

Math Connections Worksheets

MAT1033C Intermediate Algebra

Chapter 7

Rational Exponents, Radicals and Complex
Numbers

Name:
Instructor:

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Section:

Chapter 7 Rational Exponents, Radicals, and Complex Numbers
Section 7.1 Radicals and Radical Functions

Learning Objectives

1. Find square roots.
2. Approximate roots.
3. Find cube roots.
4. Find n th roots.
5. Find $\sqrt[n]{a}$ where a is a real number.
6. Graph square and cube root functions.

Vocabulary.

Use the choices to complete each statement.

Index	Radical sign	Radicand
Cubes	Squares	True
False		

1. In the expression $\sqrt[4]{5}$, 4 is the _____; 5 is the _____, and the $\sqrt{\quad}$ is the _____.
2. True or false. The square root of -4 is -2 . _____
3. The numbers 9, 25, and 81 are perfect _____.
4. The numbers 1, 27, and 64 are perfect _____.

Objective 1

Simplify.

5. $\sqrt{3600}$ 5. _____

6. $\sqrt{\frac{4}{9}}$ 6. _____

7. $\sqrt{0.25}$ 7. _____

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8. $-\sqrt{49}$

8. _____

9. $\sqrt{-16}$

9. _____

10. $\sqrt{81x^{16}}$

10. _____

Objective 2

Use a calculator to approximate each square root to 3 decimal places.

11. $\sqrt{24}$

11. _____

12. $\sqrt{120}$

12. _____

13. $\sqrt{104}$

13. _____

14. $\sqrt{260}$

14. _____

Objective 3

Find each cube root.

15. $\sqrt[3]{64}$


15. _____

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16. $\sqrt[3]{\frac{1}{-27}}$

16. _____

 17. $\sqrt[3]{-27x^9}$

17. _____

18. $\sqrt[3]{1000}$


18. _____

Objective 4

Find each root. Assume all variables represent nonnegative real numbers.

19. $\sqrt[5]{243}$

19. _____

 20. $\sqrt[6]{64x^{12}}$

20. _____

21. $\sqrt[4]{-81x^{16}}$

21. _____

Objective 5

Simplify, Assume all variables represent nonnegative real numbers.

22. $\sqrt{(x-5)^2}$

22. _____

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23. $\sqrt[8]{y^8}$

23. _____

24. $\sqrt{(-5)^2}$

24. _____

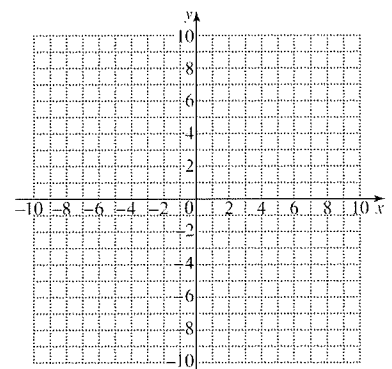
25. $\sqrt[3]{(x-1)^3}$

25. _____

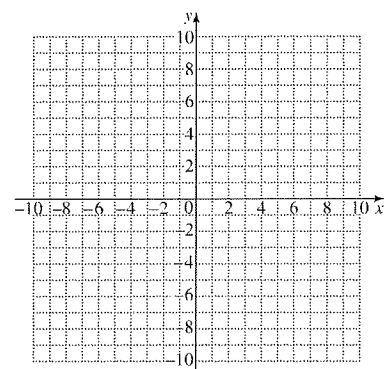
Objective 6

Graph the following functions.

26. $f(x) = \sqrt{x+5}$



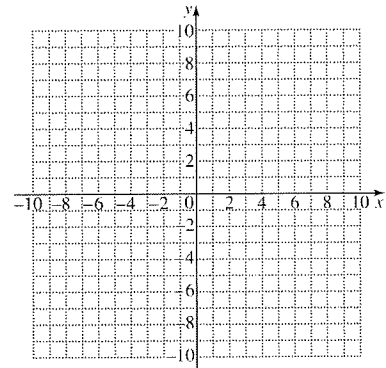
27. $g(x) = \sqrt[3]{x-2}$



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28. $h(x) = \sqrt{x} - 4$



Concept Extension

Without a calculator, state what whole number the following square roots are closest to.

29. $\sqrt{389}$

29. _____

30. $\sqrt{2480}$

30. _____

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Section 7.2 Rational Exponents

Learning Objectives

1. Understand the meaning of $a^{1/n}$.
2. Understand the meaning of $a^{m/n}$.
3. Understand the meaning of $a^{-m/n}$.
4. Use rules for exponents to simplify expressions that contain rational exponents.
5. Use rational exponents to simplify radical expressions.

