

Grade 9 Math

Unit 1: Square Roots and Surface Area.

Review from Grade 8: Perfect Squares

What is a perfect square?

- ▶ Perfect square numbers are formed when we multiply a number (factor) by itself, or square a number.

For Example: $3 \times 3 = 9$

9 is a perfect square, and 3 is it's factor.

There are other ways to ask the same question....

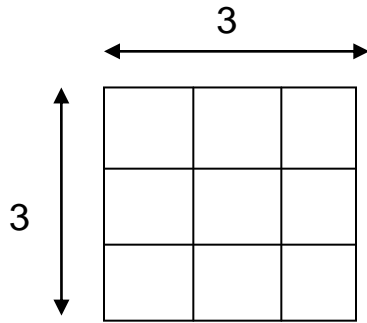
- ▶ What is the square of 3? Meaning what is 3×3 , or what is $3^2 = 9$
- ▶ What is 3 squared ? Meaning what is 3×3 , or what is $3^2 = 9$
- ▶ What is 3 to the power of 2? Meaning what is 3×3 , or what is $3^2 = 9$

We can sketch a diagram of perfect squares, by actually drawing squares. The factors (the number that multiplies by itself) are the side length of the square and the area of the square is the perfect square number.

Length \times Length = Area of a Square

$$(\text{Length})^2 = \text{Area}$$

$$\begin{array}{ccc} 3 & \times & 3 & = & 9 \\ \uparrow & & \uparrow & & \uparrow \\ \text{Length} & & \text{Length} & & \text{Area} \end{array}$$

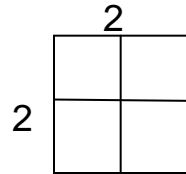


and there are 9 little squares

$$3 \times 3 = 9$$

The List of Perfect Squares from 1 to 20.

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



... etc



These are the perfect square numbers.

Review from Grade 8: Square Root

When we multiply a number by itself we find the perfect square

$$10^2 = 10 \times 10 = 100$$

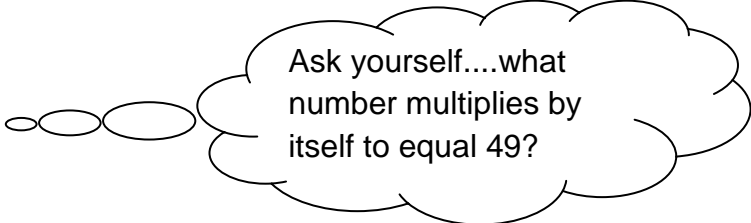
Finding the square root of a number is doing the opposite. We are given the perfect square and asked to find what number multiplied by itself to get that number.

Finding the perfect square and finding the square root are called **inverse operations**. (they are opposites).

The symbol for square root is $\sqrt{\quad}$

$$\sqrt{100} = \sqrt{10 \times 10} = 10$$

What is $\sqrt{49}$?



Ask yourself....what number multiplies by itself to equal 49?

Sec 1.1: Square Roots of Perfect Squares.

Review from Grade 8: Decimals and Fractions

How to change a decimal to a fraction:

A). 0.6



The 6 is in the first decimal place called the **tenths** place. Therefore,

$$0.6 = \frac{6}{10}$$

B). 0.08



The 8 is in the second decimal place called the **hundredths** place.

Therefore,

$$0.08 = \frac{8}{100}$$

C). 0.25



The 5 is in the hundredths place, therefore,

$$0.25 = \frac{25}{100}$$

Always look at the last number and that's the decimal position we are looking for

D). 0.379



The 9 is in the third decimal place, called the thousandths place, Therefore,

$$0.379 = \frac{379}{1000}$$

Remember:

$$0.1 = \frac{1}{10} \quad (\text{tenth})$$

$$0.01 = \frac{1}{100} \quad (\text{hundredth})$$

$$0.001 = \frac{1}{1000} \quad (\text{thousandth})$$

Some fractions and decimals can also be perfect squares. If we can represent the area using squares than it is a perfect square.

To determine if a fraction is a perfect square, we need to find out if the numerator (top number) and the denominator (bottom number) are both perfect squares.

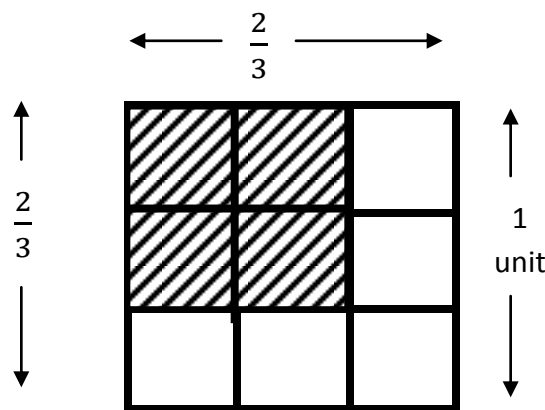
Examples of Fractions:

