Name _____ Date _____ Class _____

Squares and Square Roots

In geometry, you find the area of a rectangle by multiplying its length by its width. A square is simply a rectangle whose sides are equal. So you can find the area of a square by multiplying the length of any side by itself.

Multiplying a Number by Itself

Because of this relationship, a number multiplied by itself is said to be *squared*. For example, the square of 3 is $3 \times 3 = 9$. In other words, the square of 3 is the area of a square whose sides are equal to 3. The superscript 2 is used as an abbreviation for squaring: $3^2 = 3 \times 3$.

A *Square Root* Is Squared to Give the Number You Started With

The *square root* of a number is the number that must be multiplied by itself to produce the original number. In geometry, if a certain number equals the area of a square, the square root of that number is the length of one of the square's sides. For example, the square root of 4 is 2 (because so $2 \times 2 = 4$), a square with an area of 4 has sides equal to 2. The square root of a number can be abbreviated using the symbol $\sqrt{\ }$ before the number: $\sqrt{4} = 2$.

How Squares and Square Roots Are Used

Squares and square roots are often used in mathematical equations. For example, if you know the length of the two smaller sides of a right triangle, you can use the Pythagorean theorem ($side^2 + side^2 = hypotenuse^2$) to find the length of the longest side, the hypotenuse. To use the Pythagorean theorem, you must be able to find both the square and the square root of a number.

The numbers from 1 to 100 whose square roots are whole numbers are:

Number	1	4	9	16	25	36	49	64	81	100
Square root	1	2	3	4	5	6	7	8	9	10

Finding a square is fairly simple even without a calculator, because it requires only multiplying a number by itself. However, it is often much more difficult to find square roots. As you can see from the table, there are only ten numbers between 1 and 100 with a whole-number square root.

Squares and Square Roots *continued*

Math Skills

Suppose you decide to make a small triangular tent. You plan to sew together three identical squares of fabric to make the sides and the floor. Each square will have sides of 2.0 m. How many square meters of fabric will you need to buy for the sides and the floor?

Solution

1. Determine the appropriate equation. Each square is the same size, so you can find the area of one square and multiply it by three to find the total amount of fabric you will need.

$$\text{total area} = 3 \times (2.0\ \text{m})^2$$

2. Perform the calculations. To find the square of a number, multiply the number by itself.

$$\text{total area} = 3 \times (2.0\ \text{m})^2 = 3 \times (2.0\ \text{m} \times 2.0\ \text{m}) = 3 \times 4.0\ \text{m}^2 = 12.0\ \text{m}^2$$

3. Round your answer to the correct number of significant digits. The given length of 2.0 m has 2 significant digits, so your answer must be rounded to 2 significant digits.

$$\text{total area} = 12\ \text{m}^2$$

Math Skills

By measuring the shadow of a tree and using the Pythagorean theorem, you determine that the tree must be $\sqrt{361.5}$ m tall. Simplify this square root to determine the height of the tree.

Solution

1. Determine the appropriate equation. The height of the tree (in meters) is equal to the square root of 361.5.

$$\text{height of tree} = \sqrt{361.5}\ \text{m}$$

2. Perform the calculations. Use your calculator to find the square root.

$$\text{height of tree} = \sqrt{361.5}\ \text{m} = 19.013\ 153\ 3418\ \text{m}$$

3. Round your answer to the correct number of significant digits. The given value $\sqrt{361.5}$ m has four significant digits, so you must round your answer to four significant digits.

$$\text{height of tree} = 19.013\ 153\ 3418\ \text{m} = 19.01\ \text{m}$$

Squares and Square Roots *continued*

Practice

1. Determine how much fabric would be needed in the sample problem with the tent if the sides of each square were 3.5 m.

2. Using the Pythagorean theorem, you discover that a certain house is $\sqrt{110.5}$ m tall. Simplify this square root to find the height of the house.

3. What is $(\sqrt{36.4444})^2$?