Objective 1

Use radical notation to write each expression. Simplify if possible.

1. $25^{1/2}$ 1. _____

2. $-(32)^{1/5}$ 2. _____

3. $(5x)^{1/3}$ 3. _____

4. $4x^{1/4}$ 4. _____

Objective 2

Use radical notation to write each expression. Simplify if possible.


5. $36^{3/2}$ 5. _____

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6. $(x+3)^{2/5}$

6. _____

 7. $(-64)^{2/3}$

7. _____

8. $(4x+3)^{5/6}$

8. _____

Objective 3

Write with positive exponents. Simplify if possible.

9. $4^{-1/2}$

9. _____

10. $x^{-1/5}$

10. _____

11. $\frac{4}{5x^{-3/4}}$

11. _____

12. $(-32)^{-5/6}$

12. _____

Objective 4

Use the properties of exponents to simplify each expression. Write with positive exponents.

13. $x^{1/2}x^{1/4}$

13. _____

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14. $(16y^4)^{3/4}$

14. _____

15. $\frac{5^{2/3}5^{1/4}}{5^{1/3}}$

15. _____


 16. $\frac{(3x^{1/4})^3}{x^{1/12}}$

16. _____

Multiply.

17. $(x^{1/2} - 2)(x^{1/3} + 1)$

17. _____

 18. $x^{2/3}(x - 2)$

18. _____

Factor the common factor from the given expression.

19. $x^{3/5}; x^{4/5} - 3x$

19. _____

20. $x^{1/3}; x^{4/3} - 4x^{5/3}$

20. _____

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Objective 5

Use rational exponents to simplify each radical. Assume that all variables represent positive numbers.

21. $\sqrt[4]{y^2}$ 21. _____

22. $\sqrt[15]{r^5 s^{10}}$ 22. _____

23. $\sqrt[6]{x^{21} y^{15}}$ 23. _____

Use rational exponents to write as a single expression.

24. $\sqrt[3]{x^2} \cdot \sqrt[4]{x^3}$ 24. _____

25. $\sqrt{5} \cdot \sqrt[3]{6}$ 25. _____

26. $\frac{\sqrt[3]{x^2}}{\sqrt[5]{x}}$ 26. _____

Concept Extension

27. What times $x^{2/3}$ will the result be $x^{1/4}$? 27. _____

28. What divided by $x^{5/8}$ will the result be $x^{7/4}$? 28. _____

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Section 7.3 Simplifying Radical Expressions

Learning Objectives

1. Use the product rule for radicals.
2. Use the quotient rule for radicals.
3. Simplify radicals.
4. Use the distance and midpoint formula.

Objective 1

Use the product rule to multiply.

1. $\sqrt{5} \cdot \sqrt{7}$ 1. _____

2. $\sqrt{13} \cdot \sqrt{x}$ 2. _____

3. $\sqrt{\frac{5}{6}} \cdot \sqrt{11}$ 3. _____

4. $\sqrt[5]{13ab} \cdot \sqrt[5]{2a^2b^3}$ 4. _____

5. $\sqrt[3]{\frac{3}{4}} \cdot \sqrt[3]{\frac{2}{5}}$ 5. _____

Objective 2

Use the quotient rule to simplify.

6. $\sqrt{\frac{3}{16}}$ 6. _____

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7. $\sqrt{\frac{81}{x^2z}}$

7. _____

8. $\sqrt[3]{\frac{27y}{8x^6}}$

8. _____

9. $\sqrt{\frac{z^{16}}{25x^{12}}}$

9. _____

Objective 3

Simplify.

10. $\sqrt{50}$

10. _____

11. $2\sqrt{8x^2}$

11. _____

12. $\sqrt[3]{250x^4}$

12. _____



13. $\sqrt[5]{-32x^{10}y}$

13. _____

14. $-\sqrt[4]{32x^6y^5}$

14. _____

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Objective 4

Find the distance between each pair of points. Give an exact distance and a three-decimal-place approximation.

15. $(1,2)$ and $(-3,5)$ 15. _____



16. $(-3,2)$ and $(1,-3)$ 16. _____

17. $(0,4)$ and $(-2,-6)$ 17. _____

Find the midpoint of the line segment whose endpoints are given.