1. Is $\frac{4}{9}$ a perfect square?

- Since $\sqrt{4} = 2$ and $\sqrt{9} = 3$ then $\frac{4}{9}$ is a perfect square

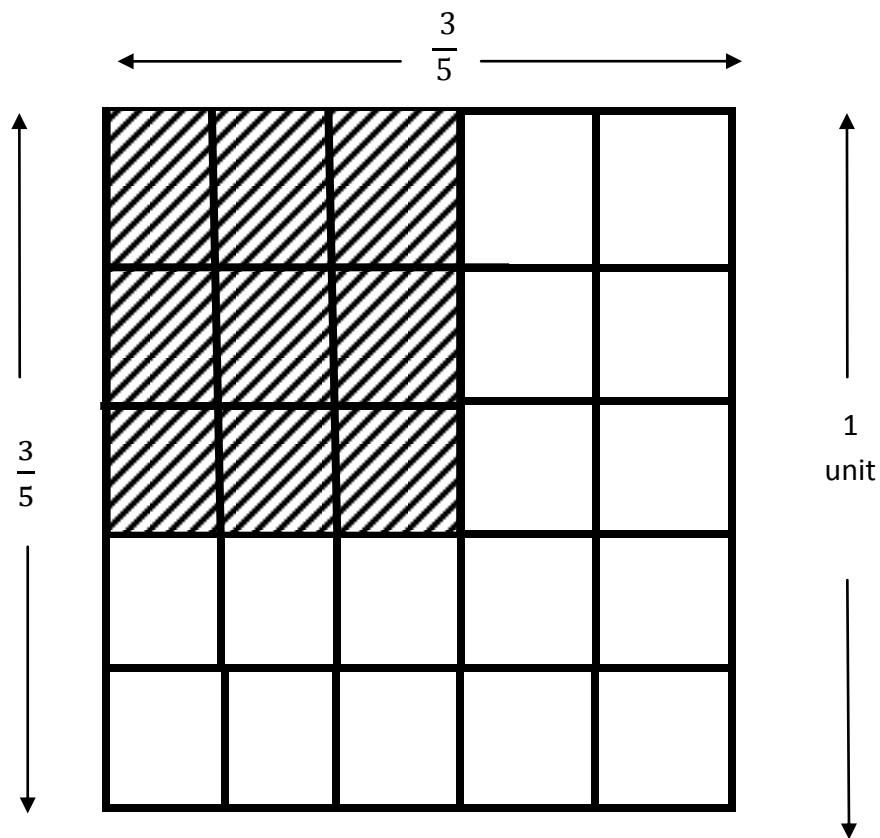
$$\sqrt{\frac{4}{9}} = \frac{\sqrt{4}}{\sqrt{9}} = \frac{2}{3} \quad \text{Check your answer} \quad \frac{2}{3} \times \frac{2}{3} = \frac{4}{9}$$

This can also be represented by drawing a diagram using squares:



There are 2 out of 3 squares shaded along the width and length of the square and there are 4 squares shaded out of a total of 9 squares. And it still created a square.

2. Use a diagram to determine the value of $\sqrt{\frac{9}{25}}$?



$$\sqrt{\frac{9}{25}} = \frac{\sqrt{9}}{\sqrt{25}} = \frac{3}{5}$$

3. Is $16\frac{4}{9}$ a perfect square?

FIRST we must change this mixed number to an improper fraction.

$$16\frac{4}{9} = \frac{148}{9}$$

Are both the numerator (148) and denominator (9) perfect squares?

No! 148 is not a perfect square therefore, $16\frac{4}{9}$ is not either.

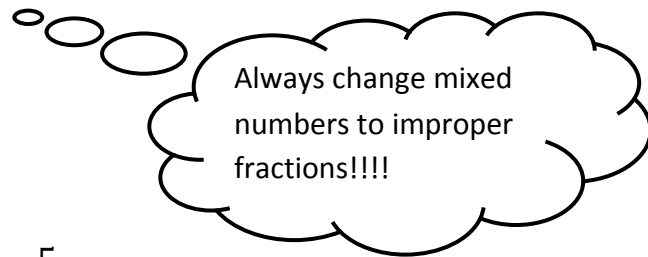
*****NOTE***** Just because 16, 4 and 9 are individually perfect squares, it did not necessarily mean that $16\frac{4}{9}$ is automatically a perfect square too. **YOU MUST CHANGE TO IMPROPER FRACTION** to get the correct answer.

4a. Is $4\frac{21}{25}$ a perfect square?

$$4\frac{21}{25} = \frac{121}{25}$$

$$\sqrt{121} = 11 \quad \text{and} \quad \sqrt{25} = 5$$

$$\text{Therefore, } \sqrt{\frac{121}{25}} = \frac{\sqrt{121}}{\sqrt{25}} = \frac{11}{5} \quad \text{It is a perfect square.}$$



4b. Is $\frac{8}{50}$ a perfect square?

