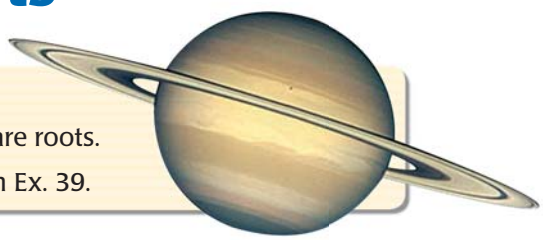
4.5 Solve Quadratic Equations by Finding Square Roots

TEKS 2A.6.A, 2A.6.B, 2A.8.A, 2A.8.D

Before You solved quadratic equations by factoring.

Now You will solve quadratic equations by finding square roots.

Why? So you can solve problems about astronomy, as in Ex. 39.



Key Vocabulary
- **square root**
- **radical**
- **radicand**
- **rationalizing the denominator**
- **conjugates**

A number r is a **square root** of a number s if $r^2 = s$. A positive number s has two square roots, written as $\sqrt{s}$ and $-\sqrt{s}$. For example, because $3^2 = 9$ and $(-3)^2 = 9$, the two square roots of 9 are $\sqrt{9} = 3$ and $-\sqrt{9} = -3$. The positive square root of a number is also called the *principal* square root.

The expression $\sqrt{s}$ is called a **radical**. The symbol $\sqrt{\ }$ is a *radical sign*, and the number s beneath the radical sign is the **radicand** of the expression.

KEY CONCEPT *For Your Notebook*

Properties of Square Roots ($a > 0, b > 0$)

Product Property $\sqrt{ab} = \sqrt{a} \cdot \sqrt{b}$ **Example** $\sqrt{18} = \sqrt{9} \cdot \sqrt{2} = 3\sqrt{2}$

Quotient Property $\sqrt{\frac{a}{b}} = \frac{\sqrt{a}}{\sqrt{b}}$ **Example** $\sqrt{\frac{2}{25}} = \frac{\sqrt{2}}{\sqrt{25}} = \frac{\sqrt{2}}{5}$

SIMPLIFYING SQUARE ROOTS You can use the properties above to simplify expressions containing square roots. A square-root expression is simplified if:
- no radicand has a perfect-square factor other than 1, and
- there is no radical in a denominator

EXAMPLE 1 Use properties of square roots

Simplify the expression.

a. $\sqrt{80} = \sqrt{16} \cdot \sqrt{5} = 4\sqrt{5}$

b. $\sqrt{6} \cdot \sqrt{21} = \sqrt{126} = \sqrt{9} \cdot \sqrt{14} = 3\sqrt{14}$

c. $\sqrt{\frac{4}{81}} = \frac{\sqrt{4}}{\sqrt{81}} = \frac{2}{9}$

d. $\sqrt{\frac{7}{16}} = \frac{\sqrt{7}}{\sqrt{16}} = \frac{\sqrt{7}}{4}$

USE A CALCULATOR
You can use a calculator to approximate $\sqrt{s}$ when s is not a perfect square. For example, $\sqrt{80} \approx 8.944$.

GUIDED PRACTICE for Example 1

Simplify the expression.

1. $\sqrt{27}$ **2.** $\sqrt{98}$ **3.** $\sqrt{10} \cdot \sqrt{15}$ **4.** $\sqrt{8} \cdot \sqrt{28}$

5. $\sqrt{\frac{9}{64}}$ **6.** $\sqrt{\frac{15}{4}}$ **7.** $\sqrt{\frac{11}{25}}$ **8.** $\sqrt{\frac{36}{49}}$