18. $(2,3)$ and $(-4,5)$ 18. _____

19. $(-3,-6)$ and $(6,4)$ 19. _____



20. $(-2,-1)$ and $(-8,6)$ 20. _____

Concept Extension

Find the midpoint and distance between the given points.

21. $(\sqrt{3},\sqrt{5})$ and $(-3\sqrt{3},6\sqrt{5})$ 21. _____

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Section 7.4 Adding, Subtracting, and Multiplying Radical Expressions

Learning Objectives

1. Add or subtract radical expressions.
2. Multiply radical expressions.

Objective 1

Add or subtract.



1. $2\sqrt{50} - 3\sqrt{125} + \sqrt{98}$

1. _____

2. $3\sqrt[3]{16x^3} - x\sqrt[3]{2} + \sqrt[3]{54x}$

2. _____

3. $3\sqrt{y^3} + \sqrt{y^5} + \sqrt{y}$

3. _____



4. $\sqrt[3]{\frac{11}{8}} - \frac{\sqrt[3]{11}}{6}$

4. _____

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5. $\sqrt{\frac{12x}{25}} - \frac{\sqrt{48x}}{5}$

5. _____

Objective 2

Multiply, and then simplify if possible.

6. $\sqrt{3}(2 + \sqrt{3})$

6. _____

7. $\sqrt{6}(\sqrt{12} - \sqrt{24})$

7. _____

8. $(2 + \sqrt{3})(4 - \sqrt{3})$

8. _____



9. $(2\sqrt{7} + 3\sqrt{5})(\sqrt{7} - 2\sqrt{5})$

9. _____

10. $(\sqrt[3]{4} - 5)(3 - \sqrt[3]{2})$

10. _____

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11. $(\sqrt{3}-2)^2$

11. _____

12. $(\sqrt{y+1}-3)^2$

12. _____

Concept Extension

13. Find the perimeter of a rectangle with the length of $\sqrt{108}$ feet and width of $\sqrt{75}$ feet.

13. _____

14. Find the length of the diagonal for the rectangle above. Round the answer to three decimal places, if necessary.

14. _____

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Section 7.5 Rationalizing Denominators and Numerators of Radical Expressions

Learning Objectives

1. Rationalize denominators.
2. Rationalize denominators having two terms.
3. Rationalize numerators.

Vocabulary.

Use the choices to complete each statement.

Conjugate

$$\frac{6}{6}$$

Rationalizing the Numerator

$$\frac{\sqrt{5}}{\sqrt{5}}$$

Rationalizing the Denominator

1. _____ is the process of removing radicals from the numerator.
2. The _____ of $5 + \sqrt{2}$ is $5 - \sqrt{2}$.
3. To rationalize the denominator of $\frac{6}{\sqrt{5}}$, you will multiply the expression by _____.

Objective 1

Rationalize each denominator.

4. $\frac{4}{\sqrt{3}}$

4. _____

5. $\sqrt{\frac{5}{6x}}$

5. _____

6. $\frac{3}{\sqrt{8x}}$

6. _____

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7. $\frac{8x}{\sqrt[5]{8x^4}}$

7. _____

Objective 2

Rationalize each denominator.

8. $\frac{3}{2+\sqrt{x}}$

8. _____

9. $\frac{\sqrt{3}+\sqrt{5}}{4-\sqrt{2}}$

9. _____

10. $\frac{3\sqrt{x}+y}{2\sqrt{x}-\sqrt{y}}$

10. _____



11. $\frac{-7}{\sqrt{x}-3}$

11. _____

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Objective 3

Rationalize each numerator.



12. $\sqrt{\frac{18}{5}}$

12. _____

13. $\frac{\sqrt{3x}}{15}$

13. _____

14. $\sqrt[3]{\frac{54}{243}}$

14. _____

15. $\frac{1+\sqrt{x}}{3}$

15. _____

16. $\frac{\sqrt{a}+\sqrt{b}}{\sqrt{a}-\sqrt{b}}$

16. _____

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17. $\frac{\sqrt{2}-4x}{x+\sqrt{2}}$

17. _____

Concept Extension

18. The formula for the radius r of a sphere with a volume of V is $r = \sqrt[3]{\frac{3V}{4\pi}}$. Rationalize the denominator of the radical expression in this formula.

18. _____

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Section 7.6 Radical Equations and Problem Solving

Learning Objectives

1. Solve equations that contain radical equations.
2. Use the Pythagorean Theorem to model problems.

Objective 1

Solve.

