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UNIT 3: SQUARE ROOTS AND SURFACE AREA

SECTION 1.1: SQUARE ROOTS OF PERFECT SQUARES

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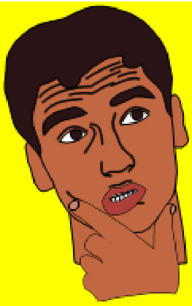
MATH 9

WHAT'S THE POINT OF TODAY'S LESSON?

We will continue working on the Math 9 Specific Curriculum Outcome (SCOs) "Numbers 4" and "Numbers 5" OR "N4" and "N5" which state:

N4: "Explain and apply the order of operations, including exponents, with and without technology."

N5: "Determine the square root of positive rational numbers that are perfect squares."



What does THAT mean???

For this unit, SCO N4 means that we will learn how to find the square root (the number that was multiplied by itself) of numbers both with and without a calculator.

SCO N5 means that we will learn several ways to find the square root (the number that was multiplied by itself) of whole numbers, fractions and decimal numbers.

SQUARE ROOTS OF PERFECT SQUARES:

On a separate sheet of loose-leaf, make a list of the first 20 perfect squares. Keep this list handy during this section of the unit.

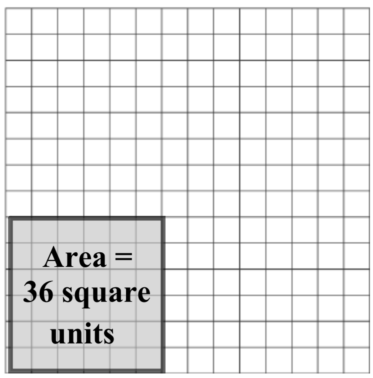
Ex.: $1^2 = 1 \times 1 = 1$
$2^2 = 2 \times 2 = 4$
$3^2 = 3 \times 3 = 9$, etc.

THE FIRST 20 PERFECT SQUARES:

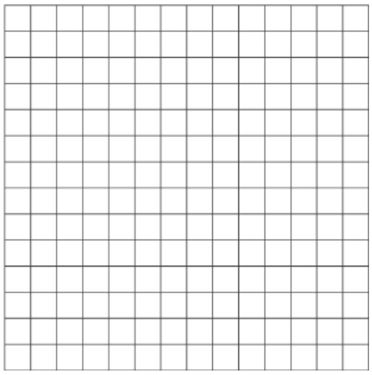
1^2	=	1 x 1	=	1	11^2	=	11 x 11	=	121
2^2	=	2 x 2	=	4	12^2	=	12 x 12	=	144
3^2	=	3 x 3	=	9	13^2	=	13 x 13	=	169
4^2	=	4 x 4	=	16	14^2	=	14 x 14	=	196
5^2	=	5 x 5	=	25	15^2	=	15 x 15	=	225
6^2	=	6 x 6	=	36	16^2	=	16 x 16	=	256
7^2	=	7 x 7	=	49	17^2	=	17 x 17	=	289
8^2	=	8 x 8	=	64	18^2	=	18 x 18	=	324
9^2	=	9 x 9	=	81	19^2	=	19 x 19	=	361
10^2	=	10 x 10	=	100	20^2	=	20 x 20	=	400

How do the dimensions of the shaded square relate to the factors of 36?

They are 6 by 6 which gives 36. The dimensions are the same, so each is a square root of 36.

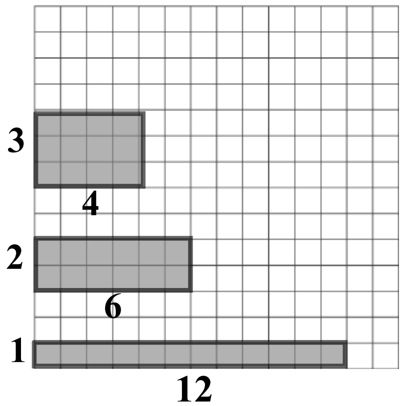


Can 12 be shown as a square on grid paper?



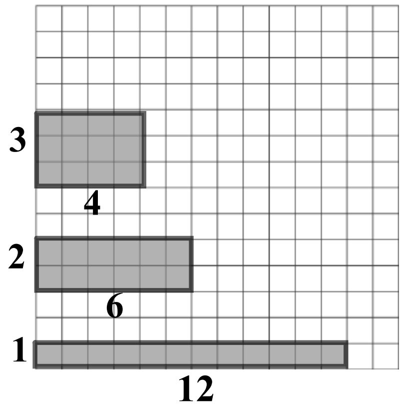
No, only as a rectangle. You can have 3 different rectangles here:

1 x 12
2 x 6
3 x 4



What do the dimensions of these rectangles represent?

They are the factors of the number that is the area of the rectangle (12).



A children's playground is a square with an area of 400 m^2.

