Grade 8 - Unit 1 Square roots & Pythagorean Theorem

Name: _____

By the end of this unit I should be able to:

✓   Determine the square of a number.

✓   List the perfect squares between 1 and 144

✓   Show that a number is a perfect square using symbols, diagram, prime factorization
      or by listing factors.

✓   Use the terms base, power and exponent

✓   Relate area of a square to perfect squares and square roots.

✓   Determine the square root of a number with and without calculator.

✓   Estimate the square root of a given number that is not a perfect square.

✓   Identify a whole number that has a square root between 2 numbers. Ex. Find a
      number whose square root is between 4 and 5. Answer is any number between 16
      and 25.

✓   Explain The Pythagorean Theorem and use a model to explain the theorem. Show
      where the legs and Hypotenuse are located.

✓   Find a missing side in a right triangle if 2 sides are known using Pythagorean
      Theorem.

✓   Determine if 3 numbers would represent the sides of a right triangle or be
      considered a Pythagorean triple.

✓   Solve word problems associated with the Pythagorean triangle.

And remember to keep organized:

✓ Hand Ins will be placed in your doutangs until the end of the unit

✓   Handouts such as notes, examples, and reference pages should be placed in your
binder and labeled with the date.

Grade 8 - Unit 1 Square roots & Pythagorean Theorem

Name: _____

Area is the amount of space a two dimensional object takes up. The area of a rectangle or a square is found by using a formula such as :

A = base x height   or   **Area = length x width**

Square	Side Length	Area

What do you notice about the side lengths of the square?

Name: _____

Squares

Squares are special shapes because both side lengths are the exact same. This means when finding the area of a square we only need to know the length of one side. If we can represent an area using squares, then it is a **perfect square or square number.**

Side Length	Area / Square Number / Perfect Square
1	1
2	4
3	9

$A = S^2$

Side Length	Area / Square Number / Perfect Square
1	1
2	4
3	9
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

If you look at the table above you can see that the numbers 1,4, and 9 are all perfect squares. **Finish the table on the right**. You will need to remember these perfect squares.

Next to each number below, write whether it is a perfect square or not

A. 100

B. 72

C. 64

D. 81

E. 74

F. 101

G. 1

H. 42

Name: _____
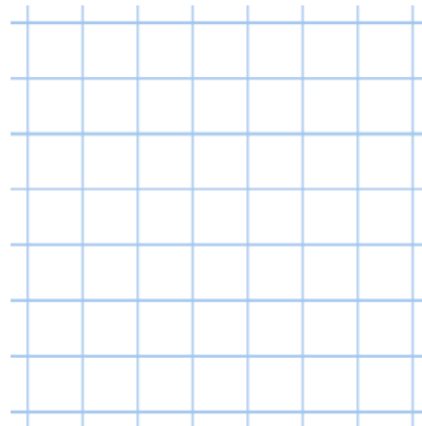
Identifying perfect squares

There are 4 ways to determine if a number is a perfect square :

1. Try to draw the square
2. Write a division sentence to show that the quotient is equal to the divisor
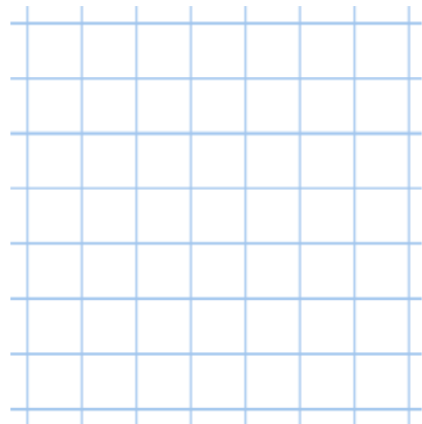3. Find the factors of the number
4. Prime factorization

We will look at each of these methods below :

1. **Try to draw the square**

Is 36 a perfect square?

Is 20 a perfect square?

Name: _____

2. **Write a division sentence to show that the quotient is equal to the divisor**

Is 36 a perfect square?

If you can write a division sentence so that the quotient is equal to the divisor
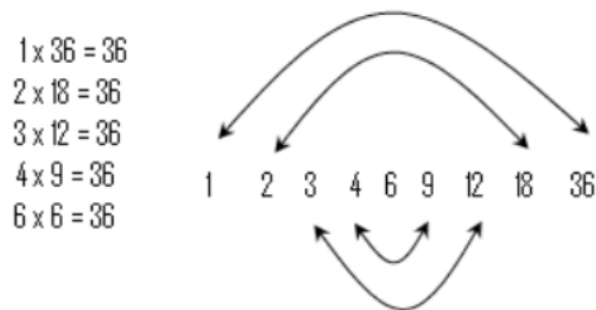
$$36 \div 6 = 6$$

Therefore, 36 is a perfect square because the quotient is the same as the divisor

Is 20 a perfect square?

