
Chapter 7 Radical Expressions and Functions

7.1 Radical Expressions and Functions

Key Terms

1. radical sign
2. cube root
3. principal n th root
4. radical expression
5. square root
6. n th root
7. index; odd root; even root
8. radicand

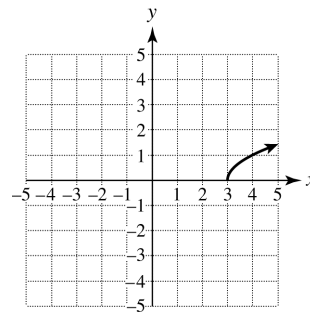
Radical Notation

1. ± 12
2. 8
3. 0.6
4. $\frac{4}{5}$
5. $|d|$
6. 4.359
7. (a) about 3 miles
(b) about 119 miles
8. 3
9. -4
10. $\frac{1}{2}$

11. a^4
12. 2.29
13. 5
14. -3
15. Not a real number
16. -2
17. $|z|$
18. $|x - 2|$
19. $|x + 3|$

The Square Root Function

20. $f(1) = 1$
 $f(-2) = \sqrt{-11}$; Not a real number
21. $f(1) = 2\sqrt{3}$
 $f(-2) = 3$
22. (a) about 2.7 seconds
(b) No, the hang time does not triple.
23. (a) $[3, \infty)$
(b) Graph is shifted three units to the right.



24. $[-2, \infty)$

25. $(-\infty, \infty)$

26. (a) \$264 thousand
\$373 thousand
\$457 thousand

(b) \$84 thousand
\$109 thousand

There is more revenue gained from 4 to 8 employees than there is from 8 to 12 employees.

The Cube Root Function

27. $f(1) = 1$
 $f(-3) = \sqrt[3]{17}$

28. $f(1) = 2$
 $f(-3) = 0$

7.2 Rational Exponents**Key Terms**

1. $\sqrt[n]{a}$

2. $\sqrt[n]{a^m} = (\sqrt[n]{a})^m$

3. $\frac{1}{a^{m/n}} = \frac{1}{\sqrt[n]{a^m}}$

4. a^{p+q}

5. $\frac{1}{a^p}$

6. $\left(\frac{b}{a}\right)^p$

7. a^{p-q}

8. a^{pq}

9. $a^p b^p$

10. $\frac{a^p}{b^p}$

Basic Concepts

1. $\sqrt{49} = 7$

2. $\sqrt[3]{15} \approx 2.47$

3. $\sqrt[4]{x}$

4. $\sqrt{3z}$

5. $(-64)^{2/3} = (\sqrt[3]{-64})^2 = 16$

6. $(32)^{3/5} = (\sqrt[5]{32})^3 = 8$

7. $A(20) \approx 27\%$
 $A(60) \approx 44\%$

After 20 seconds about 27% of the viewers have abandoned the online video, and after 60 seconds just under half, or 44%, of the viewers have abandoned the online video.

8. $16^{-3/4} = \frac{1}{(\sqrt[4]{16})^3} = \frac{1}{8}$

9. $-27^{-2/3} = -\frac{1}{(\sqrt[3]{27})^2} = -\frac{1}{9}$

10. $x^{5/6}$

11. $a^{-7/2}$

12. $(x+4)^{3/4}$

13. $(s^4 - t^4)^{1/4}$

14. Approximately 0.86 step per second

Properties of Rational Exponents

15. $x^{3/4}$
16. $2^{5/4}x^{3/2}$
17. $\frac{3}{x^{1/6}}$
18. $\frac{y}{7}$
19. $(z+3)^{1/8}$
20. y^3
21. $\frac{b^{1/4}}{a^{1/3}}$
22. $x^{1/2} + x$

7.3 Simplifying Radical Expressions**Key Terms**

1. perfect n th power
2. $\frac{\sqrt[n]{a}}{\sqrt[n]{b}}$
3. perfect cube
4. $\sqrt[n]{a \cdot b}$
5. perfect square

Product Rule for Radical Expressions

1. 10
2. -5
3. $\frac{1}{2}$
4. x^4
5. $\sqrt[3]{28y^2}$
6. $\sqrt{6ab}$
7. 3
8. $5\sqrt{3}$
9. $3\sqrt[3]{3}$
10. $2\sqrt{6}$
11. $3\sqrt[4]{2}$
12. (a) $L = 1.5\sqrt{R}$
(b) 45 mph
13. $4y^3$
14. $2x^2\sqrt{2x}$
15. $-3ab^2\sqrt[3]{2a}$
16. $4m\sqrt[3]{n}$
17. $6^{5/6} = \sqrt[6]{7776}$
18. 3
19. $b^{9/20} = \sqrt[20]{b^9}$

