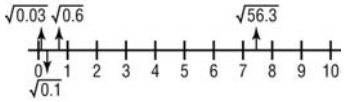
c) 1.8 **d)** 2.9

13. **a)** 1.3 cm **b)** About 2.7 cm

c) About 4.85 cm **d)** 0.7 cm

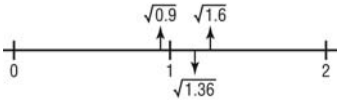
14. There is no limit to the number of decimals and fractions; for example 0.3025 and $\frac{61}{200}$

15.



16. **a)** $\sqrt{0.25}$, $\sqrt{0.5}$, $\sqrt{1.44}$, and $\sqrt{3.6}$ are correctly placed.

b)



17. **a)** $\sqrt{52.9} \doteq 7.2732$ **b)** $\sqrt{5.29} = 2.3$

c) $\sqrt{2.25} = 1.5$ **d)** $\sqrt{22.5} \doteq 4.7434$

18. **a)** The numbers are greater than 1.

b) The number must be 0 or 1.

c) The numbers are less than 1.

19. For example:

a) 0.64 **b)** 3

c) $\frac{2}{5}$ **d)** 15

20. **a)** 1.82 km **b)** 2.36 km

21. **a)** **i)** About 0.0707 **ii)** About 0.7071

iii) About 7.0711 **iv)** About 70.7107

v) About 707.1068

b) $\sqrt{0.000\,05} \doteq 0.007\,071$

$\sqrt{0.000\,0005} \doteq 0.000\,7071$

$\sqrt{50\,000\,000} \doteq 7071.0678$

$\sqrt{5\,000\,000\,000} \doteq 70\,710.678$

22. Yes. All numbers between 0.775 and 0.781 have squares between 0.6 and 0.61.

23. For example: (1.1, 0.2), (0.6, 0.2) and (0.6, 0.7)

24. **a)** About 7.8 cm

b) Doubling the side length would increase the area by a factor of 4.

Unit 1: Mid-Unit Review, page 21

1. **a)** $\sqrt{\frac{25}{36}} = \frac{5}{6}$ **b)** $\sqrt{0.36} = 0.6$

2. **a)** 1.96 **b)** $\frac{9}{64}$

c) $\frac{49}{16}$ **d)** 0.25

3. **a)** 0.2 **b)** $\frac{1}{4}$

c) 1.4 **d)** $\frac{2}{9}$

e) 1.3 **f)** $\frac{11}{7}$

g) 0.3 **h)** $\frac{17}{10}$

4. a) 1.8 **b)** 9.5

c) 1.6

5. a) 12.2 cm **b)** 48.8 cm

6. No, the student is incorrect. $\sqrt{0.16} = 0.4$

7. a) $\frac{9}{64}$ is a perfect square, since both 9 and 64 are perfect squares.

b) $3.6 = \frac{36}{10}$ is not a perfect square, since 10 is not a perfect square.

c) $\frac{6}{9}$ is not a perfect square, since 6 is not a perfect square.

d) $5.76 = \frac{576}{100}$ is a perfect square, since both 576 and 100 are perfect squares.

8. Estimates will vary, for example:

a) About 2.4 **b)** About 0.95

c) About 6.5 **d)** About 5.97

e) About 0.24 **f)** 0.3

9. a) About 3.0 cm

b) 4 cm

10. a) Correct **b)** About 1.3

c) Correct **d)** Correct

11. For example:

a) 20.25, 33.64 **b)** 0.5625, 0.64

c) 1.69, 1.7 **d)** 0.09, 0.1024

e) 22.09, 28.09 **f)** 0.0036, 0.0049

Unit 1: Start Where You Are, page 22

1. About 1385 cm^2

2. About 1546 cm^2

1.3 Surface Areas of Objects Made from Right Rectangular Prisms, page 30

4. a) 14 square units **b)** 18 square units

c) 22 square units **d)** 20 square units

e) 22 square units **f)** 26 square units

5. a) **i)** 18 cm^2 **ii)** 18 cm^2

iii) 18 cm^2

6. a) **i)** 20 cm^2 **ii)** 20 cm^2

iii) 22 cm^2

8. a) 68 cm^2 **b)** 144 cm^2

c) 255.5 cm^2

10. a) 165.03 m^2 **b)** $1609.20

11. 1346 m^2

12. a) 54 square units

b) 9 ways

c) **i)** 6 cubes **ii)** 12 cubes

iii) 8 cubes **iv)** 1 cube

v) 0 cubes

14. c) 22 cm^2, 24 cm^2, 26 cm^2

16. 110 m^2

17. a) The piece made from 3 cubes has surface area 14 cm^2; pieces made from 4 cubes have surface area 18 cm^2.

c) 68 faces will not be painted.

1.4 Surface Areas of Other Composite Objects, page 40

3. a) 121 cm^2 **b)** 117 cm^2

c) 283 cm^2 **d)** 360 cm^2

e) 256 cm^2

4. a) 58.1 cm^2 **b)** 62.1 m^2

5. a) About 21.9 m^2 **b)** About 58.3 cm^2

6. Including the bottom of base: About 707 cm^2

7. a) 35 m^2

8. a) 5.42 m^2

b) 2 cans of 1-L wood stain

9. a)

b) About 2081.3 cm^2

10. a) 2832.3 cm^2 **b)** 3652.1 cm^2

11. 1155 cm^2

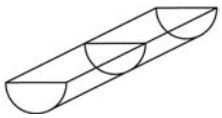
12. a) 61.1 m^2

13. a) 3456 cm^2 **b)** 4509 cm^2

14. About 10 700 cm^2

15. a) About 3336 cm^2

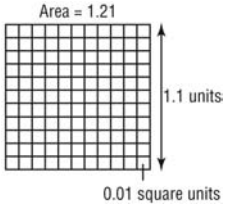
b) **i)**



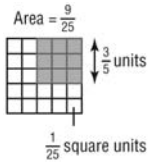
ii) About 4882 cm^2

Unit 1: Review, page 45

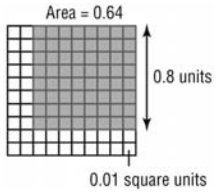
1. **a)** 1.1



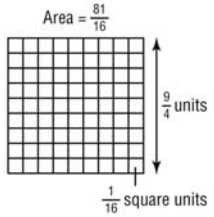
b) $\frac{3}{5}$



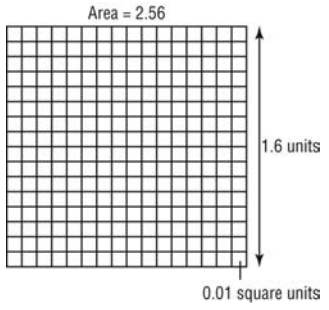
c) 0.8



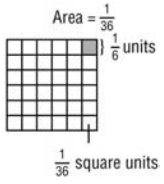
d) $\frac{9}{4}$



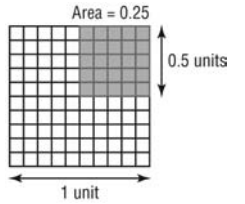
e) 1.6



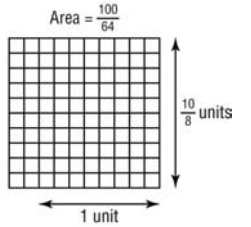
f) $\frac{1}{6}$



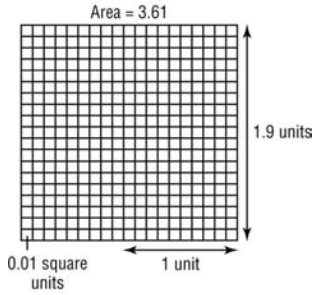
g) 0.5



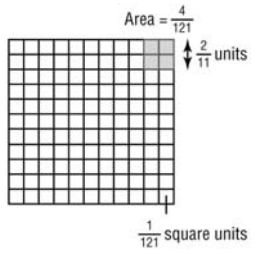
h) $\frac{10}{8} = \frac{5}{4}$



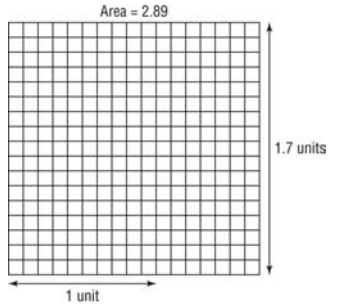
i) 1.9



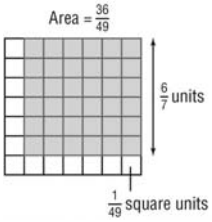
j) $\frac{2}{11}$



k) 1.7



l) $\frac{6}{7}$



2. **a)** $\frac{12}{5}$ **b)** $\frac{15}{8}$

c) $\frac{14}{9}$ **d)** $\frac{18}{11}$

e) 0.14 **f)** 0.17

g) 1.3 **h)** 2.1

3. **a)** $\frac{48}{120}$ is not a perfect square since neither 48 nor 120 are perfect squares.

b) 1.6 is not a perfect square since $1.6 = \frac{16}{10}$ and 10 is not a perfect square.

c) $\frac{49}{100} = \left(\frac{7}{10}\right)^2$ is a perfect square.

d) $0.04 = 0.2^2$ is a perfect square.

e) $\frac{144}{24} = 6$ is not a perfect square.

f) $2.5 = \frac{25}{10}$ is not a perfect square since 10 is not.

g) $\frac{50}{225}$ is not a perfect square since 50 is not.

h) $1.96 = 1.4^2$ is a perfect square.

i) $\frac{63}{28}$ simplifies to $\frac{9}{4}$, which is a perfect square.

