GUIDED PRACTICE for Examples 3 and 4

Solve the equation.

3. $a^2 + 5a = 0$ **4.** $3s^2 - 9s = 0$ **5.** $4x^2 = 2x$

VERTICAL MOTION A *projectile* is an object that is propelled into the air but has no power to keep itself in the air. A thrown ball is a projectile, but an airplane is not. The height of a projectile can be described by the **vertical motion model**.

UNDERSTAND THE MODEL
The vertical motion model takes into account the effect of gravity but ignores other, less significant, factors such as air resistance.

KEY CONCEPT *For Your Notebook*

Vertical Motion Model

The height h (in feet) of a projectile can be modeled by

$$h = -16t^2 + vt + s$$

where t is the time (in seconds) the object has been in the air, v is the initial vertical velocity (in feet per second), and s is the initial height (in feet).

TAKS

EXAMPLE 5 TAKS REASONING: Multi-Step Problem

ARMADILLO A startled armadillo jumps straight into the air with an initial vertical velocity of 14 feet per second. After how many seconds does it land on the ground?

Solution

STEP 1 **Write** a model for the armadillo's height above the ground.

$h = -16t^2 + vt + s$ Vertical motion model

$h = -16t^2 + 14t + 0$ Substitute 14 for v and 0 for s.

$h = -16t^2 + 14t$ Simplify.

STEP 2 **Substitute** 0 for h. When the armadillo lands, its height above the ground is 0 feet. Solve for t.

$0 = -16t^2 + 14t$ Substitute 0 for h.

$0 = 2t(-8t + 7)$ Factor right side.

$2t = 0$ *or* $-8t + 7 = 0$ Zero-product property

$t = 0$ *or* $t = 0.875$ Solve for t.

▶ The armadillo lands on the ground 0.875 second after the armadillo jumps.

AVOID ERRORS
The solution $t = 0$ means that before the armadillo jumps, its height above the ground is 0 feet.

GUIDED PRACTICE for Example 5

6. WHAT IF? In Example 5, suppose the initial vertical velocity is 12 feet per second. After how many seconds does the armadillo land on the ground?