$\sqrt{\frac{8}{50}}$ this doesn't work however, if you reduce the fractions to lowest terms

$$\sqrt{\frac{8}{50}} = \sqrt{\frac{4}{25}} = \frac{\sqrt{4}}{\sqrt{25}} = \frac{2}{5} \quad \text{so it actually is a perfect square. BE CAREFUL!!!!}$$

Examples of Decimals:

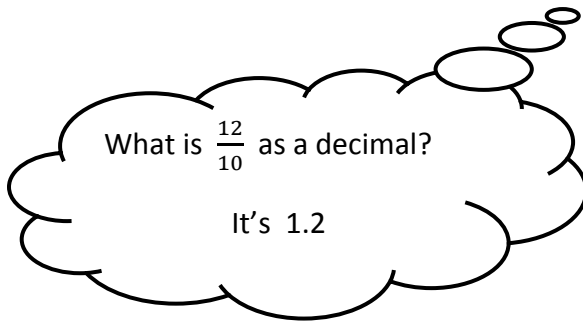
5. Find $\sqrt{1.44}$

- There are a couple of ways to approach this question.

First change 1.44 to a fraction. $1.44 = \frac{144}{100}$

Then determine if the numerator and denominator are perfect squares.

$$\sqrt{\frac{144}{100}} = \frac{\sqrt{144}}{\sqrt{100}} = \frac{12}{10} \quad \text{Therefore, it is a perfect square.}$$



- Another way to complete this question is to recognize that $12 \times 12 = 144$ and that $1.2 \times 1.2 = 1.44$, so 1.44 is a perfect square.

6. Which decimal is a perfect square 6.4 or 0.64? Justify your answer.

$$6.4 = \frac{64}{10} \quad \sqrt{\frac{64}{10}} = \frac{\sqrt{64}}{\sqrt{10}} = \frac{8}{\sqrt{10}}$$

since 10 is not a perfect square than 6.4 is not a perfect square.

$$0.64 = \frac{64}{100} \quad \sqrt{\frac{64}{100}} = \frac{\sqrt{64}}{\sqrt{100}} = \frac{8}{10}$$

Therefore, 0.64 is a perfect square.

Examples of square roots and perfect squares.

$$1. \sqrt{8100} = 90$$

$$\sqrt{81} = 9$$

$$\sqrt{0.81} = 0.9$$

$$\sqrt{0.0081} = 0.09$$

** Many students find it tricky....where does the decimal go?

Here's a hint ... if the perfect square is a whole number, than the square root answer is smaller than the original number.

$$\sqrt{81} = 9 \quad (9 \text{ is less than } 81)$$

... if the perfect square is a rational number (decimal or fraction) between 0 and 1, than the square root is bigger than the original number.

$$\sqrt{0.81} = 0.9 \quad (0.9 \text{ is greater than } 0.81)$$

When finding a square root, you find the number that multiplies by itself.

$$\sqrt{81} = 9 \quad \text{because} \quad 9 \times 9 = 81$$

What about -9 ?

$$\text{Can } \sqrt{81} = -9 \quad \text{because} \quad -9 \times -9 = 81 \text{ ?}$$

YES! Square roots can have negative answers, but for us we will only be finding the principal square root and that's the positive answer.

2. Calculate the number whose square root is:

a). $\frac{17}{5}$

b). 1.21

c). 0.5

$$\frac{17}{5} \times \frac{17}{5} = \frac{289}{25}$$

$$\begin{array}{r} 1.21 \\ \times 1.21 \\ \hline 1.4641 \end{array}$$

$$\begin{array}{r} 0.5 \\ \times 0.5 \\ \hline 0.25 \end{array}$$

Just multiply each number by itself.

The List of Some Perfect Squares Decimal Numbers.

0.1^2	=	0.1×0.1	=	0.01
0.2^2	=	0.2×0.2	=	0.04
0.3^2	=	0.3×0.3	=	0.09
0.4^2	=	0.4×0.4	=	0.16
0.5^2	=	0.5×0.5	=	0.25
0.6^2	=	0.6×0.6	=	0.36
0.7^2	=	0.7×0.7	=	0.49
0.8^2	=	0.8×0.8	=	0.64
0.9^2	=	0.9×0.9	=	0.81
1.1^2	=	1.1×1.1	=	1.21
1.2^2	=	1.2×1.2	=	1.44
1.3^2	=	1.3×1.3	=	1.69
1.4^2	=	1.4×1.4	=	1.96
1.5^2	=	1.5×1.5	=	2.25
1.6^2	=	1.6×1.6	=	2.56
1.7^2	=	1.7×1.7	=	2.89
1.8^2	=	1.8×1.8	=	3.24
1.9^2	=	1.9×1.9	=	3.61

These are the perfect square numbers.

3. Determine whether each decimal is a perfect square.

You can use a calculator to find out if a decimal is a perfect square.

The square root of a **perfect square** decimal is either a

- **terminating decimal** (ends after a certain number of decimal places) or
- a **repeating decimal** (has a repeating pattern of digits in the decimal).

Decimal	Value of Square Root	Type of Decimal	Is decimal a perfect square?
1.69	1.3	Terminating	Yes
3.5	1.8708286...	Non-terminating Non-repeating	No
70.5	8.3964278...	Non-terminating Non-repeating	No
5.76	2.4	Terminating	Yes
0.25	0.5	Terminating	Yes
2.5	1.5811388...	Non-terminating Non-repeating	No