4. **a)** $\frac{9}{25}$ **b)** 2.56

c) $\frac{81}{49}$ **d)** 0.64

5. **a)** 0.9 m **b)** 0.1 m

c) 2.2 cm **d)** 2.5 cm

e) 0.4 km **f)** 1.2 km

6. Estimates will vary, for example:

a) $\sqrt{3.8} \doteq 1.9$, using $\sqrt{1} = 1$ and $\sqrt{4} = 2$

b) $\sqrt{33.8} \doteq 5.8$, using $\sqrt{25} = 5$ and $\sqrt{36} = 6$

c) $\sqrt{133.8} \doteq 11.6$, using $\sqrt{121} = 11$ and $\sqrt{144} = 12$

d) $\sqrt{233.8} \doteq 15.3$, using $\sqrt{225} = 15$ and $\sqrt{256} = 16$

7. Estimates will vary, for example:

a) $\sqrt{\frac{77}{10}} \doteq \frac{14}{5}$, using $\sqrt{\frac{784}{100}} = \frac{14}{5}$

b) $\sqrt{\frac{18}{11}} \doteq \frac{14}{11}$, using $\sqrt{\frac{196}{121}} = \frac{14}{11}$

c) $\sqrt{\frac{15}{39}} \doteq \frac{15}{24}$, using $\sqrt{\frac{225}{576}} = \frac{15}{24}$

d) $\sqrt{\frac{83}{19}} \doteq \frac{9}{5}$, using $\sqrt{\frac{81}{25}} = \frac{9}{5}$

e) $\sqrt{\frac{28}{103}} \doteq \frac{5}{10}$, using $\sqrt{\frac{25}{100}} = \frac{5}{10}$

f) $\sqrt{\frac{50}{63}} \doteq \frac{7}{8}$, using $\sqrt{\frac{49}{64}} = \frac{7}{8}$

8. Estimates will vary, for example:

a) About 2.4 **b)** About 0.6

c) About 0.8 **d)** About 0.6

e) About 4.8 **f)** About 3

9. **a)** Correct **b)** Incorrect; $\sqrt{1.6} \doteq 1.3$

c) Incorrect; $\sqrt{156.8} \doteq 12.5$

d) Correct **e)** Correct

f) Incorrect; $\sqrt{0.7} \doteq 0.8$

10. $\sqrt{27.4}$, $\sqrt{60.8}$

11. **a)** $\sqrt{3.2}, \sqrt{2.3}, \sqrt{2.8}, \sqrt{1.2}$

b) $\sqrt{125.4}, \sqrt{134.5}, \sqrt{129.9}$

c) $\sqrt{12.9}, \sqrt{15.2}$

d) $\sqrt{5.7}, \sqrt{4.8}, \sqrt{3.2}, \sqrt{2.3}, \sqrt{2.8}$

e) $\sqrt{21.2}, \sqrt{23.1}, \sqrt{29.1}$

f) $\sqrt{237.1}, \sqrt{222.1}, \sqrt{213.1}$

12. **a)** About 3.9 cm **b)** About 3.5 cm

c) 8.5 cm

13. For example:

a) $\frac{1}{2}$ **b)** 0.0625

c) 1.97 **d)** $\frac{1}{25}$

14. **a)** **i)** About 0.0387 **ii)** About 0.3873

iii) About 3.8730 **iv)** About 38.7298

v) About 387.2983

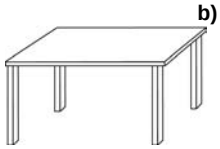
15. **a)** 18 cm^2 **b)** 22 cm^2

c) 26 cm^2

16. **a)** 51.7 cm^2 **b)** 515.48 m^2

c) 253.28 m^2

17. **a)** **b)** 14 824 cm^2

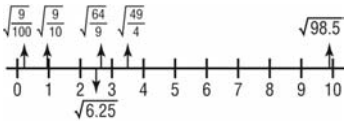


19. **a)** 940.2 cm^2 **b)** 1192.8 cm^2

20. **a)** 30.2 m^2 **b)** 2 containers; $39.90

Unit 1: Practice Test, page 48

1. **a)**



2. **a)** **i)** About 0.65 **ii)** 7.25
iii) 4.8 **iv)** 14.6
v) About 11.64

b) ii, iii, and iv are exact, i and v are approximate

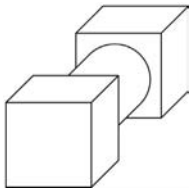
3. For example

a) 0.25 **b)** 0.04

4. 8.67 km

5. **a)** 68.2 m^2 **b)** $49.84

6. **a)**



b) 229.7 cm^2

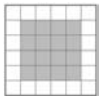
Unit 2 Powers and Exponent Laws, page 50

2.1 What is a Power?, page 55

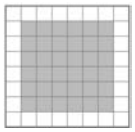
4. **a)** 2^2 **b)** 3^2
c) 5^2

5. **a)** 3^3 **b)** 2^3
c) 5^3

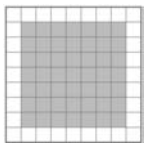
6. **a)** 4^2



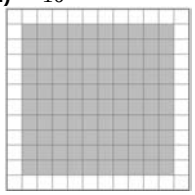
b) 6×6



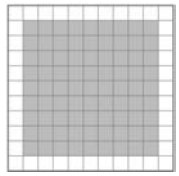
c) 49



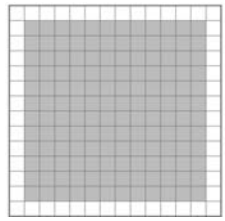
d) 10^2



e) 81



f) 12×12



7. **a)** 2 **b)** 4
c) 8 **d)** –10
e) –6 **f)** 8

8. **a)** 5 **b)** 4
c) 1 **d)** 2
e) 9 **f)** 3

9. **a)** 3×3 **b)** $10 \times 10 \times 10 \times 10$
c) $8 \times 8 \times 8 \times 8 \times 8$ **d)** $(-6)(-6)(-6)(-6)(-6)$
e) $-6 \times 6 \times 6 \times 6 \times 6$ **f)** -4×4

10. **a)** 3^2 can be modelled by 9 unit square tiles arranged in a 3 by 3 square. 2^3 can be modelled by 8 unit cubes arranged in a 2 by 2 by 2 cube.

b) 3^2 represents the area of a square and 2^3 represents the volume of a cube.

11. $6^4 = 6 \times 6 \times 6 \times 6 = 1296$
$4^6 = 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4096$

12. **a)** 4^4 **b)** 2^3
c) 5^6 **d)** 10^3
e) $(-79)^2$ **f)** $-(-2)^8$

13. **a)** $5^2 = 25$ **b)** $3^4 = 81$
c) $10^5 = 100\,000$ **d)** $-9^3 = -729$
e) $(-2)^3 = -8$ **f)** $-(-4)^3 = 64$
g) $(-5)^4 = 625$ **h)** $-5^4 = -625$
i) $-(-5)^4 = -625$

14. **a)** 8 **b)** 1 000 000
c) 3 **d)** –343
e) –343 **f)** 256
g) –256 **h)** –1296
i) 1296 **j)** –1296
k) –125 **l)** –256

15. **a)** **i)** $3^2 = 9$ **ii)** $13.95
b) **i)** $4^2 = 16$ **ii)** $8.32

16. **a)** 531 441 **b)** –823 543
c) 48 828 125 **d)** –1 048 576
e) 43 046 721 **f)** 8 388 608

17. **a)** **i)** $4 \times 4 \times 4 = 64$ **ii)** $-4 \times 4 \times 4 = -64$
iii) $-(-4 \times 4 \times 4) = 64$
iv) $(-4 \times 4 \times 4) = -64$

b) i and iii are positive. ii and iv are negative.

c) **i)** $4 \times 4 = 16$ **ii)** $-4 \times 4 = -16$
iii) $-(-4 \times 4) = 16$ **iv)** $(-4 \times 4) = -16$

d) i and iii are positive. ii and iv are negative.

18. a) All three expressions are the same.
For $(-3)^5$, the negative sign is part of the base, –3.
For (-3^5), the brackets serve no purpose.
b) -4^6 and (-4^6) are the same.
For -4^6, the negative sign is not part of the base.
For $(-4)^6$, the negative sign is part of the base, –4.

19. a) When the exponent is an odd number, for example: $(-3)^5$, $(-6)^3$, $(-2)^{17}$
b) When the exponent is an even number, for example: $(-3)^6$, $(-6)^2$, $(-2)^{10}$

20. a) 2^2 **b)** 2^4
c) 2^6 **d)** 2^8
e) 2^5 **f)** 2^7

21. a) **i)** 2^4, 4^2, 16^1 **ii)** 3^4, 9^2, 81^1
iii) 2^8, 4^4, 16^2, 256^1

22. a) Same: same numbers
Different: base and exponent interchanged
b) **i)** 3^2 **ii)** 2^5
iii) 3^4 **iv)** 4^5

23. 3^5, 6^3, 3^4, 5^2

24. a) $64 = 8^2$ **b)** $49 = 7^2$
c) $36 = 6^2$ **d)** $25 = 5^2$
e) $16 = 4^2$ **f)** $9 = 3^2$
g) $4 = 2^2$ **h)** $1 = 1^2$
Each number of squares is a square number that decreases as the size of the squares increases.

2.2 Powers of Ten and the Zero Exponent, page 61

4. a) 1 **b)** 1
c) 1 **d)** 1

5. a) 1 **b)** –1
c) –1 **d)** 1

6. a) 10^3 **b)** 10^5
c) 10^9 **d)** 10^4
e) 10^{11}

7. For example: 10^0, 1^4, $(-6)^0$

8. a) 10 000 000 **b)** 100
c) 1 **d)** 10 000 000 000
e) 10 **f)** 1 000 000

9. a) 6×10^9 **b)** 2×10^2
c) $(5 \times 10^4) + (1 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (5 \times 10^0)$
d) $(6 \times 10^7) + (7 \times 10^5) + (2 \times 10^3) + (8 \times 10^0)$
e) $(3 \times 10^5) + (2 \times 10^3) + (4 \times 10^2) + (1 \times 10^1) + (1 \times 10^0)$
f) $(2 \times 10^6) + (8 \times 10^0)$

10. a) 70 000 000 **b)** 39 057
c) 800 500 200 **d)** 98 000 000 001
e) 1 000 000 000 000 000 **f)** 904 031

11. 5×10^8; 4×10^4; 3×10^6; $(1 \times 10^4) + (7 \times 10^3)$; $(1 \times 10^5) + (3 \times 10^4)$; 6×10^2

12. Negative bases may vary.

Exponent	Power	Standard Form
5	$(-3)^5$	–243
4	$(-3)^4$	81
3	$(-3)^3$	–27
2	$(-3)^2$	9
1	$(-3)^1$	–3
0	$(-3)^0$	1

13. a) 4667 > 4327 **b)** 24 240 > 2432
c) 70 007 000 > 777 777

14. a) 1 billion = 10^9; 100 000 = 10^5; 1000 = 10^3; 1 = 10^0; 100 = 10^2; 10 million = 10^7
b) 10^0, 10^2, 10^3, 10^5, 10^7, 10^9
c) You only need to order or compare the exponents.