1. $\sqrt{x+1} = 6$

1. _____

2. $\sqrt{2x+5} + 2 = 7$

2. _____

3. $\sqrt{x-3} = -6$


3. _____

4. $\sqrt[3]{x-7} = 3$

4. _____

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 5. $\sqrt[3]{2x-3} - 2 = -5$

5. _____

6. $\sqrt{x+8} = \sqrt{2x+6}$


6. _____

7. $x + \sqrt{x+1} = 1$

7. _____

8. $\sqrt{x+2} - \sqrt{x-2} = 1$

8. _____

 9. $\sqrt{5x-1} - \sqrt{x+2} = 3$

9. _____

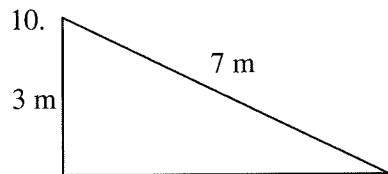
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Objective 2

Solve.

Find the length of the unknown side of the triangle.

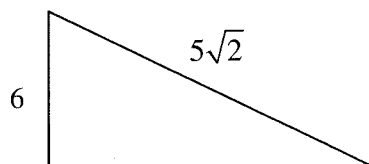


10. _____

11. A two cars leave Dallas, one heads north, the other heads east. The car traveling north averages a speed of 50 mph while the other car averages 45 mph. After 3 hours, how far apart are the two cars? Round your answer to the nearest whole number.

11. _____

12. Find the length of the unknown side.



12. _____

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Concept Extension

13. $\sqrt{(x^2 - x) + 4} = 3(x^2 - x) + 2$

13. _____

14. Solve: $\sqrt{\sqrt{x-2} + \sqrt{x}} = \sqrt{5}$

14. _____

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Section 7.7 Complex Numbers

Learning Objectives

1. Write square roots of negative numbers in the form bi .
2. Add or subtract complex numbers.
3. Multiply complex numbers.
4. Divide complex numbers.
5. Raise i to powers.

Vocabulary

Use the choices to complete each statement.

Complex	Imaginary Unit	Pure Imaginary
Real	- 1	1
$\sqrt{-1}$	$\sqrt{1}$	

1. In the complex number system, i is the _____.
2. A _____ number is any number that can be written in the form: $a + bi$, where both a and b are real numbers.
3. A _____ is the complex number, where $a = 0$ and b does not.
4. $i =$ _____.
5. A complex number is considered a _____ number, if $b = 0$.
6. $i^2 =$ _____.

Objective 1

Simplify.

7. $\sqrt{-36}$ 7. _____

8. $\sqrt{-25}$ 8. _____

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9. $\sqrt{-5}$

9. _____

10. $\sqrt{-72}$

10. _____

Objective 2

Add or subtract. Write the sum or difference in the form $a + bi$.

11. $(4 + i) + (3 - 2i)$

11. _____

12. $(5 + 6i) - (4 + 2i)$

12. _____

13. $(5 + 4i) + (3 + 2i) - (4 - 3i)$

13. _____

14. $(4 + 10i) - (11 + 2i)$

14. _____

Objective 3

Multiply. Write the product in the form $a + bi$.

15. $-5i \cdot 12i$

15. _____

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16. $4i \cdot (2 + 3i)$

16. _____

17. $(3 - 7i)(2 - 3i)$

17. _____

18. $(8 - 2i)^2$

18. _____



19. $(6 - 2i)(3 + i)$

19. _____

Objective 4

Write each quotient in the form $a + bi$.

20. $\frac{3}{2i}$

20. _____

21. $\frac{4}{2 - i}$

21. _____

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22. $\frac{3+2i}{1+5i}$

22. _____



23. $\frac{3+5i}{1+i}$

23. _____

Objective 5

Find each power of i .

24. i^9

24. _____

25. i^{30}

25. _____



26. $(2i)^6$

26. _____

27. $(-4i)^3$

27. _____

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Concept Extension

Write in the form $a + bi$.