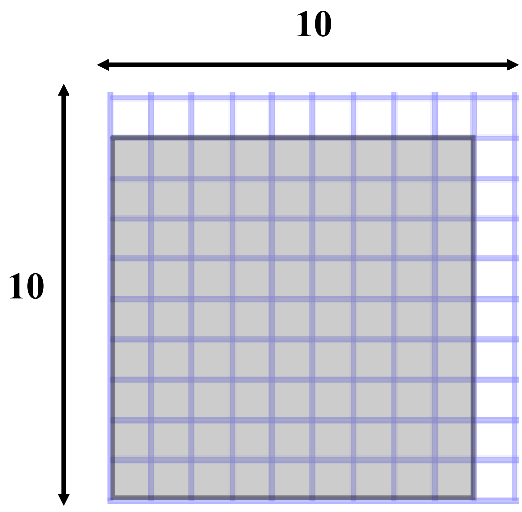
What is the side length of the square?

$\sqrt{400} = 20$ m

How much fencing is needed to go around the playground?

Perimeter of a square = 4 x side length
= 4 x 20 m
= 80 m of fencing

For the shaded square:



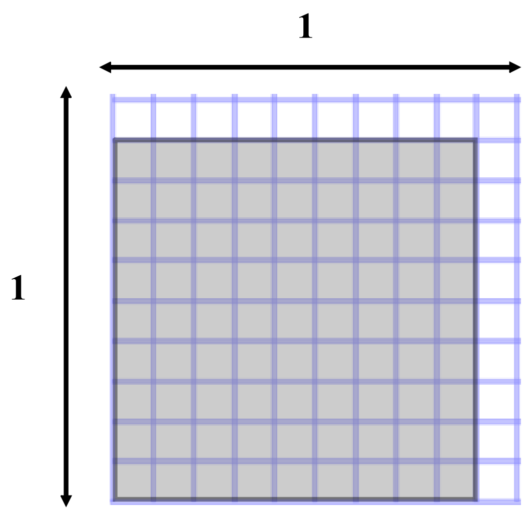
*   What is its area?

*   Write this area as a product.

*   How can you use a square root to relate the side length and area?

The side length is equal to the square root of the area.

For the shaded square:



*   What is its area?

*   Write this area as a product of fractions.

*   How can you use a square root to relate the side length and area?

The side length is equal to the square root of the area.

$(0.9)(0.9) = 0.81$

The rational numbers on the left side of the table to the right each represent the area of a square.

* Write each area as a product.

* Write the side length as a square root.

Area as a Product	Side Length as a Square Root
49 =	
$\frac{49}{100}$ =	
64 =	
$\frac{64}{100}$ =	
121 =	
$\frac{121}{100}$ =	
144 =	
$\frac{144}{100}$ =	

Area as a Product	Side Length as a Square Root
49 = 7×7	$\sqrt{49} = 7$
$\frac{49}{100}$ = $\frac{7}{10} \times \frac{7}{10}$	$\sqrt{\frac{49}{100}} = \frac{7}{10}$ $\sqrt{0.49} = 0.7$
64 = 8×8	$\sqrt{64} = 8$
$\frac{64}{100}$ = $\frac{8}{10} \times \frac{8}{10}$	$\sqrt{\frac{64}{100}} = \frac{8}{10}$ $\sqrt{0.64} = 0.8$
121 = 11×11	$\sqrt{121} = 11$
$\frac{121}{100}$ = $\frac{11}{10} \times \frac{11}{10}$	$\sqrt{\frac{121}{100}} = \frac{11}{10}$ $\sqrt{1.21} = 1.1$
144 = 12×12	$\sqrt{144} = 12$
$\frac{144}{100}$ = $\frac{12}{10} \times \frac{12}{10}$	$\sqrt{\frac{144}{100}} = \frac{12}{10}$ $\sqrt{1.44} = 1.2$

How can you use the square roots of whole numbers to determine the square roots of fractions?

Look at the numerator and the denominator of the fraction separately and determine the square root of each.

$$\left(\frac{3}{4}\right)^2 = \frac{9}{16}$$

$$\sqrt{\frac{36}{49}} = \frac{6}{7}$$

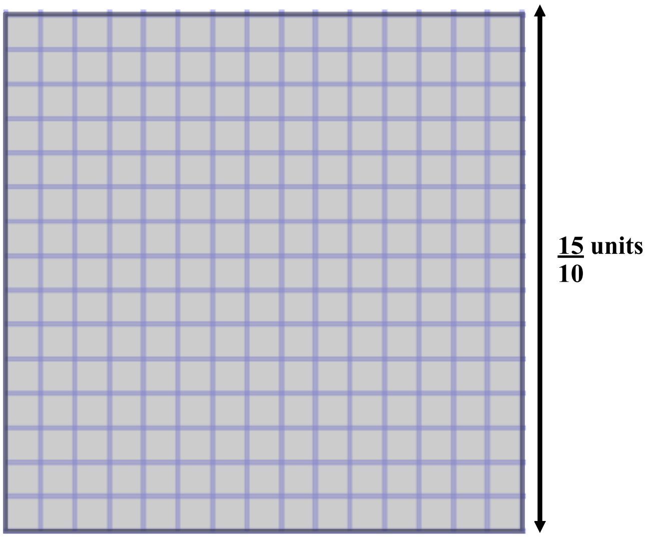
$$\left(\frac{36}{49}\right)^{\frac{1}{2}} = \frac{6}{7}$$

Suppose each fraction in the table is written as a decimal number.

