ACE Applications | Connections | Extensions

Applications

1. Find the area of every square that can be drawn by connecting dots on a 3 dot-by-3 dot grid.

2. On dot paper, draw a hexagon with an area of 16 square units.

3. On dot paper, draw a square with an area of 2 square units. Write an argument to convince a friend that the area is 2 square units.

For Exercises 4–37, do not use the $\sqrt{\ }$ key on your calculator.

4. Graph the following set of numbers in order on a number line.

2.3	$2\frac{1}{4}$	$\sqrt{5}$	$\sqrt{2}$	$\frac{5}{2}$	$\sqrt{4}$
4	-2.3	$-2\frac{1}{4}$	$\frac{4}{2}$	$-\frac{4}{2}$	2.09

For Exercises 5–7, estimate each square root to one decimal place.

5. $\sqrt{11}$

6. $\sqrt{30}$

7. $\sqrt{172}$

8. **Multiple Choice** Between which pair of numbers does $\sqrt{15}$ lie?

A. 3.7 and 3.8

B. 3.8 and 3.9

C. 3.9 and 4.0

D. 14 and 16

Find exact values for each square root.

9. $\sqrt{144}$

10. $\sqrt{0.36}$

11. $\sqrt{961}$

Find the two consecutive whole numbers between which each square lies. Explain.

12. $\sqrt{27}$

13. $\sqrt{1{,}000}$

Tell whether each statement is true.

14. $6 = \sqrt{36}$ **15.** $1.5 = \sqrt{2.25}$ **16.** $11 = \sqrt{101}$

Find the missing number.

17. $\sqrt{\blacksquare} = 81$ **18.** $14 = \sqrt{\blacksquare}$ **19.** $\blacksquare = \sqrt{28.09}$

20. $\sqrt{\blacksquare} = 3.2$ **21.** $\sqrt{\blacksquare} = \frac{1}{4}$ **22.** $\sqrt{\frac{4}{9}} = \blacksquare$

Find each product.

23. $\sqrt{2} \cdot \sqrt{2}$ **24.** $\sqrt{3} \cdot \sqrt{3}$

25. $\sqrt{4} \cdot \sqrt{4}$ **26.** $\sqrt{5} \cdot \sqrt{5}$

Find the positive and negative square roots of each number.

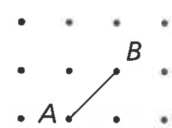
27. 1 **28.** 4 **29.** 2

30. 16 **31.** 25 **32.** 5

Find x.

33. $x^2 = 144$ **34.** $x^2 = \frac{1}{4}$ **35.** $\sqrt{x} = \frac{1}{4}$ **36.** $\sqrt{\frac{1}{4}} = x$ **37.** $\sqrt{144} = x$

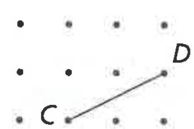
38. Consider segment AB at the right.



a. On dot paper, draw a square with side AB. What is the area of the square?

b. Use a calculator to estimate the length of segment AB.

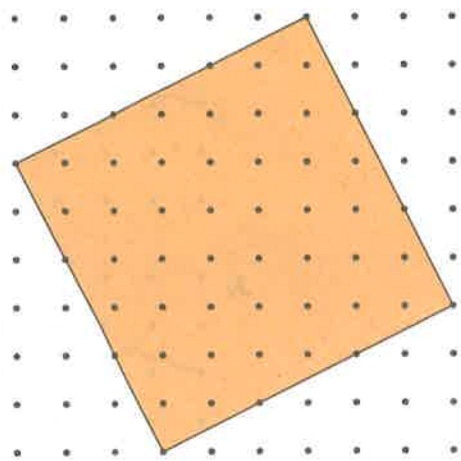
39. Consider segment CD at the right.



a. On dot paper, draw a square with side CD. What is the area of the square?

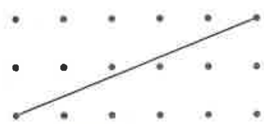
b. Use a calculator to estimate the length of segment CD.

40. Find the area and the side length of this square.



41. Find the length of every line segment that can be drawn by connecting dots on a 3 dot-by-3 dot grid.

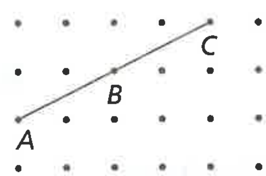
42. Consider this segment.



a. Express the length of the segment, using the $\sqrt{\ }$ symbol.

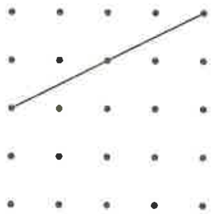
b. Between which two consecutive whole numbers does the length of the segment lie?

43. Show that $2\sqrt{5}$ is equal to $\sqrt{20}$ by finding the length of line segment AC in two ways.

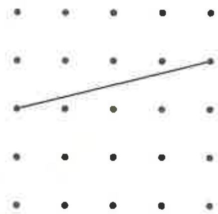


44. Multiple Choice Which line segment has a length of $\sqrt{17}$ units?

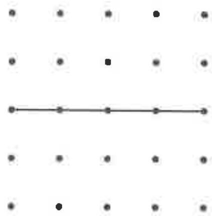
F.