28. $\frac{4 - \sqrt{-4}}{6}$

28. _____

29. $\frac{7 - \sqrt{-72}}{14}$

29. _____

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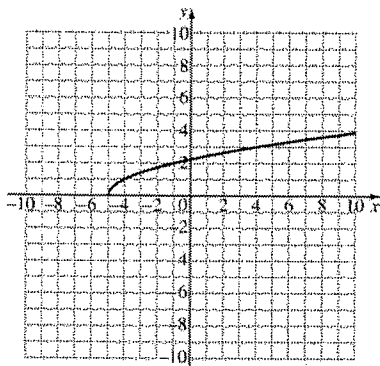
Chapter 7 Vocabulary

Vocabulary Word	Definition	Example
Principal, or square root	$\sqrt{a} = b$ if $b^2 = a$	$\sqrt{100} = 10$
Cube root	$\sqrt[3]{a} = b$ if $b^3 = a$	$\sqrt[3]{27} = 3$
Radical Function	Function that contains a root of x .	$f(x) = \sqrt{x} - 4$
Distance Formula	$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$	$(0, 2)(-2, 4)$ $\sqrt{(0+2)^2 + (2-4)^2} = \sqrt{4+4} = 2\sqrt{2}$
Midpoint Formula	$\left(\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}\right)$	$(0, 2)(-2, 4)$ $\left(\frac{0-2}{2}, \frac{2+4}{2}\right) = \left(\frac{-2}{2}, \frac{6}{2}\right) = (-1, 3)$
Like Radical	Radicals with the same index and the same radicand	$5\sqrt{3}$ and $x\sqrt{3}$ are like terms
Conjugate	The conjugate of $a + b$ is $a - b$	$4c + 2$ and $4c - 2$ are conjugates
Rationalizing the denominator	The process of writing the denominator without the radicals.	$\frac{2 \cdot \sqrt{3}}{\sqrt{3} \cdot \sqrt{3}} = \frac{2\sqrt{3}}{3}$
Rationalizing the numerator	The process of writing the denominator without the radicals.	$\frac{\sqrt{2} \cdot \sqrt{2}}{5 \cdot \sqrt{2}} = \frac{2}{5\sqrt{2}}$
Complex number	Any number that can be written as $a + bi$	$4 + 3i$
Complex Conjugates	$a + bi$ and $a - bi$ are conjugates.	The conjugate of $2 + 3i$ is $2 - 3i$

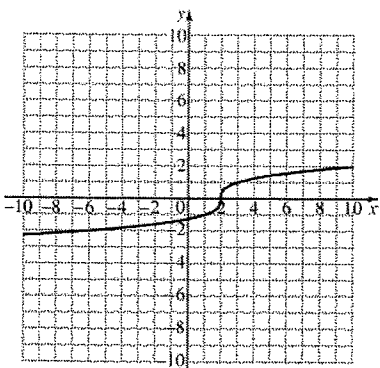
Answers

Chapter 7 Section 7.1

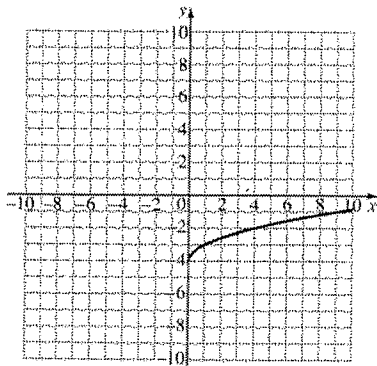
1. index; radicand; radical sign
2. false
3. squares
4. cubes
5. 60
6. $\frac{2}{3}$
7. 0.5
8. -7
9. Not a real number
10. $9x^8$
11. 4.899
12. 10.954
13. 10.198
14. 16.125
15. 4
16. $-\frac{1}{3}$
17. $-3x^3$
18. 10
19. 3
20. $2x^6$
21. Not a real number
22. $x-5$
23. y
24. 5
25. $x-1$
- 26.



27.



28.



29. 20
30. 50

Section 7.2

1. 5
2. -2
3. $\sqrt[3]{5x}$
4. $4\sqrt[4]{x}$
5. 216
6. $\sqrt[5]{(x+3)^2}$
7. 16
8. $\sqrt[6]{(4x+3)^5}$
9. $\frac{1}{2}$
10. $\frac{1}{x^{1/5}}$
11. $\frac{4x^{3/4}}{5}$
12. Not a real number
13. $x^{3/4}$
14. $8y^3$
15. $5^{7/12}$
16. $27x^{2/3}$
17. $x^{5/6} + x^{1/2} - 2x^{1/3} - 2$
18. $x^{5/3} - 2x^{2/3}$
19. $x^{3/5} \left(x^{1/5} - 3x^{2/5} \right)$
20. $x^{1/3} \left(x - 4x^{4/3} \right)$
21. \sqrt{y}
22. $\sqrt[3]{rs^2}$
23. $\sqrt{x^7 y^5}$
24. $\sqrt[12]{x^{17}}$
25. $\sqrt[6]{4500}$
26. $\sqrt[15]{x^7}$
27. $x^{-5/12} = \frac{1}{x^{5/12}}$
28. $x^{19/8}$