Quotient Rule for Radical Expressions

20. $\frac{\sqrt[3]{3}}{2}$

21. $\frac{\sqrt[4]{x}}{3}$

22. $\frac{5}{t}$

23. 3

24. $\frac{1}{5}$

25. m

26. $\frac{y\sqrt[4]{y}}{2x}$

27. $\frac{6x^2}{5}$

28. $\sqrt{x^2 - 16}$

29. $\sqrt[3]{x+1}$

5. $5\sqrt{3}, 4\sqrt{3}$

6. $\sqrt{8} = 2\sqrt{2}, \sqrt{4} = 2$; not possible

7. $14\sqrt[3]{3}, 6\sqrt[3]{3}$

8. $7\sqrt{2}$

9. $3\sqrt[3]{3}$

10. $10\sqrt{2}$

11. $5\sqrt[4]{2}$

12. $-11\sqrt{x}$

13. $27\sqrt{5b}$

14. $4\sqrt{5}$

15. $\sqrt[3]{7} + \sqrt[3]{10}$

16. $3\sqrt{t} + \sqrt[3]{t}$

17. $4\sqrt[3]{m^2n}$

18. $2y\sqrt{y}$

19. $\frac{\sqrt[3]{7x}}{4}$

20. (a) $425\sqrt{x} + 3300$
(b) \$88,300

21. $\frac{13\sqrt{2}}{12}$

22. $(3xy^2 - 2)\sqrt[4]{x^2y}$

23. $(t-4)\sqrt[3]{t}$

24. $14\sqrt{3}$ feet \approx 24.25 feet

7.4 Operations on Radical Expressions**Key Terms**

- like radicals
- rationalizing the denominator
- conjugate

Addition and Subtraction

1. $13\sqrt{7}$

2. $5\sqrt[3]{5}$

3. $3 + 2\sqrt{3}$; not possible

4. $\sqrt{6} + \sqrt{10}$; not possible

Multiplication

25. $a + 4\sqrt{a} - 12$

26. -1

Rationalizing the Denominator

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

28. $\frac{\sqrt{2}}{7}$

29. $\frac{\sqrt{2}y}{10}$

30. $y\sqrt{x}$

31. $x\sqrt{3}$

32. $3\sqrt{5} - 6$

33. $\frac{9 - 5\sqrt{3}}{6}$

34. $\frac{x + 4\sqrt{x}}{x - 16}$

35. $\frac{4\sqrt[3]{y^2}}{y}$

7.5 More Radical Functions**Key Terms**

1. power function; root function

Root Functions

1. $f(-5) = \sqrt{-1}$; Not a real number
 $f(5) = \sqrt{9} = 3$
2. $f(-5) = \sqrt[3]{8} = 2$
 $f(30) = \sqrt[3]{-27} = -3$

3. $f(1) = \sqrt[4]{-4}$; Not a real number
 $f(21) = \sqrt[4]{16} = 2$

4. $f(-243) = \sqrt[5]{-243} = -3$
 $f(1) = \sqrt[5]{1} = 1$

Power Functions

5. Not possible
6. 9
7. (a) 3181 square inches
(b) 138 square inches
8. Larger exponents result in graphs that increase (rise) faster for $x > 1$. Smaller exponents result in graphs that have larger y -values for $0 < x < 1$.

Modeling with Power Functions (Optional)

9. (a) $k \approx 0.85$
(b) About 0.717 m

7.6 Equations Involving Radical Expressions**Key Terms**

1. extraneous solutions
2. Pythagorean theorem
3. distance

Solving Radical Equations

1. 10
2. 14
3. 2
4. 5
5. -4
6. Approximately 5.2 pounds
7. $x \approx -2.52, 1.94$

The Distance Formula

8. 16 feet
9. $11\sqrt{2}$

Solving the Equations $x^n = k$

10. -3
11. No real solutions
12. 2, 8
13. (a) $v(W) = \sqrt[3]{\frac{W}{2.8}}$
(b) 8.1 mph

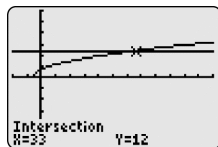
Understanding Concepts through Multiple Approaches

14. (a) 33
(b) 33

X	Y1
30	11.489
31	11.662
32	11.835
33	12.008
34	12.181
35	12.354
36	12.498

Y1=12

- (c) 33

**7.7 Complex Numbers****Key Terms**

1. complex; standard form; real; imaginary
2. imaginary
3. complex conjugate
4. pure imaginary
5. imaginary
6. real

Basic Concepts

1. $4i$
2. $i\sqrt{5}$
3. $5i\sqrt{2}$

Addition, Subtraction, and Multiplication

4. $9+9i$
5. $-10+2i$
6. $2+11i$
7. 40

Powers of i

8. 1
9. i
10. -1

Complex Conjugates and Division

11. $4-i$
12. $-5+2i$
13. $-6i$
14. 3
15. $-\frac{9}{10}-\frac{13}{10}i$
16. $3i$