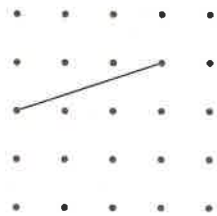
G.



H.

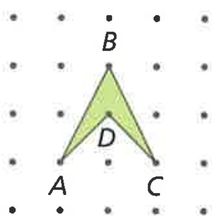


J.

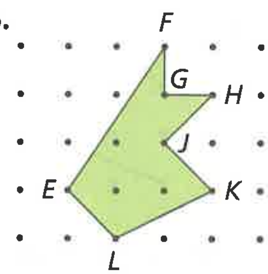


For Exercise 45 and 46, find the length of each side of the figure.

45.



46.



Find the edge length of a cube with the given volume.

47. 216 cube units

48. 512 cubic inches

49. 1,000 cubic feet

Find the value of each cube root.

50. $\sqrt[3]{216}$

51. $\sqrt[3]{512}$

52. $\sqrt[3]{1{,}000}$

Find the volume of a cube with the given edge length.

53. 6 yards

54. 8 inches

55. 10 feet

Find the missing number.

56. $\sqrt[3]{\blacksquare} = 6$

57. $\sqrt[3]{\blacksquare} = 8$

58. $\sqrt[3]{\blacksquare} = 10$

59. **a.** Between which two consecutive whole numbers does $\sqrt[3]{80}$ lie? Explain.

b. Which whole number from part (a) is closer to $\sqrt[3]{80}$? Explain.

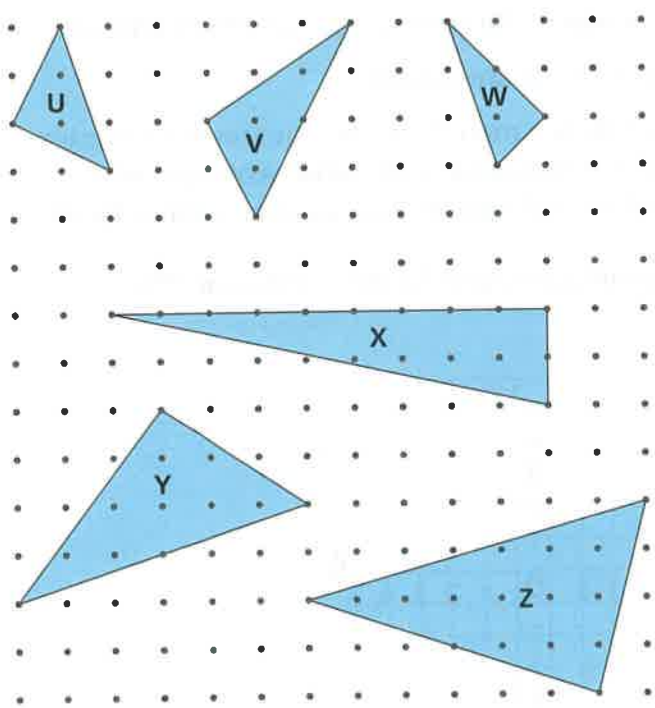
c. Estimate the value of $\sqrt[3]{80}$ to one decimal place.

Find x.

60. $x^3 = 64$ **61.** $x^3 = -64$ **62.** $x^3 = \frac{27}{64}$ **63.** $\sqrt[3]{x} = -8$ **64.** $\sqrt[3]{-8} = x$

Connections

65. **a.** Which of the triangles below are right triangles? Explain.



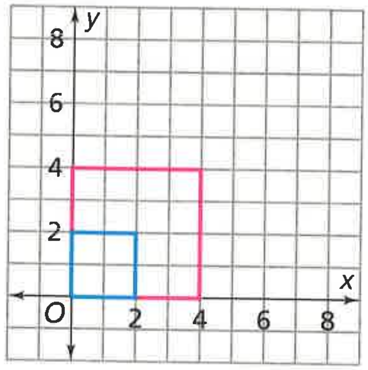
b. Find the area of each right triangle.

66. Refer to the squares you drew in Problem 2.1.

a. Find the perimeter of each square to the nearest hundredth of a unit.

b. What rule can you use to calculate the perimeter of a square when you know the length of a side?

67. In Problem 2.1, it was easier to find the "upright" squares. Two of these squares are represented on the coordinate grid.



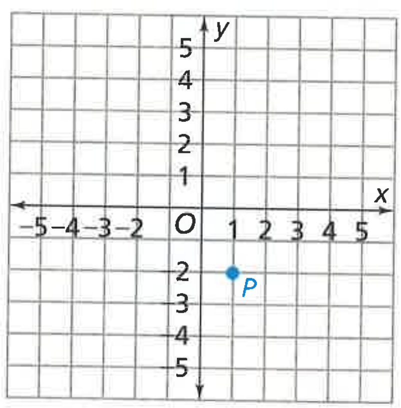
a. Are these squares similar? Explain.

b. How are the coordinates of the corresponding vertices related?

c. How are the areas of the squares related?

d. Copy the drawing. Add two more "upright" squares with a vertex at (0, 0). How are the coordinates of the vertices of these new squares related to the 2×2 square? How are their areas related?