15. One trillion is 10^{12}, one quadrillion is 10^{15}, and one quintillion is 10^{18}.

2.3 Order of Operations with Powers, page 66

3. a) 10 **b)** 8
c) 16 **d)** 4
e) 8 **f)** 0
g) 36 **h)** 4
i) –14 **j)** –12

4. a) 40 **b)** 50
c) 1000 **d)** 100
e) –200 **f)** –10
g) –8 **h)** 1

5. a) 0 **b)** –1
c) 35 **d)** 125
e) –8 **f)** 1
g) –64 **h)** 8

6. a) **i)** $4^2 + 4^3 = 80$ **ii)** $5^3 + 5^6 = 15\,750$
b) **i)** $6^3 - 6^2 = 180$ **ii)** $6^3 - 6^5 = -7560$

7. Correction:
$= 9 + 4 \times 16 + 36$
$= 9 + 64 + 36$
$= 109$
$(-6)^2$ should be 36, not –36.
Calculate 4×16 first, not $9 + 4$.

8. a) Multiply: (7)(4); 3 **b)** Subtract: (2 – 5); 54
c) Evaluate: $(-3)^2$; 37 **d)** Evaluate: 4^0; –8
e) Divide: [10 ÷ (–2)]; 4
f) Divide: [18 ÷ (–6)]; –54

10. a) –392 **b)** –216
c) –8 **d)** 9
e) 16 **f)** 1

11. The order of operations matches the order in which the multiplication and division are written.
$-4^3 \times 10 - 6 \div 2 = -64 \times 10 - 3 = -640 - 3 = -643$

12. $1035

13. 5 different answers:
$2^3 + (3 \times 4)^2 - 6 = 8 + 144 - 6 = 146$;
$(2^3 + 3) \times 4^2 - 6 = 170$; $2^3 + 3 \times (4^2 - 6) = 38$;
$(2^3 + 3 \times 4^2) - 6 = 50$; $(2^3 + 3 \times 4)^2 - 6 = 394$;
$2^3 + (3 \times 4^2 - 6) = 50$

14. **a)** 43, 43 **b)** 13, 25
c) 191, 191 **d)** 72, 7776
e) 119, 20

15. The student multiplied 3 by 4 instead of squaring 4 first. This does not affect the answer because any nonzero number with exponent 0 equals 1.
A more efficient solution:
$-(24 - 3 \times 4^2)^0 \div (-2)^3 = -(1) \div (-8) = \frac{1}{8}$

16. **a)** –197 568 **b)** –92 000
c) –4 **d)** 40.5
e) 169 744 **f)** –1 185 191

17. $(30 + 9 \times 11 \div 3)^0$

18. **a)** Marcia
b) Robbie forgot that the square of –4 is positive.
Nick forgot that the square of –6 is positive.

19. $84.81

20. **a)** $(10 + 2) \times 3^2 - 2 = 106$
b) $10 + 2 \times (3^2 - 2) = 24$
c) $(10 + 2) \times (3^2 - 2) = 84$
d) $(10 + 2 \times 3)^2 - 2 = 254$

21. **a)** $20 \div (2 + 2) \times 2^2 + 6 = 26$
b) $20 \div 2 + 2 \times (2^2 + 6) = 30$
c) $20 \div (2 + 2 \times 2^2) + 6 = 8$
d) $(20 \div 2 + 2) \times (2^2 + 6) = 120$

22. No, Blake did not win the prize.
$5 \times 4^2 - (2^3 + 3^3) \div 5$
$= 5 \times 16 - (8 + 27) \div 5$
$= 80 - 35 \div 5$
$= 80 - 7$
$= 73$

24. **a)** $1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 = 21^2$
$1^3 + 2^3 + 3^3 + 4^3 + 5^3 + 6^3 + 7^3 = 28^2$
b) $3^2 - 1^2 = 2^3$; $6^2 - 3^2 = 3^3$; $10^2 - 6^2 = 4^3$;
$15^2 - 10^2 = 5^3$; $21^2 - 15^2 = 6^3$; $28^2 - 21^2 = 7^3$;
$36^2 - 28^2 = 8^3$

25. For example, use –2 and 3.
a) $(-2)^2 + 3^2 = 4 + 9 = 13$ **b)** $(-2 + 3)^2 = 1^2 = 1$
c) The answers are different.
d) I do not agree. The two expressions are not equal because the operations are performed in different orders.

26. Answers may vary. For example:
$4 \div 4 + 4 - 4 = 1$; $4 \div 4 + 4 \div 4 = 2$;
$4 - 4 + 4 - 4^0 = 3$; $4^0 + 4^0 + 4^0 + 4^0 = 4$;
$4 - 4 + 4 + 4^0 = 5$; $4 + 4 - 4^0 - 4^0 = 6$;
$4 + 4^0 + 4^0 + 4^0 = 7$; $(4 + 4) \times 4 \div 4 = 8$;
$4 \div 4 + 4 + 4 = 9$

27. **a)** **i)** $2^4 = 16$ **ii)** $2^2 = 4$
iii) $2^5 = 32$ **iv)** $2^3 = 8$
b) **i)** $28 = 2^4 + 2^3 + 2^2$
ii) $12 = 2^3 + 2^2$ **iii)** $25 = 2^4 + 2^3 + 2^0$
iv) $31 = 2^4 + 2^3 + 2^2 + 2^1 + 2^0$
v) $50 = 2^5 + 2^4 + 2^1$ **vi)** $75 = 2^6 + 2^3 + 2^1 + 2^0$
c) For example:
i) $28 = 3^3 + 3^0$ **ii)** $12 = 3^2 + 3^1$
iii) $25 = 3^2 + 3^2 + 3^1 + 3^1 + 3^0$
iv) $31 = 3^3 + 3^1 + 3^0$
v) $50 = 3^3 + 3^2 + 3^2 + 3^1 + 3^0 + 3^0$
vi) $75 = 3^3 + 3^3 + 3^2 + 3^2 + 3^1$

Unit 2: Mid-Unit Review, page 69

1. **a)** 196 **b)** 5
c) –512 **d)** –256
e) –216 **f)** 256

2.

	Power	Base	Exponent	Repeated Multiplication	Standard Form
a)	4^3	4	3	4 × 4 × 4	64
b)	2^5	2	5	2 × 2 × 2 × 2 × 2	32
c)	8^6	8	6	8 × 8 × 8 × 8 × 8 × 8	262 144
d)	7^2	7	2	7 × 7	49
e)	3^4	3	4	3 × 3 × 3 × 3	81

3. **a)**

Power of 7	Standard Form
7^1	7
7^2	49
7^3	343
7^4	2401
7^5	16 807
7^6	117 649
7^7	823 543
7^8	5 764 801

b) The pattern in the ones digits is 7, 9, 3, 1, 7, 9, 3, 1, …

c)

Power of 7	Standard Form
7^9	40 353 607
7^{10}	282 475 249
7^{11}	1 977 326 743

d) **i)** 1 **ii)** 9
iii) 7 **iv)** 9

4. **a)** 1 000 000 **b)** 1
c) 100 000 000 **d)** 10 000

5. **a)** 10^9 **b)** 10^0
c) 10^2 **d)** 10^5

6. **a)** 1 **b)** 1

c) -1 **d)** 1

7. 10^4 m^2

8. **a)** Subtract: $(-21 - 6)$; 743

b) Multiply: (2×3); 33

c) Subtract: $[5 - (-4)]$; 648

d) Evaluate the power with exponent 0; 1

e) Subtract: $(3 - 5)$; 8

f) Subtract: $(7 - 4)$; -57

9. Sophia is correct. Victor might have included the negative sign in the power -2^4 and evaluated it as 16.

10. $(-3)^3 = -27$, not 27; $(-9)^0 = 1$, not -1

Correction:

$(-2)^4 - (-3)^3 \div (-9)^0 \times 2^3$

$= 16 - (-27) \div 1 \times 8$

$= 16 - (-27) \times 8$

$= 16 - (-216)$

$= 232$

Unit 2: Start Where You Are, page 70

1. **a)** 64.8 **b)** 162

c) 15 **d)** -9

e) 2

2. **a)** 1 **b)** 1.0125

c) 1

2.4 Exponent Laws I, page 76

4. **a)** 5^9 **b)** 10^{13}

c) $(-3)^6$ **d)** 21^{10}

e) $(-4)^4$ **f)** 6^{15}

g) 2^4 **h)** $(-7)^3$

5. **a)** 4^2 **b)** 8^3

c) 15^{10} **d)** $(-6)^5$

e) 2^2 **f)** $(-10)^6$

g) 6^4 **h)** $(-1)^1$

6. **a)** **i)** 1 **ii)** 1

iii) 1 **iv)** 1

7. **a)** **i)** $3^{13} = 1\,594\,323$ **ii)** $3^{13} = 1\,594\,323$

8. **a)** 3^2 **b)** $(-4)^{11}$

c) 6^1 **d)** 4^0

e) $(-3)^4$

9. **a)** **i)** $(-6)^1 = -6$ **ii)** $(-6)^1 = -6$

10. **a)** $10^4 + 10^4 = 20\,000$ **b)** $10^6 - 10^3 = 999\,000$

c) $10^{11} - 10^9 = 99\,000\,000\,000$

d) $10^1 + 10^7 = 10\,000\,010$

e) $10^6 = 1\,000\,000$ **f)** $10^0 = 1$

g) $10^6 = 1\,000\,000$ **h)** $10^5 = 100\,000$

i) $10^5 = 100\,000$ **j)** $10^2 + 10^2 = 200$

11. **a)** 32 **b)** 248

12. **a)** 10^4 m $\times$ 10^3 m $= 10^7$ m^2, or 10 000 000 m^2

b) $2(10^4 \text{ m} + 10^3 \text{ m}) = 22\,000$ m

c) **i)** 10^7 m $\times$ 10^0 m; 10^6 m $\times$ 10^1 m; 10^5 m $\times$ 10^2 m; 10^4 m $\times$ 10^3 m

ii) $2(10^7 \text{ m} + 10^0 \text{ m}) = 20\,000\,002$ m

$2(10^6 \text{ m} + 10^1 \text{ m}) = 2\,000\,020$ m

$2(10^5 \text{ m} + 10^2 \text{ m}) = 200\,200$ m

$2(10^4 \text{ m} + 10^3 \text{ m}) = 22\,000$ m

13. **a)** -32 **b)** 91

c) 21 **d)** -12

e) 80 **f)** -272

g) -10

15. **a)** The student multiplied the exponents instead of adding them. Correction: $4^3 \times 4^4 = 4^7$

b) The student divided the exponents instead of subtracting them.