Section 7.3

1. $\sqrt{35}$
2. $\sqrt{13x}$
3. $\sqrt{\frac{55}{6}}$
4. $\sqrt[5]{26a^3 b^4}$
5. $\sqrt[3]{\frac{3}{10}}$
6. $\frac{\sqrt{3}}{4}$
7. $\frac{9}{x\sqrt{z}}$
8. $\frac{3\sqrt[3]{y}}{2x^2}$
9. $\frac{z^8}{5x^6}$
10. $5\sqrt{2}$
11. $4x\sqrt{2}$
12. $5x\sqrt[3]{2x}$
13. $-2x^2\sqrt[5]{y}$
14. $-2xy^4\sqrt{2x^2 y}$
15. 5; 5
16. $\sqrt{41}$; 6.403
17. $2\sqrt{26}$; 10.198
18. (-1, 4)
19. $\left(\frac{3}{2}, -1\right)$
20. $\left(-5, \frac{5}{2}\right)$
21. $\left(-\sqrt{3}, \frac{7}{2}\sqrt{5}\right)$; $\sqrt{173}$

Section 7.4

- $17\sqrt{2} - 15\sqrt{5}$
- $5x\sqrt[3]{2} + 3\sqrt[3]{2x}$
- $(y^2 + 3y + 1)\sqrt{y}$
- $\frac{\sqrt[3]{11}}{3}$
- $\frac{-2\sqrt{3x}}{5}$
- $2\sqrt{3} + 3$
- $6\sqrt{2} - 12$
- $5 + 2\sqrt{3}$
- $-16 - 3\sqrt{5}$
- $-17 + 3\sqrt[3]{4} + 5\sqrt[3]{2}$
- $7 - 4\sqrt{3}$
- $y + 10 - 6\sqrt{y+1}$
- $22\sqrt{3}$ feet
- 13.528 feet

Section 7.5

- Rationalizing the numerator
- Conjugate
- $\frac{\sqrt{5}}{\sqrt{5}}$
- $\frac{4\sqrt{3}}{3}$
- $\frac{\sqrt{30x}}{6x}$
- $\frac{3\sqrt{2x}}{4x}$
- $4\sqrt[5]{4x}$
- $\frac{3(2 - \sqrt{x})}{4 - x}$
- $\frac{\sqrt{10} + 4\sqrt{5} + \sqrt{6} + 4\sqrt{3}}{14}$
- $\frac{6x + 2y\sqrt{x} + 3\sqrt{xy} + y\sqrt{y}}{4x - y}$
- $\frac{7(3 + \sqrt{x})}{9 - x}$
- $\frac{6}{\sqrt{10}}$
- $\frac{x}{5\sqrt{3x}}$

- $\frac{2}{\sqrt[3]{36}}$
- $\frac{1 - x}{3(1 - \sqrt{x})}$
- $\frac{a - b}{a - b - 2\sqrt{ab}}$
- $\frac{2 - 16x^2}{4x^2 + 2 + 5x\sqrt{2}}$
- $r = \frac{\sqrt[3]{6\pi^2V}}{2\pi}$

Section 7.6

- 35
- 10
- \emptyset
- 34
- 12
- 2
- 0
- $\frac{17}{4}$
- 1
- $2\sqrt{10}m$
- 202 miles
- $\sqrt{14}$
- 1 and 0
- $\frac{729}{100}$

Section 7.7

- Imaginary Unit
- Complex
- Pure imaginary
- $\sqrt{-1}$
- Real
- 1
- $6i$
- $5i$
- $i\sqrt{5}$
- $6i\sqrt{2}$
- $7 - i$
- $1 + 4i$
- $4 + 9i$
- $-7 + 8i$
- 60
- $-12 + 8i$
- $-15 - 23i$
- $60 - 32i$
- 20

- $-\frac{3}{2}i$
- $\frac{8}{5} + \frac{4}{5}i$
- $\frac{1}{2} - \frac{1}{2}i$
- $4 + i$
- i
- 1
- 64
- $64i$
- $\frac{2}{3} - \frac{1}{3}i$
- $\frac{1}{2} - \frac{3\sqrt{2}}{7}i$