68. On grid paper, draw coordinate axes like the ones below. Plot point P at $(1, -2)$.



a. Draw a square $PQRS$ with an area of 10 square units.

b. Name a vertex of your square that is $\sqrt{10}$ units from point P.

c. Give the coordinates of at least two other points that are $\sqrt{10}$ units from point P.

69. In Problem 2.3, you drew segments of length 1 unit, $\sqrt{2}$ units, 4 units, and so on. On a copy of the number line below, locate and label each length you drew. On the number line, $\sqrt{1}$ and $\sqrt{2}$ have been marked as examples.

70. Sketch a cube with a volume of 64 cube units. Label the edge length of the cube on your drawing.

Extensions

71. On dot paper, draw a nonrectangular parallelogram with an area of 6 square units.

72. On dot paper, draw a triangle with an area of 5 square units.

73. Dalida claims that $\sqrt{8} + \sqrt{8}$ is equal to $\sqrt{16}$ because 8 plus 8 is 16. Is she right? Explain.

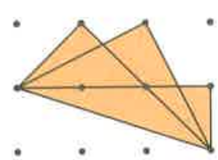
You know that $\sqrt{5} \cdot \sqrt{5} = \sqrt{5 \cdot 5} = \sqrt{25} = 5$. Tell whether each product is a whole number. Explain.

74. $\sqrt{2} \cdot \sqrt{50}$

75. $\sqrt{4} \cdot \sqrt{16}$

76. $\sqrt{4} \cdot \sqrt{6}$

77. The drawing shows three right triangles with a common side.



a. Find the length of the common side.

b. Do the three triangles have the same area? Explain.

You know that $\sqrt[3]{4} \cdot \sqrt[3]{4} \cdot \sqrt[3]{4} = \sqrt[3]{4 \cdot 4 \cdot 4} = \sqrt[3]{64} = 4$. Tell whether each product is a whole number. Explain.

78. $\sqrt[3]{5} \cdot \sqrt[3]{25}$

79. $\sqrt[3]{4} \cdot \sqrt[3]{16}$

80. $\sqrt[3]{5} \cdot \sqrt[3]{125}$

Mathematical Reflections 2

In this Investigation, you worked with square roots and cube roots, and explored squares and segments drawn on dot paper. You learned that the side length of a square is the positive square root of the square's area. You also discovered that, in many cases, a square root is not a whole number. The following questions will help you summarize what you have learned.

Think about these questions. Discuss your ideas with other students and your teacher. Then write a summary of your findings in your notebook.

1. **Describe** how you would find the length of a line segment connecting two dots on dot paper. Be sure to consider horizontal, vertical, and tilted segments.
2. a. **Explain** what it means to find the square root of a number.

   b. **Explain** whether or not a number can have more than one square root.
3. a. **Explain** what it means to find the cube root of a number.

   b. **Explain** whether or not a number can have more than one cube root.

Common Core Mathematical Practices

As you worked on the Problems in this Investigation, you used prior knowledge to make sense of them. You also applied Mathematical Practices to solve the Problems. Think back over your work, the ways you thought about the Problems, and how you used Mathematical Practices.

Ken described his thoughts in the following way:

In Problem 2.1, we showed that we had a square using the same reasoning we used in Problem 1.2 to show that the figures we drew on the coordinate grid were squares, rectangles, and right triangles. Then, to find the area of the square, we counted the number of square units inside the square.

Common Core Standards for Mathematical Practice

MP8 Look for and express regularity in repeated reasoning.

- What other Mathematical Practices can you identify in Ken's reasoning?
- Describe a Mathematical Practice that you and your classmates used to solve a different Problem in this Investigation.

Investigation 3

The Pythagorean Theorem

In earlier grades, you learned about the properties of triangles. In this Investigation, you will learn about a special property of one type of triangle.

- What are characteristics that all triangles share?
- In what ways are the three triangles below different?
- How do the three side lengths of any triangle relate to each other?

Triangle A Triangle B Triangle C

Triangle A is an acute triangle. An **acute triangle** has three acute angles.

Triangle B is an obtuse triangle. An **obtuse triangle** has one obtuse angle.

Triangle C is a right triangle. A **right triangle** has one angle with a measure of exactly 90°. A 90° angle is called a *right angle* and is often marked with a small square. The longest side of a right triangle is the side opposite the right angle. This side is called the **hypotenuse.** The other two sides are called the **legs.**

- Can a triangle have more than one angle that is 90°? Explain.

Common Core State Standards

8.G.B.6 Explain a proof of the Pythagorean Theorem and its converse.

8.G.B.7 Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions.

8.G.B.8 Apply the Pythagorean Theorem to find the distance between two points in a coordinate system.