GUIDED PRACTICE

Vocabulary Check ✓

1. Explain what it means to "rationalize the denominator" of a quotient containing square roots.

Concept Check ✓

2. State the product and quotient properties of square roots in words.

3. How many real-number solutions does the equation $x^2 = s$ have when $s > 0$? when $s = 0$? when $s < 0$?

Skill Check ✓

Simplify the expression.

4. $\sqrt{49}$ 5. $\sqrt{12}$ 6. $\sqrt{45}$ 7. $\sqrt{3} \cdot \sqrt{27}$

8. $\sqrt{\frac{16}{25}}$ 9. $\sqrt{\frac{7}{9}}$ 10. $\frac{1}{\sqrt{3}}$ 11. $\sqrt{\frac{5}{2}}$

Solve the equation.

12. $x^2 = 64$ 13. $x^2 - 9 = 16$ 14. $4x^2 + 7 = 23$

15. $\frac{x^2}{6} - 2 = 0$ 16. $5(x - 1)^2 = 50$ 17. $\frac{1}{2}(x + 8)^2 = 14$

18. **ENGINEERING** At an engineering school, students are challenged to design a container that prevents an egg from breaking when dropped from a height of 50 feet. Write an equation giving a container's height h (in feet) above the ground after t seconds. How long does the container take to hit the ground?

PRACTICE AND APPLICATIONS

STUDENT HELP

Extra Practice to help you master skills is on p. 946.

USING THE PRODUCT PROPERTY **Simplify the expression.**

19. $\sqrt{18}$ 20. $\sqrt{48}$ 21. $\sqrt{27}$ 22. $\sqrt{52}$

23. $\sqrt{72}$ 24. $\sqrt{175}$ 25. $\sqrt{98}$ 26. $\sqrt{605}$

27. $2\sqrt{7} \cdot \sqrt{7}$ 28. $\sqrt{8} \cdot \sqrt{2}$ 29. $\sqrt{3} \cdot \sqrt{12}$ 30. $3\sqrt{20} \cdot 6\sqrt{5}$

31. $\sqrt{12} \cdot \sqrt{2}$ 32. $\sqrt{6} \cdot \sqrt{10}$ 33. $4\sqrt{3} \cdot \sqrt{21}$ 34. $\sqrt{8} \cdot \sqrt{6} \cdot \sqrt{3}$

USING THE QUOTIENT PROPERTY **Simplify the expression.**

35. $\sqrt{\frac{1}{9}}$ 36. $\sqrt{\frac{4}{49}}$ 37. $\sqrt{\frac{36}{25}}$ 38. $\sqrt{\frac{100}{81}}$

39. $\sqrt{\frac{3}{16}}$ 40. $\sqrt{\frac{11}{64}}$ 41. $\sqrt{\frac{75}{36}}$ 42. $\sqrt{\frac{40}{169}}$

43. $\frac{2}{\sqrt{3}}$ 44. $\frac{5}{\sqrt{17}}$ 45. $\sqrt{\frac{6}{5}}$ 46. $\sqrt{\frac{144}{11}}$

47. $\sqrt{\frac{7}{8}}$ 48. $\sqrt{\frac{18}{13}}$ 49. $\sqrt{\frac{45}{32}}$ 50. $\sqrt{\frac{15}{7}} \cdot \sqrt{\frac{4}{3}}$

STUDENT HELP

HOMEWORK HELP

Example 1: Exs. 19–50
Example 2: Exs. 51–59
Example 3: Exs. 60–68
Example 4: Exs. 69–73

SOLVING QUADRATIC EQUATIONS **Solve the equation.**

51. $x^2 = 121$ 52. $x^2 = 90$ 53. $3x^2 = 108$

54. $2x^2 + 5 = 41$ 55. $-x^2 - 12 = -87$ 56. $7 - 10u^2 = 1$

57. $\frac{v^2}{25} - 1 = 11$ 58. $6 - \frac{p^2}{8} = -4$ 59. $\frac{5q^2}{6} - \frac{q^2}{3} = 72$