Correction: $\frac{(-7^6)}{(-7^3)} = \frac{-7^6}{-7^3} = \frac{7^6}{7^3} = 7^3$

c) The student used the exponent laws but the bases are different. Correction: $3^2 \times 2^3 = 9 \times 8 = 72$

d) The student multiplied the exponents in the divisor instead of adding them.

Correction: $\frac{5^8}{5^4 \times 5^2} = \frac{5^8}{5^6} = 25$

e) The student added all the exponents even though only 2 of them were parts of products of powers. Correction: $1^2 + 1^3 \times 1^2 = 1^2 + 1^5 = 1 + 1 = 2$

16. **a)** $10^2 \times 10^1 = 10^3$ **b)** 1000 times as large

17. **a)** **i)** 150 **ii)** 3125

b) Part ii is a product of two powers that can be simplified using an exponent law.

18. **a)** **i)** 48 **ii)** 4

b) Part ii is a quotient of two powers that can be simplified using an exponent law.

19. Since the base is negative, the power is negative when the exponent is an odd number.

a) $(-2)^5$ **b)** $(-2)^5$

c) $(-2)^2 = 4$ **d)** $(-2)^0 = 1$

e) $(-2)^2 = 4$ **f)** $(-2)^1$

20. For example: $4^2 \times 2^2$

21. **a)** 1 km $= 10^3$ m $= 10^3 \times 10^2$ cm $= 10^5$ cm

b) 1 km $= 10^5$ cm $= 10^5 \times 10^1$ mm $= 10^6$ mm

c) 10^5 m $= (10^5 \div 10^3)$ km $= 10^2$ km

d) 10^9 mm $= (10^9 \div 10^3)$ m $= 10^6$ m

22. **a)** 10^2 km^2 $= (10^3 \times 10^3) \times 10^2$ m^2 $= 10^8$ m^2

b) 10^6 cm^2 $= 10^6 \div (10^2 \times 10^2)$ m^2 $= 10^2$ m^2

c) 10^6 cm^2 $= (10^1 \times 10^1) \times 10^6$ mm^2 $= 10^8$ mm^2

d) 1 km^2 $= (10^3 \times 10^3) \times (10^2 \times 10^2)$ cm^2 $= 10^{10}$ cm^2

2.5 Exponent Laws II, page 84

4. **a)** $6^3 \times 4^3$ **b)** $2^4 \times 5^4$

c) $(-2)^5 \times 3^5$ **d)** $25^2 \times 4^2$

e) $11^1 \times 3^1$ **f)** $(-3)^3 \times (-2)^3$

5. a) $8^3 \div 5^3$ **b)** $21^4 \div 5^4$

c) $(-12)^5 \div (-7)^5$ **d)** $\frac{10^3}{3^3}$

e) $\frac{1^2}{3^2}$ **f)** $\frac{27^4}{100^4}$

6. a) 3^8 **b)** 6^9 **c)** 5^3

d) 7^0 **e)** -8^4 **f)** $(-3)^8$

7. $(2^4)^2 = 2^8$; $(2^2)^4 = 2^8$; The results are the same because each expression is the product of 8 factors of 2.

8. a) $3^3 \times (-5)^3$ **b)** $-2^5 \times 4^5$

c) $\frac{2^4}{3^4}$ **d)** $\frac{(-7)^2}{(-2)^2}$

e) $-(-10)^3 \times 3^3$ **f)** $16^2 \div 9^2$

9. Since $-5^2 = -25$, the base is negative. The power $(-5^2)^3$ is negative when the exponent is an odd number.

10. a) I multiplied first because it was easier than using the power of a product law: $(3 \times 2)^3 = 6^3 = 216$

b) I multiplied first because it was easier than using the power of a product law: $[(-2) \times 4]^2 = (-8)^2 = 64$

c) I divided first because it was easier than using the power of a quotient law: $\left(\frac{9}{-3}\right)^3 = (-3)^3 = -27$

d) I divided first because it was easier than using the power of a quotient law: $\left(\frac{8}{2}\right)^2 = 4^2 = 16$

e) I used the zero exponent law: $(12^8)^0 = 1$

f) I used the power of a power law: $[(-4)^2]^2 = (-4)^4 = 256$

11. $[(-2)^3]^4 = (-2)^{12}$; $(-2)^{12}$ is positive because its exponent is even. $[(-2)^3]^5 = (-2)^{15}$; $(-2)^{15}$ is negative because its exponent is odd.

12. $-(4^2)^3 = -4096$; $(-4^2)^3 = -4096$; $[(-4)^2]^3 = 4096$

13. a) i) $(4 \times 3)^3 = 12^3 = 1728$

$(4 \times 3)^3 = 4^3 \times 3^3 = 64 \times 27 = 1728$

b) i) $[(-2) \times (-5)]^2 = 10^2 = 100$

$[(-2) \times (-5)]^2 = (-2)^2 \times (-5)^2 = 4 \times 25 = 100$

c) i) $\left(\frac{6}{2}\right)^4 = 3^4 = 81$

$\left(\frac{6}{2}\right)^4 = \frac{6^4}{2^4} = \frac{1296}{16} = 81$

d) i) $\left(\frac{14}{2}\right)^0 = 7^0 = 1$

$\left(\frac{14}{2}\right)^0 = \frac{14^0}{2^0} = 1$

e) i) $[(-5)^2]^2 = 25^2 = 625$

$[(-5)^2]^2 = (-5)^4 = 625$

f) i) $(2^5)^3 = 32^3 = 32\,768$

$(2^5)^3 = 2^{15} = 32\,768$

14. a) 729 **b)** 256

c) 64 **d)** 1 000 000

e) 1 000 000 000 000 **f)** 144

g) 1 **h)** –512

15. a) The student multiplied the bases and multiplied the powers.

$(3^2 \times 2^2)^3 = 3^6 \times 2^6 = 729 \times 64 = 46\,656$

b) The student added the exponents instead of multiplying them. $[(-3)^2]^3 = (-3)^6 = 729$

c) The student might have thought that 6^1 is 1.

$\left(\frac{6^2}{6^1}\right)^2 = (6^1)^2 = 6^2 = 36$

d) The student did not simplify the powers in the brackets correctly.

$(2^6 \times 2^2 \div 2^4)^3 = (2^{6+2-4})^3 = (2^4)^3 = 2^{12} = 4096$

e) The student multiplied the powers in the brackets instead of adding them.

$(10^2 + 10^3)^2 = (100 + 1000)^2 = 1100^2 = 1\,210\,000$

16. a) 1 047 951 **b)** 28

c) 4100 **d)** 46 720

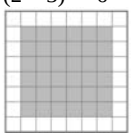
e) –255 **f)** 1 006 561

17. a) 1015 **b)** –59 045

c) 1033 **d)** 59 053

e) –5 **f)** 60 073

18. a) i) $(2 \times 3)^2 = 6^2$

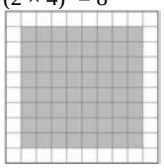


ii) $(2 \times 3)^2 = 2^2 \times 3^2$

iii)

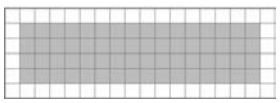
iv) Both rectangles have an area of 36 but they have different dimensions.

b) i) $(2 \times 4)^2 = 8^2$



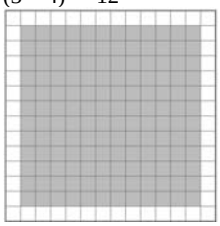
ii) $(2 \times 4)^2 = 2^2 \times 4^2$

iii)



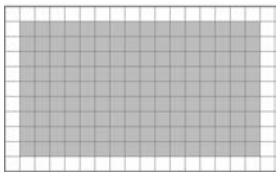
iv) Both rectangles have an area of 64 but they have different dimensions.

c) **i)** $(3 \times 4)^2 = 12^2$



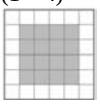
ii) $(3 \times 4)^2 = 3^2 \times 4^2$

iii)



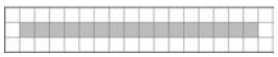
iv) Both rectangles have an area of 144 but they have different dimensions.

d) **i)** $(1 \times 4)^2 = 4^2$



ii) $(1 \times 4)^2 = 1^2 \times 4^2$

iii)



iv) Both rectangles have an area of 16 but they have different dimensions.

19. **a)** 255 583 **b)** 254 819 593
c) 2 097 152 **d)** 1631
e) 6560 **f)** 54 899

20. **a)** **i)** 9^2 **ii)** $(3 \times 3)^2$ **iii)** 3^4
b) **i)** 8^2 **ii)** $(2 \times 4)^2$ **iii)** 2^6

21. **a)** 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024, 2048, 4096

b) **i)** $2^5 \times 2^6 = 2048$ **ii)** $2^4 \times 2^3 \times 2^5 = 4096$

iii) $2^{10} \div 2^7 = 8$ **iv)** $\dfrac{2^4 \times 2^8}{2^{10}} = 4$

v) $(2^3 \times 2^2)^3 = 32\,768$

vi) $\left(\dfrac{2^8}{2^6}\right)^4 = 256$

Unit 2: Review, page 87

1. **a)** $4 \times 4 \times 4 = 64$ **b)** $7 \times 7 = 49$
c) $-(-2)(-2)(-2)(-2)(-2) = 32$
d) $-3 \times 3 \times 3 \times 3 = -81$
e) $-1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 \times 1 = -1$
f) $(-1)(-1)(-1)(-1)(-1)(-1)(-1)(-1) = 1$

2. 2^2 can be modelled as the area of a square with side length 2 units. 2^3 can be modelled as the volume of a cube with edge length 2 units.

