approach is to factor the number as far as possible with prime factors.

Write 50 as a set of prime factors.	Look for any square factors (factors that appear twice).	Squaring and taking the square root undo each other.

$$\sqrt{50} = \sqrt{5 \cdot 5 \cdot 2} = \sqrt{5^2 \cdot 2} = \sqrt{5^2} \cdot \sqrt{2} = 5\sqrt{2}$$

Giving an exact answer to a problem involving a square root is important in many situations. Some patterns are easier to find with simplified square roots than with decimal approximations. Standardized tests often give answers in simplified form. Also, when you multiply radical expressions, you often have to simplify the answer.

EXAMPLE B Multiply $3\sqrt{6}$ by $5\sqrt{2}$.

Solution To multiply radical expressions, associate and multiply the quantities outside the radical sign, and associate and multiply the quantities inside the radical sign.

$$(3\sqrt{6})(5\sqrt{2}) = 3 \cdot 5 \cdot \sqrt{6 \cdot 2} = 15 \cdot \sqrt{12} = 15 \cdot \sqrt{4 \cdot 3} = 15 \cdot 2\sqrt{3} = 30\sqrt{3}$$

Exercises

In Exercises 1–5, express each product in its simplest form.

1. $(\sqrt{3})(\sqrt{2})$ **2.** $(\sqrt{5})^2$ **3.** $(3\sqrt{6})(2\sqrt{3})$ **4.** $(7\sqrt{3})^2$ **5.** $(2\sqrt{2})^2$

In Exercises 6–15, express each square root in its simplest form.

6. $\sqrt{12}$ **7.** $\sqrt{18}$ **8.** $\sqrt{40}$ **9.** $\sqrt{75}$ **10.** $\sqrt{85}$

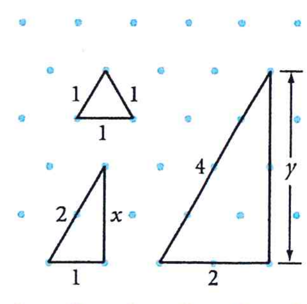
11. $\sqrt{96}$ **12.** $\sqrt{576}$ **13.** $\sqrt{720}$ **14.** $\sqrt{784}$ **15.** $\sqrt{828}$

16. Give a geometric explanation for your answer to Exercise 7 using two right triangles on square dot paper.

17. Draw a right triangle on square dot paper with a base of 2 and a height of 1. What radical expression does the hypotenuse represent? Draw a second right triangle to explain geometrically why $\sqrt{20} = 2\sqrt{5}$.

18. Represent $\sqrt{10}$ geometrically on square dot paper, then explain why $\sqrt{40} = 2\sqrt{10}$.

19. How could you represent $\sqrt{13}$ geometrically on square dot paper?

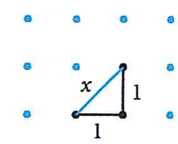


20. Each dot on isometric dot paper is exactly one unit from the six dots that surround it. Notice that you can connect any three adjacent dots to form an equilateral triangle. In the diagram at right, solve for x and y, and use this to give a geometric explanation for your answer to Exercise 6.

21. How could you represent $\sqrt{7}$ geometrically on isometric dot paper?

USING YOUR ALGEBRA SKILLS 10

Radical Expressions

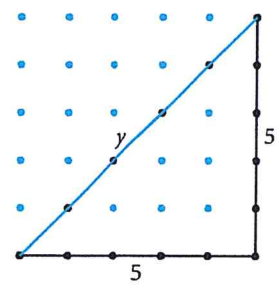


$x^2 = 1^2 + 1^2$

$x^2 = 2$

$x = \sqrt{2}$

If you use the Pythagorean Theorem to find the length of the diagonal segment on square dot paper at right, you get the radical expression $\sqrt{2}$. Until now you may have left these expressions as radicals, or you may have found a decimal approximation using a calculator, such as $\sqrt{2} \approx 1.4142$. Geometrically, you can think of a radical expression as a side of a right triangle. In this case you can think of $\sqrt{2}$ as the hypotenuse of a right triangle with both legs equal to 1.



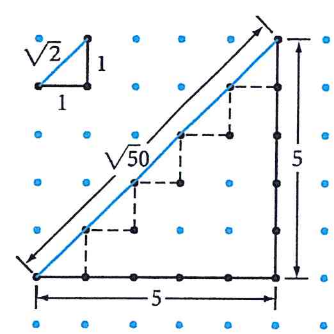
Let's look at another case. By applying the Pythagorean Theorem to the diagram at right, you'll find that the hypotenuse of this right triangle is equal to $\sqrt{50}$.

$y^2 = 5^2 + 5^2$

$y^2 = 50$

$y = \sqrt{50}$

So, you can think of $\sqrt{50}$ as the hypotenuse of a right triangle with both legs equal to 5.



You can use this idea of radicals as sides of right triangles to simplify some radical expressions. Let's compare the previous two examples. How does the $\sqrt{50}$ segment compare to the $\sqrt{2}$ segment? Notice that one $\sqrt{50}$ segment is made up of five of the $\sqrt{2}$ segments, so we can write this equation: $\sqrt{50} = 5\sqrt{2}$.

The expression $5\sqrt{2}$ is considered simplified because it expresses the radical using a simpler geometric representation, the diagonal of a 1-by-1 square.

You can also simplify a square root algebraically by taking the square root of any perfect square factors in the radical expression. As you will notice in this example, you get the same answer.

EXAMPLE A Simplify $\sqrt{50}$.

Solution One way to simplify a square root is to look for perfect-square factors.

The largest perfect-square factor of 50 is 25.

$$\sqrt{50} = \sqrt{25 \cdot 2} = \sqrt{25} \cdot \sqrt{2} = 5\sqrt{2}$$

25 is a perfect square, so you can take its square root.