SOLVING QUADRATIC EQUATIONS **Solve the equation.**

60. $2(x - 3)^2 = 8$ **61.** $4(x + 1)^2 = 100$ **62.** $-3(x + 2)^2 = -18$

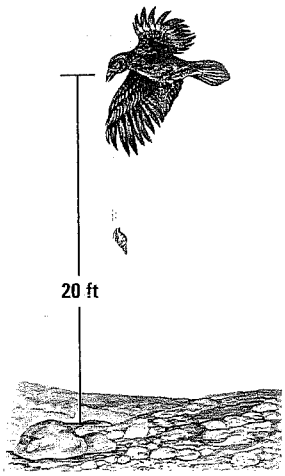
63. $5(x - 7)^2 = 135$ **64.** $8(x + 4)^2 = 9$ **65.** $2(a - 6)^2 - 45 = 53$

66. $\frac{1}{4}(b - 8)^2 = 7$ **67.** $(2r - 5)^2 = 81$ **68.** $\frac{(s + 1)^2}{10} - \frac{12}{5} = \frac{15}{2}$

69. **HISTORY CONNECTION** According to legend, in 1589 the Italian scientist Galileo Galilei dropped two rocks of different weights from the top of the Leaning Tower of Pisa. He wanted to show that the rocks would hit the ground at the same time. Given that the tower's height is about 177 feet, how long would it have taken for the rocks to hit the ground?

70. **ORNITHOLOGY** Many birds drop shellfish onto rocks to break the shell and get to the food inside. Crows along the west coast of Canada use this technique to eat whelks (a type of sea snail). Suppose a crow drops a whelk from a height of 20 feet, as shown.

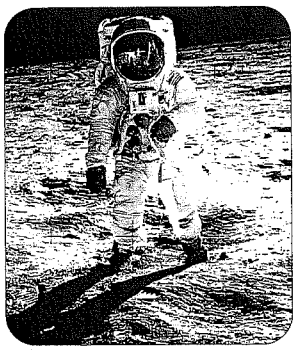
▶ Source: *Cambridge Encyclopedia of Ornithology*



a. Write an equation giving the whelk's height h (in feet) after t seconds.

b. Use the *Table* feature of a graphing calculator to find h when $t = 0, 0.1, 0.2, 0.3, \ldots, 1.4, 1.5$. (You'll need to scroll down the table to see all the values.) To the nearest tenth of a second, how long does it take for the whelk to hit the ground? Check your answer by solving a quadratic equation.

FOCUS ON APPLICATIONS



REAL LIFE **ASTRONOMY** The acceleration due to gravity on the moon is about 5.3 ft/sec^2. This means that the moon's gravity is only about one sixth as strong as Earth's.

INTERNET **APPLICATION LINK**
www.mcdougallittell.com

71. **ASTRONOMY** On *any* planet, the height h (in feet) of a falling object t seconds after it is dropped can be modeled by

$$h = -\frac{g}{2}t^2 + h_0$$

where h_0 is the object's initial height and g is the acceleration (in feet per second squared) due to the planet's gravity. For each planet in the table, find the time it takes for a rock dropped from a height of 200 feet to hit the ground.

Planet	Earth	Mars	Jupiter	Neptune	Pluto
g (ft/sec^2)	32	12	81	36	2.1

▶ Source: STARLab, Stanford University

72. **OCEANOGRAPHY** The equation $h = 0.019s^2$ gives the height h (in feet) of the largest ocean waves when the wind speed is s knots. How fast is the wind blowing if the largest waves are 15 feet high? ▶ Source: *Encyclopaedia Britannica*

STUDENT HELP

Skills Review
For help with the Pythagorean theorem, see p. 917.

73. **TELEVISION** The *aspect ratio* of a TV screen is the ratio of the screen's width to its height. For most TVs, the aspect ratio is 4:3. What are the width and height of the screen for a 27 inch TV? (*Hint:* Use the Pythagorean theorem and the fact that TV sizes such as 27 inches refer to the length of the screen's diagonal.)