3. **a)** $3^6 = 729$ **b)** $(-8)^3 = -512$
c) $-2^7 = -128$ **d)** $12^2 = 144$
e) $4^5 = 1024$ **f)** $(-5)^4 = 625$

4. 5^8 means $5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 \times 5 = 390\,625$
8^5 means $8 \times 8 \times 8 \times 8 \times 8 = 32\,768$

5. 16 min

6. **a)** $-4^2 = -16$; $(-4)^2 = 16$
The values are different. The brackets indicate that the negative sign is included in the base.

b) $-2^3 = -8$; $(-2)^3 = -8$
The values are the same. The brackets indicate that the negative sign is included in the base.

7. **a)** **i)** –9 **ii)** –9
iii) –9 **iv)** 9

b) **ii)** The brackets indicate that the negative sign is not part of the base.
iii) The brackets indicate that the first negative sign is not part of the base and the second negative sign is part of the base.
iv) The brackets indicate that the negative sign is part of the base.

8. **a)** 10^8 **b)** 10^4
c) 10^0 **d)** 10^9
e) 10^3

9. **a)** 7×10^8
b) $(3 \times 10^2) + (4 \times 10^1) + (5 \times 10^0)$
c) $(8 \times 10^4) + (2 \times 10^1) + (7 \times 10^0)$

10. **a)**

Power	Repeated Multiplication	Standard Form
3^5	$3 \times 3 \times 3 \times 3 \times 3$	243
3^4	$3 \times 3 \times 3 \times 3$	81
3^3	$3 \times 3 \times 3$	27
3^2	3×3	9
3^1	3	3

b) The exponents are decreasing by 1; the number of factors is decreasing by 1; each number in standard form is divided by 3 to get the number below it.

c) $3^0 = 1$

11. **a)** $10^4 \div 10^2 = 10^2$, or 100 times as high
b) $10^{12} \div 10^7 = 10^5$, or 100 000 times as great

12. **a)** 4729 **b)** 300 208

13. **a)** 90 **b)** –48
c) 900 **d)** 600

14. **a)** 89 **b)** 175
c) 0 **d)** 26

e) 73 **f)** 40 000

15. **a)** **i)** 1000 **ii)** 2000
iii) 4000 **iv)** 8000

b) **i)** $1000 \times 2^4 = 16\,000$ **ii)** $1000 \times 2^6 = 64\,000$
iii) $1000 \times 2^9 = 512\,000$
iv) $1000 \times 2^{12} = 4\,096\,000$

16. 6 different answers:
$4^3 - (2 \times 3)^4 + 11 = -1221$; $(4^3 - 2) \times 3^4 + 11 = 5033$;
$(4^3 - 2 \times 3)^4 + 11 = 11\,316\,507$
$4^3 - (2 \times 3^4 + 11) = -109$; $4^3 - 2 \times (3^4 + 11) = -120$;
$4^3 - (2 \times 3)^4 + 11 = -87$

17. The student incorrectly applied the exponent law when the bases, (–2) and 2, are not the same. Also, $-9 \div (-3)$ is 3, not –3. Correction:
$(-2)^2 \times 2^3 - 3^2 \div (-3) + (-4)^2$
$= 4 \times 8 - 9 \div (-3) + 16$
$= 32 - (-3) + 16$
$= 35 + 16$
$= 51$

18. **a)** $5^7 = 78\,125$ **b)** $(-2)^5 = -32$
c) $3^6 = 729$ **d)** $-10^4 = -10\,000$

19. $10^{22} = 10\,000\,000\,000\,000\,000\,000\,000$

20. **a)** $7^2 = 49$ **b)** $(-10)^6 = 1\,000\,000$
c) $8^2 = 64$ **d)** $-6^3 = -216$

21. **a)** No, the laws of exponents cannot be used because the powers have different bases.
One can only use the exponent laws to simplify power expressions with the same base.

b) Yes, even though these powers have different bases, both bases are powers of 3:
$27^2 \div 9^2 = 3^6 \div 3^4$

22. **a)** The student divided the exponents instead of subtracting them. $(-3)^6 \div (-3)^2 = (-3)^4 = 81$

b) The student misread the addition sign as a multiplication sign.
$(-4)^2 + (-4)^2 = 16 + 16 = 32$

c) After the first step, the student divided the exponents instead of subtracting them.
$$\frac{(-5)^2 \times (-5)^4}{(-5)^3 \times (-5)^0} = \frac{(-5)^6}{(-5)^3} = (-5)^3 = -125$$

23. **a)** $3^3 \times 5^3 = 3375$ **b)** $12^5 \div 3^5 = 1024$
c) $(-4)^4 \times 2^4 = 4096$ **d)** $63^0 \times 44^0 = 1$
e) $\frac{3^5}{2^5} = \frac{243}{32}$, or 7.593 75
f) $\frac{15^2}{2^2} = \frac{225}{4}$, or 56.25

24. **a)** 3^6 **b)** 4^0
c) $(-2)^9$ **d)** 5^{10}

25. **a)** **i)** $(5 \times 3)^3 = 15^3 = 3375$
ii) $(5 \times 3)^3 = 5^3 \times 3^3 = 3375$

b) **i)** $(3 \times 3)^4 = 9^4 = 6561$
ii) $(3 \times 3)^4 = 3^4 \times 3^4 = 6561$

c) **i)** $(8 \div 2)^5 = 4^5 = 1024$
ii) $(8 \div 2)^5 = 8^5 \div 2^5 = 1024$

d) **i)** $\left(\frac{9}{3}\right)^2 = 3^2 = 9$ **ii)** $\left(\frac{9}{3}\right)^2 = \frac{9^2}{3^2} = 9$

e) **i)** $(2^3)^4 = 8^4 = 4096$ **ii)** $(2^3)^4 = 2^{12} = 4096$

f) **i)** $(6^2)^0 = 36^0 = 1$ **ii)** $(6^2)^0 = 6^0 = 1$

26. **a)** $6^7 = 279\,936$ **b)** $(-11)^2 = 121$
c) $3^6 = 729$ **d)** $5^0 = 1$
e) $(-4)^3 = -64$ **f)** $10^1 = 10$

27. **a)** 33 **b)** $\frac{8}{3}$
c) 186 623 **d)** 199 065.6

Unit 2: Practice Test, page 90

1. **a)** $3^3 \times 4^3$ **b)** $(-5)^4 \times 2^4$
c) $\frac{1^4}{4^4}$ **d)** $-\frac{9^3}{3^3}$

2. **a)** -2^9 **b)** 6^0
c) $(-5)^6$ **d)** $-(-3)^8$

3. **a)** 1296 **b)** $\frac{1}{32} = 0.031\,25$
c) 1 **d)** 729

4. The value of a power with a negative base is positive when the exponent is an even number, and is negative when the exponent is an odd number.
For example: $(-3)^2 = (-3) \times (-3) = 9$
$(-3)^3 = (-3) \times (-3) \times (-3) = -27$

5. The area of the diamond is: 27 m × 27 m = 729 m^2, which is less than 1000 m^2.

6. The brackets are not necessary because the order of operations ensures that the multiplication and division are performed before the subtraction.
$(-3^5 \times 10) - (9 \div 3) = (-243 \times 10) - (9 \div 3) =$
$-2430 - 3 = -2433$

7. **a)** $(2^3 + 4)^2$ was calculated as $(2^3 + 4) \times 2$.
b) The answer –1440 is correct.
c) $(-10)^3$ was evaluated as 1000.
d) The brackets of $(5 + 5)^2$ were ignored, so $(-10)^3$ was divided by 5 and then 5^2 was added.

8. **a)** 625; The simplified expression $(-5)^{3+2-1} = (-5)^4$ has an even exponent, so the value will be positive.
b) 1; A power with an exponent of 0 gives a value of 1, so the answer will be positive.
c) The simplified expression $(-1)^{2+4-3-2} = (-1)^1$ has an odd exponent, so the answer will be negative.

d) 4352; Each power in the simplified expression $(-4)^6 + (-4)^4$ has an even exponent, so the value will be positive.

Unit 3 Rational Numbers, page 92

3.1 What Is a Rational Number?, page 101

5. $\frac{-3}{2} = -\frac{3}{2} = \frac{3}{-2}$; $\frac{-2}{3} = -\frac{2}{3} = \frac{2}{-3}$

6. **a)** $-\frac{7}{9}, \frac{-7}{9}$ **b)** $-\frac{5}{3}, \frac{5}{-3}$

c) $\frac{-6}{11}, \frac{6}{-11}$

7. **a)** 1.2 **b)** –1.2

c) 2.25 **d)** $-1.8\overline{3}$

8. **a)** A: –7.9, B: –7.2 **b)** C: –4.4, D: –3.2

c) J: –0.7, K: –0.2

d) G: –15.37, H: –15.32

9. **a)** B: –7.2 **b)** D: –3.2

c) K: –0.2 **d)** H: –15.32

10. **a)** E: $-\frac{45}{4}$, F: $-\frac{43}{4}$ **b)** L: $-\frac{41}{8}$, M: $-\frac{23}{4}$

c) N: $-\frac{25}{6}$, P: $-\frac{11}{3}$ **d)** Q: $-\frac{9}{16}$, R: $-\frac{3}{16}$

11. **a)** E: $-\frac{45}{4}$ **b)** M: $-\frac{23}{4}$

c) N: $-\frac{25}{6}$ **d)** Q: $-\frac{9}{16}$

12. Answers will vary. For example:

a) 3.8, 3.9, 4.1 **b)** –1.2, –1.1, –0.6

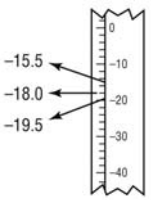
c) –4.4, –4.3, –4.1 **d)** –5.4, –5.1, –4.8

e) –3.2, –0.1, 4.7 **f)** 4.3, 2.1, –2.9

g) –5.63, –5.66, –5.68

h) –2.982, –2.987, –2.989

13. **a)** *See diagram below.*



b) No, the temperature in the freezer may be above –18°C.

