

## 11-3 Rational Square Roots

**Objective:** To find the square roots of numbers that have rational square roots.

### Vocabulary

**Square root** If  $a^2 = b$ , then  $a$  is a square root of  $b$ . Positive numbers have two square roots that are opposites. Example: Since  $5^2 = 25$ , 5 is a square root of 25. Since  $(-5)^2 = 25$ ,  $-5$  is also a square root of 25.

**Radicand** The symbol written beneath a radical sign.

**Principal square root** The positive square root of a positive number.

### Symbols

$\sqrt{\quad}$  (radical sign)

$\sqrt{9}$  (the positive square root of 9)

$-\sqrt{9}$  (the negative square root of 9)

$\pm\sqrt{9}$  (the positive or negative square root of 9)

Properties	Examples
<b>Product Property of Square Roots</b> For any nonnegative real numbers $a$ and $b$ : $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}.$	$\sqrt{4 \cdot 9} = \sqrt{4} \cdot \sqrt{9}$
<b>Quotient Property of Square Roots</b> For any nonnegative real number $a$ and any positive real number $b$ : $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}.$	$\sqrt{\frac{36}{4}} = \frac{\sqrt{36}}{\sqrt{4}}$

**CAUTION** Negative numbers do not have square roots in the set of real numbers.  
The square root of zero is zero.

**Example 1** Find  $\sqrt{256}$ .

**Solution**

$$\begin{aligned} \sqrt{256} &= \sqrt{4 \cdot 64} \\ &= \sqrt{4} \cdot \sqrt{64} \\ &= 2 \cdot 8 \\ &= 16 \end{aligned}$$

**Example 2** Find  $\sqrt{1764}$ .

**Solution**

$$\begin{aligned} \sqrt{1764} &= \sqrt{2^2 \cdot 3^2 \cdot 7^2} \\ &= \sqrt{2^2} \cdot \sqrt{3^2} \cdot \sqrt{7^2} \\ &= 2 \cdot 3 \cdot 7 \\ &= 42 \end{aligned}$$

{ If you cannot see any squares that divide into the radicand, begin by factoring the radicand.

**11-3 Rational Square Roots** (continued)

Find the indicated square root.

- |                     |                      |                   |                  |
|---------------------|----------------------|-------------------|------------------|
| 1. $\sqrt{49}$      | 2. $\sqrt{81}$       | 3. $\sqrt{144}$   | 4. $\sqrt{196}$  |
| 5. $-\sqrt{225}$    | 6. $-\sqrt{121}$     | 7. $\sqrt{576}$   | 8. $\sqrt{400}$  |
| 9. $\pm\sqrt{1600}$ | 10. $\pm\sqrt{2025}$ | 11. $\sqrt{900}$  | 12. $\sqrt{784}$ |
| 13. $\pm\sqrt{676}$ | 14. $\pm\sqrt{529}$  | 15. $-\sqrt{441}$ | 16. $\sqrt{484}$ |

**Example 3** Find the indicated square root: a.  $\sqrt{\frac{25}{81}}$  b.  $\pm\sqrt{\frac{121}{289}}$

**Solution** a.  $\sqrt{\frac{25}{81}} = \frac{\sqrt{25}}{\sqrt{81}} = \frac{5}{9}$  b.  $\pm\sqrt{\frac{121}{289}} = \pm\frac{\sqrt{121}}{\sqrt{289}} = \pm\frac{11}{17}$

Find the indicated square root.

- |                                 |                               |                                  |                                  |
|---------------------------------|-------------------------------|----------------------------------|----------------------------------|
| 17. $\sqrt{\frac{81}{400}}$     | 18. $-\sqrt{\frac{225}{64}}$  | 19. $\pm\sqrt{\frac{121}{36}}$   | 20. $\sqrt{\frac{144}{625}}$     |
| 21. $\pm\sqrt{\frac{484}{529}}$ | 22. $-\sqrt{\frac{324}{361}}$ | 23. $\sqrt{\frac{225}{484}}$     | 24. $-\sqrt{\frac{289}{400}}$    |
| 25. $\pm\sqrt{\frac{64}{2025}}$ | 26. $\sqrt{\frac{256}{1225}}$ | 27. $\pm\sqrt{\frac{441}{1024}}$ | 28. $\sqrt{\frac{529}{256}}$     |
| 29. $-\sqrt{\frac{169}{100}}$   | 30. $-\sqrt{\frac{289}{729}}$ | 31. $\sqrt{\frac{361}{2500}}$    | 32. $\pm\sqrt{\frac{1156}{225}}$ |

**Example 4**  $\sqrt{0.64} = \sqrt{\frac{64}{100}} = \frac{\sqrt{64}}{\sqrt{100}} = \frac{8}{10} = 0.8$

Find the indicated square root.

- |                    |                      |                      |                   |
|--------------------|----------------------|----------------------|-------------------|
| 33. $\sqrt{0.16}$  | 34. $\pm\sqrt{0.49}$ | 35. $-\sqrt{1.44}$   | 36. $\sqrt{2.56}$ |
| 37. $-\sqrt{2.89}$ | 38. $\sqrt{3.24}$    | 39. $\pm\sqrt{4.84}$ | 40. $\sqrt{6.25}$ |

**Mixed Review Exercises**

Express as a fraction in simplest form.

- |                      |  |   |
|----------------------|--|---|
| 1. 0.375             | 2. -3.2  | 3. $0.\overline{2}$                                     |
| 4. $1.\overline{08}$ | 5. $\frac{1}{2}\left(\frac{3}{4} - \frac{2}{3}\right)$ | 6. $\frac{3}{4}\left(\frac{x}{2} - \frac{2x}{5}\right)$ |

Factor completely.

- |                       |                          |                         |
|-----------------------|--------------------------|-------------------------|
| 7. $2n^2 - 10n - 48$  | 8. $6(x - 1) + y(x - 1)$ | 9. $9k^3 - k$           |
| 10. $4w^2 - 20w + 25$ | 11. $2x^2 + 5xy - 3y^2$  | 12. $2 - 7ab + 3a^2b^2$ |