How can you use the square roots of whole numbers to determine the square roots of decimal numbers?

Convert decimal numbers to fractions and determine the square root of the numerator and denominator. Use patterns. For example, when the number has 2 digits after the decimal, its square root has 1 digit after the decimal.

To determine the area of a square, we multiply the side length by itself. We *square* the side length.



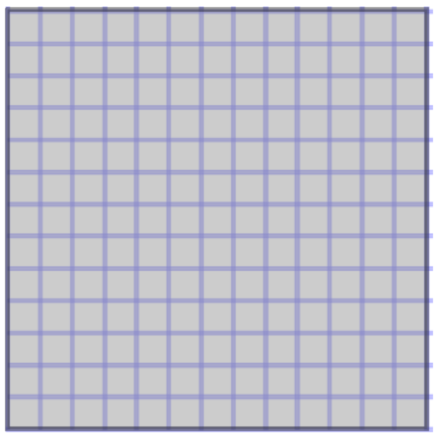
Area $= \left(\frac{15}{10}\right)\left(\frac{15}{10}\right)$

$= \frac{225}{100}$

$= 2.25 \text{ units}^2$

To determine the side length of a square, we calculate the square root of its area.

Area $= \frac{169}{100}$ square units



Side Length $= \sqrt{\frac{169}{100}}$

$= \frac{13}{10}$

$= 1.3$

Squaring and taking the square root are opposite, or *inverse*, operations.

That is, $\sqrt{\frac{225}{100}} = \frac{15}{10}$ **and** $\sqrt{\frac{169}{100}} = \frac{13}{10}$ **.**

We can rewrite these equations using decimals.

$$\sqrt{2.25} = 1.5 \text{ and } \sqrt{1.69} = 1.3$$

***NOTE: 1.5 and 1.3 are TERMINATING decimal numbers.**

Examples:

Calculate the number whose square root is:

a) 3

3×3

9

b) 8

8×8

64

c) $\frac{3}{8}$

$\frac{3}{8} \times \frac{3}{8}$

$\frac{9}{64}$

d) 1.8

1.8×1.8

3.24

The square roots of some fractions are repeating decimal numbers. For example, determine the side length of a square with an area of $\frac{1}{9}$ square units.

$$\sqrt{\frac{1}{9}} = \frac{1}{3}$$

A fraction in simplest form is a *perfect square* if it can be written as a product of two equal fractions.

Example: $\sqrt{\frac{2}{8}} = \sqrt{\frac{1}{4}}$

$$= \frac{1}{2}$$

When a decimal number can be written as a fraction that is a perfect square, then the decimal number is also a perfect square. Its square root is a terminating or repeating decimal number.

Examples: $\sqrt{0.36} = \sqrt{\frac{36}{100}}$ $= \frac{6}{10}$ $= 0.6$

$\sqrt{0.\overline{4}} = \sqrt{\frac{4}{9}}$ $= \frac{2}{3}$

Examples:

Is each fraction a perfect square? Explain.

a) $\sqrt{\frac{8}{18}} = \sqrt{\frac{4}{9}}$ $= \frac{2}{3}$

Yes

b) $\frac{16}{5}$ $= 3.2$

$\sqrt{3.2} = 1.78\ldots$

No

c) $\frac{2}{9}$

$\sqrt{0.\overline{2}}$

$0.4714\ldots$

No

Examples:

Is each decimal number a perfect square? Explain.

a) 6.25

$\sqrt{\frac{625}{100}}$

$\frac{25}{10}$

2.5

$\sqrt{6.25}$

$= 2.5$

yes

b) 0.627

$\sqrt{0.627}$

$= 0.7918...$

No

How can you tell if a decimal number is a perfect square?

A decimal number is a perfect square if it can be rewritten as a fraction that is a perfect square or if its square root on the calculator is a terminating or repeating decimal number.

How can you tell if a fraction is a perfect square?

A fraction is a perfect square if the numerator and the denominator of the fraction are perfect squares or, if in its simplest form, the numerator and denominator are perfect squares. Also, a fraction is a perfect square if its square root on the calculator is a terminating or repeating decimal number

CONCEPT REINFORCEMENT:

MMS9
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