14. Answers will vary. For example:

a) $\frac{7}{8}, \frac{9}{8}, \frac{11}{8}$ **b)** $\frac{11}{10}, \frac{3}{10}, -\frac{13}{10}$

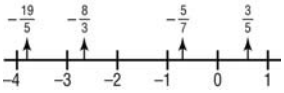
c) $-\frac{179}{48}, -\frac{89}{24}, -\frac{177}{48}$

d) $-\frac{3}{8}, -\frac{1}{4}, -\frac{3}{16}$ **e)** $0.25, \frac{1}{3}, \frac{5}{12}$

f) $-0.27, \frac{7}{24}, -0.29$ **g)** $-\frac{71}{25}, -\frac{72}{25}, -\frac{74}{25}$

h) $5\frac{16}{25}, 5\frac{17}{25}, 5\frac{19}{25}$

15.



16. **a)** 2.34 **b)** –2.3

c) 1.4 **d)** 3.96

e) –5.6 **f)** $2.8\overline{6}$

17. **a)** $\frac{3}{5}$ **b)** $-1\frac{7}{8}$

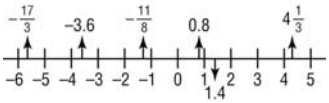
c) $-\frac{13}{5}$ **d)** $-\frac{11}{3}$

18. **a)** $\frac{6}{7}$ **b)** $-\frac{3}{4}$

c) $-\frac{6}{7}$ **d)** $\frac{5}{9}$

19. The statement is true when both numbers are positive.

20. **a)**



b) $-\frac{17}{3}, -3.6, -\frac{11}{8}$ **c)** $-\frac{11}{8}, 0.8, 1.4, 4\frac{1}{3}$

d) Answers will vary. For example:

$-4.5, -2\frac{1}{3}, -0.3, 1.1, 3\frac{5}{8}$

21. **a)** $-\frac{5}{7} < -\frac{4}{7}$ **b)** $-\frac{5}{6} < -\frac{5}{7}$

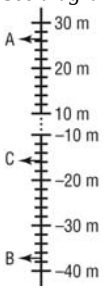
c) $-2.2 = -\frac{11}{5}$ **d)** $-4.46 < -4.46$

22. **a)** Hiker A: 26.4 or $\frac{132}{5}$ m

Hiker B: –37.2 or $-\frac{186}{5}$ m

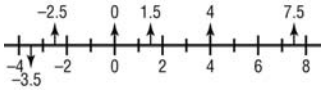
Hiker C: –15.7 or $-\frac{157}{10}$ m

b) *See diagram below.*

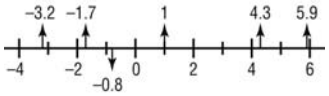


c) Hiker C **d)** Hiker B

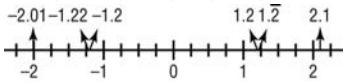
23. **a)** $-3.5, -2.5, 0, 1.5, 4, 7.5$



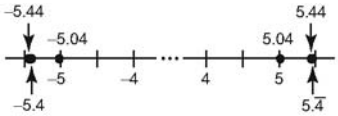
b) $-3.2, -1.7, -0.8, 1, 4.3, 5.9$



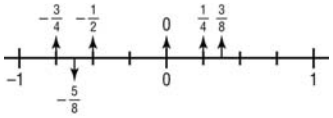
c) $-2.01, -1.22, -1.2, 1.2, 1.\overline{2}, 2.1$



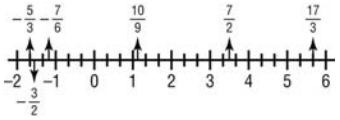
d) $-5.44, -5.4, -5.04, 5.04, 5.44, 5.\overline{4}$



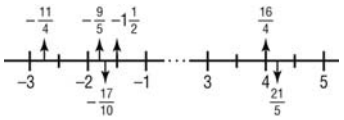
24. **a)** $\frac{3}{8}, \frac{1}{4}, 0, -\frac{1}{2}, -\frac{5}{8}, -\frac{3}{4}$



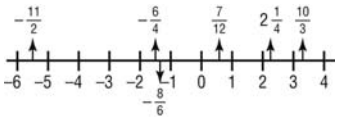
b) $\frac{17}{3}, \frac{7}{2}, \frac{10}{9}, -\frac{7}{6}, -\frac{3}{2}, -\frac{5}{3}$



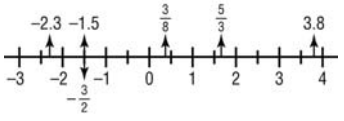
c) $\frac{21}{5}, \frac{16}{4}, -1\frac{1}{2}, -\frac{17}{10}, -\frac{9}{5}, -\frac{11}{4}$



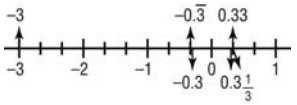
d) $\frac{10}{3}, 2\frac{1}{4}, \frac{7}{12}, -\frac{8}{6}, -\frac{6}{4}, -\frac{11}{2}$



25. **a)** $-2.3, -1.5 = -\frac{3}{2}, \frac{3}{8}, \frac{5}{3}, 3.8$



b) $-3, -0.\overline{3}, -0.3, 0.3, 0.33, \frac{1}{3}$



26. **a)** $3 = \frac{3}{1}$ **b)** $-2 = \frac{-2}{1}$ **c)** $-0.5 = \frac{-1}{2}$ **d)** $-7.45 = \frac{-149}{20}$

27. **a)** Rational number **b)** Irrational number
c) Rational number **d)** Rational number

Unit 3: Start Where You Are, page 105

1. **a)** $3\frac{1}{6}$ **b)** $2\frac{7}{8}$
c) $1\frac{1}{2}$ **d)** $5\frac{5}{12}$
e) $2\frac{7}{10}$ **f)** $\frac{1}{2}$
g) $1\frac{17}{20}$ **h)** $2\frac{5}{6}$

2. **a)** 4 **b)** −4
c) −10 **d)** 4
e) −1 **f)** −3
g) 18 **h)** −18

3.2 Adding Rational Numbers, page 111

3. **a)** $0.8 + 1.5 = 2.3$ **b)** $1.5 + (-0.8) = 0.7$
c) $(-0.8) + (-1.5) = -2.3$
d) $(-1.5) + 0.8 = -0.7$

4. **a)** $\frac{1}{2} + \frac{5}{4} = \frac{7}{4}$ **b)** $\left(-\frac{5}{4}\right) + \frac{1}{2} = -\frac{3}{4}$
c) $\frac{5}{4} + \left(-\frac{1}{2}\right) = \frac{3}{4}$ **d)** $\left(-\frac{1}{2}\right) + \left(-\frac{5}{4}\right) = -\frac{7}{4}$

5. **a)** **i)** 5 **ii)** 6.2
b) **i)** −5 **ii)** −6.2
c) **i)** −1 **ii)** −1.4
d) **i)** 1 **ii)** 1.4

6. Parts c and d

7. **a)** **i)** 12 **ii)** 6
b) **i)** −12 **ii)** −6
c) **i)** −6 **ii)** −3
d) **i)** 6 **ii)** 3

8. Part c

9. **a)** −2.4 **b)** 3.44
c) −32.825 **d)** −96.05
e) 182.281 **f)** −17.938

10. Yes, the sum of two negative rational numbers is less than both numbers.

11. **a)** $-\frac{1}{6}$ **b)** $\frac{7}{15}$
c) $-3\frac{19}{20}$ **d)** $7\frac{1}{10}$
e) $-4\frac{1}{12}$ **f)** $-1\frac{1}{30}$
g) $\frac{7}{8}$ **h)** $-3\frac{5}{6}$

i) $-5\frac{5}{12}$ **j)** $\frac{29}{40}$

12. **a)** The sum is positive. **b)** The sum is negative.
c) The sum has the same sign as the rational number farther away from 0.

13. **a)** –36.25 and –25.35
b) **i)** –36.25 + (–25.35) = –61.60
ii) $61.60
c) **i)** –61.60 + (14.75) = –46.85
ii) $46.85

14. **a)** –0.38 **b)** 0.38
c) $\frac{16}{15}$ **d)** $\frac{11}{20}$

15. **a)** –7.7°C **b)** –17.1°C
c) *See diagram below.*

16. **a)** The sum in part ii is greater since the positive number is farther away from 0.
i) –5.77 **ii)** 5.77
b) The sum in part ii is greater since the sum in part i is a sum of two negative numbers.
i) $-1\frac{5}{12}$ **ii)** $\frac{1}{12}$

17. **a)** 45.50, 22.25, –15.77, –33.10
b) 45.50 + 22.25 + (–15.77) + (–33.10) = 18.88
c) $18.88

18. No, Lucille's business lost $266.04 in the first 6 months.
–545.50 + (–978.44) + 2115.70 + (–888) + 2570.4 + (–2540.2) = –266.04

19. **a)** Any number less than or equal to 3.5
b) Any number greater than or equal to –11.6
c) Any number greater than or equal to 14.4
d) Any number less than or equal to 14.4

20. **a)** $1\frac{5}{8}$ **b)** $-1\frac{7}{15}$
c) $5\frac{5}{8}$ **d)** $-3\frac{7}{12}$

21. Any number less than or equal to 3.3

22. The greatest possible sum less than 0 is $-\frac{1}{12}$.
For example: $-\frac{1}{3}+\frac{1}{4}=-\frac{1}{12}$

3.3 Subtracting Rational Numbers, page 119

3. **a)** **i)** 2 **ii)** 1.8
b) **i)** –8 **ii)** –8.4
c) **i)** 2 **ii)** 1.8
d) **i)** –2 **ii)** –1.8

4. Part d

5. **a)** **i)** 9 **ii)** $\frac{9}{5}$
b) **i)** –13 **ii)** $-\frac{13}{5}$
c) **i)** 13 **ii)** $\frac{13}{5}$
d) **i)** 13 **ii)** $\frac{13}{5}$

6. Part c

7. **a)** 7.3 **b)** –85.77
c) 64.73 **d)** –31.57
e) –38.03 **f)** 151.84

8. **a)** 4.6°C or –4.6°C
b) There are two possible answers depending on which temperature is subtracted from the other temperature.

9. **a)** $-3\frac{5}{6}$ **b)** $-4\frac{14}{15}$
c) $-4\frac{11}{12}$ **d)** $-4\frac{1}{24}$
e) $3\frac{1}{3}$ **f)** $2\frac{5}{24}$

10. Yes, it is possible when you subtract a negative number from a positive number. For example:
1.3 – (–3.5) = 5.8; $\frac{3}{2}-\left(-\frac{5}{2}\right)=4$

11. **a)** –417.5, 8844.43
b) 8844.43 – (–417.5) = 9261.93
The points are 9261.93 m apart.

12. **a)** Negative; –44.98 **b)** Positive; 7.11
c) Positive; $2\frac{1}{4}$ **d)** Negative; $-6\frac{4}{15}$

13. **a)** $1\frac{23}{30}$ **b)** 0.55
c) $4\frac{43}{60}$ **d)** 7.69

14. **a)** Any number greater than or equal to –4.9
For example: –4.8
b) Any number less than or equal to –4.6
For example: –5.2
c) Any number greater than or equal to 8.2
For example: 9.3

d) Any number less than or equal to –3.7
For example: –3.8

15. **a)** 65.7 **b)** $\frac{3}{10}$

c) –2.03 **d)** $4\frac{1}{6}$

e) –5 **f)** $-8\frac{3}{4}$

16. **a)** Any 2 numbers with a difference of –3.5
For example: –1.1 and 2.4; 7.2 and 10.7

b) Any 2 numbers with a sum of –13.9
For example: –5.7 and –8.2; –15.7 and 1.8

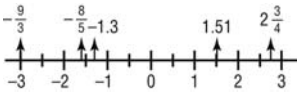
c) Any 2 numbers with a sum of –6.2
For example: –9.3 and 3.1; 1.3 and –7.5

17. **a)** Any number greater than or equal to –17.5

b) Any number less than or equal to –3.1

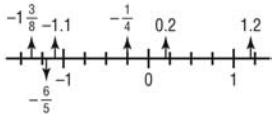
Unit 3: Mid-Unit Review, page 121

1. **a)**



b) $-\frac{9}{3}$, and $-\frac{8}{5}$; they are on the left of –1.5 on the number line.

2. $-1\frac{3}{8}, -\frac{6}{5}, -1.1, -\frac{1}{4}, 0.2, 1.2$



3. **a)** > **b)** <

c) < **d)** >

4. Answers will vary. For example:

a) 1.3 **b)** 0

c) $\frac{7}{20}$ **d)** –1

5. **a)** The sum of two positive numbers is positive.
The sum of two negative numbers is negative.
The sum of a negative number and a positive number has the same sign as the number farther away from 0.

b) **i)** Positive; 5.82 **ii)** Negative; –6.03

iii) Negative; $-1\frac{19}{24}$ **iv)** Positive; 1.31

v) Negative; $-2\frac{43}{45}$ **vi)** Negative; –0.04

6. **a)** 8.95 **b)** –57.82

c) –124.7 **d)** $\frac{37}{72}$

e) $-3\frac{1}{20}$ **f)** $-4\frac{20}{21}$

7. **a)** **i)** 1.4°C **ii)** An increase

b) 10.9°C

8. **a)** –22.85 **b)** –97.4

c) $-\frac{1}{2}$ **d)** $-8\frac{5}{18}$

e) –6.1 **f)** $6\frac{3}{8}$

9. 6193.7 – (–86) = 6279.7
The distance between the two points is 6279.7 m.

10. **b)** **i)** Positive; 8.7 **ii)** Negative; –2.52

iii) Negative; $-\frac{49}{60}$ **iv)** Positive; $13\frac{1}{6}$

3.4 Multiplying Rational Numbers, page 127

3. Part d

a) –15.6 **b)** –10.4

c) –6.5 **d)** 6.39

4. Parts a, c, and d

a) –2 **b)** $1\frac{1}{4}$

c) $-1\frac{3}{5}$ **d)** $-\frac{7}{16}$

5. **a)** –0.128 **b)** 2.855

c) 3.304 **d)** 5.95

6. Parts a, b, c, e

7. **a)** $-\frac{2}{15}$ **b)** $-\frac{3}{20}$

c) $\frac{2}{5}$ **d)** $\frac{5}{9}$

8. **a)** 12.75

b) The product is less than 10.

c) 11

d) The product is less than 10.

e) 12.5

f) The product is less than 10.

9. **a)** –$96 **b)** –$105

c) $14.95

10. (–10.4)(3.6) = –37.44
The diver's depth is 37.44 m after 3.6 min.

11. **a)** –3.444 **b)** 28.44

c) 231.04 **d)** 104.52

12. **a)** –4 **b)** $\frac{5}{9}$

c) $-14\frac{29}{36}$ **d)** $7\frac{1}{3}$

13. **a)** 104

b) **i)** 1.04 **ii)** –0.104

iii) –10.4 **iv)** 0.104

c) I only need to determine the sign and estimate the decimal point.

d) Answers will vary. For example:
(260)(0.04) = 10.4; (0.026)(4000) = 104;
(–2.6)(–4) = 10.4

14. **a)** (–3457.25)(25) = –86 431.25

b) −$40 863.38

15. **a)** Positive; 3.1 **b)** Negative; $-\frac{5}{7}$

16. **a)** –4.7 **b)** $\frac{7}{2}$

c) –0.4 **d)** $1\frac{2}{5}$

17. Yes, it is possible when both numbers are between 1 and –1. For example: (–0.6)(0.4) = –0.24

18. **b)** $-\frac{2759}{7826}$

3.5 Dividing Rational Numbers, page 134

3. **a)** –0.5 **b)** –1.4

c) 2.1 **d)** –0.2

e) 2.4 **f)** –0.9

4. **a)** $-\frac{2}{3}$ **b)** $-\frac{4}{3}$

c) $\frac{7}{16}$ **d)** $\frac{3}{44}$

e) $-\frac{15}{4}$ **f)** $\frac{36}{55}$

5. Parts c, d, e, and f

6. –1.6 m/h

7. **a)** 0.8 **b)** –1.4625

c) $-0.41\overline{6}$ **d)** 5.1

e) $-12.5\overline{3}$ **f)** 3.5

8. 5 h

9. **a)** –11.52 **b)** $-23.28\overline{3}$

c) 36.7 **d)** 4.8

e) $-10.217\overline{3}$ **f)** $-0.240\overline{2}$

10. **a)** 41

b) The quotient will be less than –10.

c) The quotient will be less than –10.

d) –1.2

11. **a)** 48 weeks

12. **a)** $-\frac{15}{14}$ **b)** $\frac{1}{8}$

c) $\frac{2}{3}$ **d)** $-6\frac{2}{15}$

e) $-1\frac{17}{27}$ **f)** $\frac{31}{57}$

13. 35 times

14. –2.8°C/h

15. –$0.32

16. Part c; $\left(\frac{5}{6}\right) \div \left(-\frac{2}{3}\right) = -\frac{5}{4} = -1\frac{1}{4}$

17. **a)** –4.5 **b)** $-\frac{21}{32}$

c) 2.35 **d)** $-\frac{17}{3}$

18. **a)** –2.6 **b)** –6.9

c) –6.3 **d)** –3.586

19. **a)** Ellice: 1300 m ÷ 7.8 min ≐ 166.67 m/min
Alex: –630 m ÷ 4.2 min = −150 m/min
1300 m represents distance in the positive direction and –630 m represents distance in the opposite direction.

b) Ellice runs at the greater average speed.

20. Answers will vary. For example: $-\frac{5}{6} \div \frac{5}{2} = -\frac{1}{3}$

21. Part d

3.6 Order of Operations with Rational Numbers, page 140

3. **a)** 3.58 **b)** –16.42

c) 73 **d)** –0.192

4. **a)** $\frac{1}{4}$ **b)** $-\frac{5}{4}$

c) $\frac{15}{8}$ **d)** $\frac{263}{60}$

5. **a)** –9.1

6. **a)** –52.64 **b)** 98.784

c) –206.99 **d)** –561.834

7. **a)** $-2\frac{7}{12}$ **b)** $\frac{8}{9}$

c) $-\frac{8}{27}$ **d)** –8

8. **a)** Correction:
$(-3.7) \times (-2.8 + 1.5) - 4.8 \div (-1.2)$
$= (-3.7) \times (-1.3) - (-4)$
$= 4.81 + 4$
$= 8.81$

b) Correction:
$-\frac{3}{8} - \frac{4}{5} \times \frac{3}{10} \div \left(-\frac{4}{5}\right)$
$= -\frac{3}{8} - \frac{6}{25} \div \left(-\frac{4}{5}\right)$
$= -\frac{3}{8} - \left(-\frac{3}{10}\right)$
$= -\frac{3}{40}$

9. $192.74

10. **a)** 330 cm^2

11. **a)** **i)** About −18°C **ii)** −40°C **iii)** About −47°C

b) **i)** 10°C **ii)** −25°C **iii)** 0°C

12. **a)** Multiplication, addition; $-6\frac{1}{3}$

b) Multiplication, addition; $6\frac{8}{15}$

c) Division, multiplication, addition; $3\frac{1}{8}$

d) Addition, multiplication, subtraction $1\frac{1}{16}$

13. **a)** 54.6 **b)** −5.62

c) About 12.82 **d)** About −14.24

14. **a)** $[-8.1 + (-16.7)] \div 2 = -12.4$; −12.4°C

b) I used brackets to add the two temperatures first before I divided the sum by 2.

15. **a)** Answers will vary. For example:

$$\frac{-3}{2} + \left(\frac{4}{-5} - \frac{-8}{6}\right) \div \frac{10}{-12} = \frac{-107}{50}$$

b) Answers will vary. For example:

$$\left(\frac{6}{-5} - \frac{-12}{10}\right)\left(\frac{2}{-3} - \frac{4}{-8}\right) = 0$$

16. **a)** Below 0°C **b)** About −1.01°C

17. Correction:

$(-8.2)^2 \div (-0.3) - 2.9 \times (-5.7)$

$= 67.24 \div (-0.3) - (-16.53)$

$= -224.1\overline{3} - (-16.53)$

$= -224.1\overline{3} + 16.53$

$= -207.60\overline{3}$

18. **a)** 1.63

b) The student likely calculated $6.8 \div (-3) \times (-6.7) + 3.5$ instead of calculating the numerator and the denominator and then finding the result of the division.

19. $\frac{5}{9}$ is equivalent to $\frac{1}{1.8}$, or dividing by 1.8.

20. −14.1°C

21. $-3.8 + 9.1 \times (-2.5 - 0.5) = -31.1$

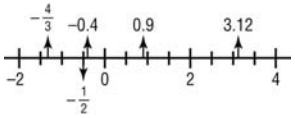
Yes, it is possible to find a positive solution.

For example: $-(3.8 + 9.1) \times (-2.5) - 0.5 = 31.75$

Unit 3: Review, page 144

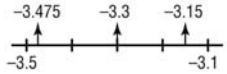
1. Parts a and c

2. $-\frac{4}{3}, -\frac{1}{2}, -0.4, 0.9, 3.12$

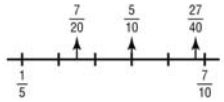


3. Answers will vary. For example:

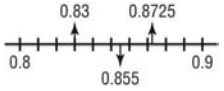
a) −3.475, −3.3, −3.15



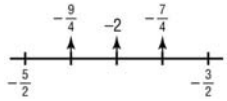
b) $\frac{7}{20}, \frac{5}{10}, \frac{27}{40}$



c) 0.83, 0.855, 0.8725



d) $-\frac{9}{4}, -2, -\frac{7}{4}$



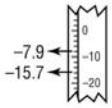
4. −2.00; −0.51; −0.09; 0.54; 0.95

5. **a)** −1.5 **b)** 78.44

c) −28.17 **d)** 48.053

6. **a)** −7.9°C

b) *See diagram below.*



7. **a)** $\frac{13}{8}$ **b)** $1\frac{5}{6}$

c) $-6\frac{1}{4}$ **d)** $-\frac{29}{18}$

8. **a)** 1.4 **b)** −83.14

c) −9.64 **d)** −16.82

9. $22.35

10. **a)** $-\frac{1}{2}$ **b)** $\frac{31}{40}$

c) $10\frac{43}{70}$ **d)** $-13\frac{5}{12}$

11. Parts c and d

a) 1.12 **b)** −1.28

c) $-\frac{4}{5}$ **d)** $\frac{5}{9}$

12. −7.1°C

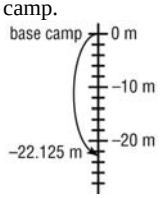
13. Answers will vary. For example:

$$\left(-\frac{7}{9}\right)\left(\frac{4}{5}\right) = \left(-\frac{4}{9}\right)\left(\frac{7}{5}\right)$$

14. **a)** −1.05 **b)** −9.43

c) $\frac{8}{21}$ **d)** −4

15. The climber will be 22.125 m lower than the base camp.



16. Parts c and d

a) –5.5 **b)** About –1.15

c) $-\frac{3}{5}$ **d)** $\frac{1}{3}$

17. Answers will vary. For example:

$\left(-\frac{3}{8}\right)\div\left(\frac{5}{11}\right) = \left(\frac{3}{8}\right)\div\left(-\frac{5}{11}\right)$

18. **a)** –3.75 **b)** –8.3

c) 1.56

19. **a)** –7 **b)** $22.\overline{8}$

c) $-\frac{45}{77}$ **d)** $-\frac{10}{21}$

20. **a)** **i)** –4.74 **ii)** –0.54

b) The orders of operations are different.

21. **a)** $-\frac{17}{20}$ **b)** $\frac{1}{5}$

c) $-\frac{1}{5}$

22. **a)** 1554.82 cm^2

23. **a)** –4.9 **b)** $1\frac{13}{36}$

c) $-1\frac{211}{365}$ **d)** $2\frac{4}{5}$

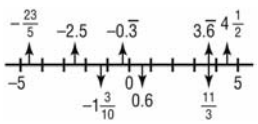
e) $-3\frac{6}{7}$ **f)** –5.8

g) –13.51

Unit 3: Practice Test, page 146

1. **a)** Answers will vary. For example: –0.55

2. **a)**



b) $4\frac{1}{2}, \frac{11}{3} = 3.\overline{6}, 0.6, -0.\overline{3}, -1\frac{3}{10}, -2.5, -\frac{23}{5}$

3. **a)** –1.3 **b)** $\frac{1}{2}$

c) 1.6 **d)** $-\frac{9}{4}$

4. **a)** It means that she owes $2.34.

b) –$67.44 **c)** 19 withdrawals

5. **a)** 823.6 **b)** $7\frac{2}{3}$

c) $2\frac{17}{30}$ **d)** About –3.75

6. **a)** $3\frac{1}{2}$

b) The student added $\frac{1}{2}+\left(-\frac{3}{4}\right)$ instead of doing the division first.

7. **a)** –13.75 **b)** 3.54

Cumulative Review Units 1-3, page 148

1. **a)** $\frac{1}{5}$ **b)** $\frac{15}{13}$

c) $\frac{3}{11}$ **d)** 1.2

e) 0.4 **f)** 1.8

2. **a)** 8 cm **b)** 1.1 m

c) 8.5 mm

3. **a)** 0.49 **b)** 2.56

c) 0.000 036 **d)** $\frac{144}{289}$

e) $\frac{1}{9}$ **f)** $\frac{4}{169}$

4. **a)** $\frac{7}{63}=\frac{1}{9}=\left(\frac{1}{3}\right)^2$, so $\frac{7}{63}$ is a perfect square.

b) $\frac{12}{27}=\frac{4}{9}=\left(\frac{2}{3}\right)^2$, so $\frac{12}{27}$ is a perfect square.

c) $\frac{4}{18}=\frac{2}{9}$, and 2 is not a perfect square, so $\frac{4}{18}$ is not a perfect square.

d) $0.016 = \frac{16}{1000}$, and 1000 is not a perfect square, so 0.016 is not a perfect square.

e) $4.9 = \frac{49}{10}$, and 10 is not a perfect square, so 4.9 is not a perfect square.

f) $0.121 = \frac{121}{1000}$, and 1000 is not a perfect square, so 0.121 is not a perfect square.

5. **a)** 2.6 m **b)** 7.8 m

6. 144.5, 168.9

7. **a)** About $\frac{1}{6}$ **b)** About 4

c) About 0.9 **d)** About $\frac{1}{3}$

8. **a)** 17.4 cm **b)** 6.3 m

9. 24 cm^2

10. **a)** 72 cm^2 **b)** About 265 cm^2

11. **a)** $4^3 = 64$ **b)** $6^4 = 1296$
c) $(-3)^7 = -2187$ **d)** $-(-2)^7 = 128$
e) $-10^5 = -100\,000$ **f)** $-1^{12} = -1$

12. **a)** Negative; -81 **b)** Positive; 15 625
c) Negative; -64 **d)** Positive; 49
e) Negative; -1 **f)** Positive; 1

13. **a)** 8×10^2 **b)** $5 \times 10^4 + 2 \times 10^3$
c) $1 \times 10^3 + 7 \times 10^2 + 6 \times 10^1$
d) $7 \times 10^6 + 4 \times 10^0$

14. **a)** 784 **b)** -5
c) -10 **d)** 139
e) 4 **f)** 1

15. **a)** 6^8 **b)** $(-3)^8$
c) $(-5)^3$ **d)** 2^{14}

16. **a)** -6 **b)** 12
c) -3250 **d)** 512

17. **a)** 10^4 m = 10 000 m **b)** 40 000 m

18. **a)** $6^8 = 1\,679\,616$ **b)** $7^6 + 3^9 = 137\,332$
c) $(-2)^3 - 1 = -9$ **d)** $6^8 + 3^{10} = 1\,738\,665$
e) $(-4)^6 - (-2)^{12} - (-3)^8 = -6561$
f) $3^6 = 729$

19. **a)** $-3.\overline{3}$, -3.3, -2.8, -1.9, 1.2, 4.8
b) $-\frac{13}{4}, -2\frac{1}{2}, -\frac{13}{10}, -\frac{2}{5}, \frac{3}{4}, \frac{19}{5}$
c) -1.01, $-\frac{1}{3}$, -0.11, 1.1, $\frac{4}{3}$, $1\frac{3}{8}$
d) -0.2, $-\frac{1}{6}$, $-0.\overline{1}$, $\frac{1}{8}$, $\frac{2}{9}$, 0.25

20. **a)** 1.44 **b)** -10.307
c) 9.17 **d)** -6.43
e) $-\frac{1}{12}$ **f)** $-4\frac{17}{24}$
g) $-7\frac{11}{12}$ **h)** $6\frac{1}{2}$

21. \$85.648

22. **a)** -36.5 **b)** 163.84
c) 3.2 **d)** -5.6
e) $11\frac{2}{5}$ **f)** $-18\frac{2}{3}$
g) $\frac{1}{20}$ **h)** $-1\frac{1}{5}$

23. **a)** $-\frac{11}{24}$ **b)** -40.55
c) $-6\frac{1}{20}$ **d)** $5\frac{1}{8}$

Unit 4 Linear Relations, page 150

Unit 4: Start Where You Are, page 153

1. $3n - 2$

2. $3n + 1$

4.1 Writing Equations to Describe Patterns, page 159

4. **a)** 2 **b)** 3
c) 4 **d)** 5

5. **a)** 7 **b)** 8
c) 9 **d)** 10

6. Parts a and c

7. $f + 5$

8. $n = 4s + 1$ **9.** $s = 2f + 3$

10. **a)** The red number 1 represents the red toothpick that is the same in each picture. The number of black toothpicks added is 4 times the number of houses in the picture.
b) $1 + 4n$ **c)** $t = 1 + 4n$

11. **a)** **i)** As the term number increases by 1, the term value increases by 11.
ii) $11t$ **iii)** $v = 11t$
b) **i)** As the term number increases by 1, the term value increases by 3.
ii) $3t + 2$ **iii)** $v = 3t + 2$
c) **i)** As the term number increases by 1, the term value decreases by 1.
ii) $8 - t$ **iii)** $v = 8 - t$

12. **a)**

Figure Number, *n*	Number of Toothpicks, *t*
1	3
2	5
3	7
4	9

b) $2n + 1$ **c)** 91
d) $t = 2n + 1$ **e)** Figure 8

13. **a)**

Number of Tables, *n*	Number of People, *p*
1	6
2	10
3	14
4	18

b) As the number of tables increases by 1, the number of people who can be seated increases by 4.
d) $p = 4n + 2$ **e)** 10 tables

14. **a)** $C = 250 + 1.25n$ **b)** \$3375
c) 300 brochures

15. **a)**

Number of Toppings, *n*	Cost of Pizza, *C* (\$)
1	9.75
2	10.50
3	11.25
4	12.00
5	12.75