3. **Find the factors of the number**

A square number will have an odd number of factors.

To find $\sqrt{36}$, list all the factors from least to greatest:

```
1 x 36 = 36
2 x 18 = 36      1   2   3   4  6  9  12  18   36
3 x 12 = 36
4 x 9 = 36
6 x 6 = 36
```

Since the middle number doesn't have a partner, it must multiply with itself so $\sqrt{36} = 6$.

Name: _____

Find all the factors of 49. (All the numbers that can be multiplied together to give you 49). How many factors are there? Is that number odd or even? Can 49 be a perfect square?

Find all the factors of 14. Repeat the same process as above. Can 14 be a perfect square?

4. <u>**Prime Factorization**</u>

A prime number is a whole number that can not be made by multiplying other whole numbers. The only factors of a prime number are 1 and itself. For example, 2 is a prime number because its only factors are 1 and 2.

Prime factorization is finding the factors of a number that are all prime. Each of these prime numbers can be multiplied to create the original number. A number is considered square if it has an even amount of the same prime factor.

To complete prime factorization ;

1. Find two factors of your number
2. Look at your two factors and determine if one or both is not prime
3. If it is not a prime factor it
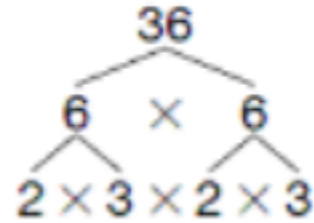4. Repeat this process until all your factors are prime.

Name: _____

To find $\sqrt{36}$, make a factor tree:

We have a pair of 2's and a pair of 3's:

$$2 \times 3 = 6, so \ \sqrt{36} = 6$$

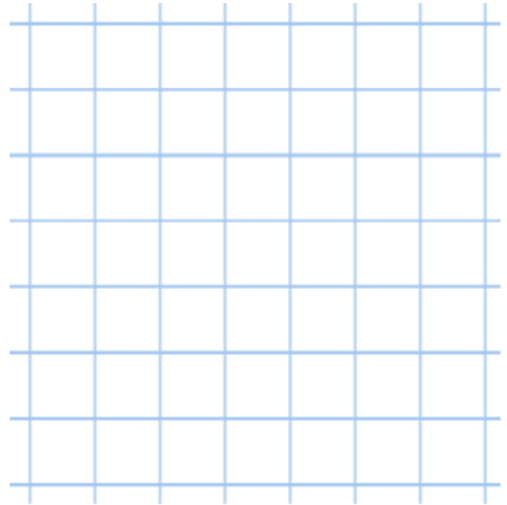Find the prime factorization of 24

Find the prime factorization of 81

Find the prime factorization of 36
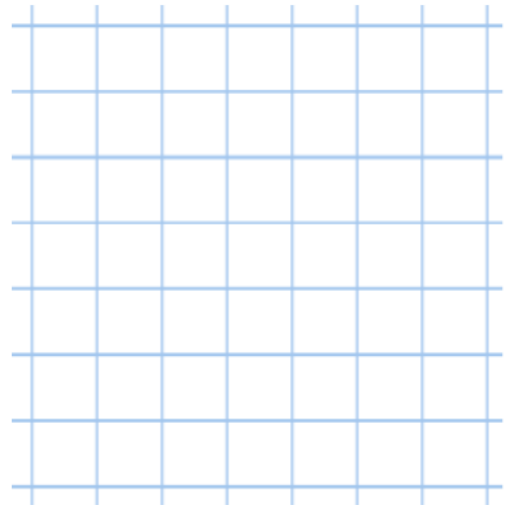
Find the prime factorization of 400

Grade 8 - Unit 1 Square roots & Pythagorean Theorem

Name: _____

Use the 4 criteria above to show that 16 is a perfect square

Use these 4 criteria to show that 28 is not a perfect square

Grade 8 - Unit 1 Square roots & Pythagorean Theorem

Name: _____

Let's look at the difference between a "square" and a "square root"

	Square	Square Root
Definition	Multiply number by itself.	What number, multiplied by itself, make the number under the symbol.
Symbol	$4^2 = 4 \times 4 = 16$	$\sqrt{64} = 8$, $since\ 8 \times 8 = 64$

Complete the following questions :

1. Square the following :
   a. 9   b. 3   c. 1   d. 23   e. 16

2. Find each square root

a) $\sqrt{9}$ b. $\sqrt{64}$ $\sqrt{49}$ d. $\sqrt{1}$ e. $\sqrt{484}$

Name: _____

Estimating Square Roots

It is important to be able to estimate square roots of a number. To estimate the square root of a number ;

1. Write out the first few perfect squares
2. Find out which two squares the number is between
3. Take the square roots of the perfect square
4. Pick a decimal number between the two perfect squares that you believe is close to the answer

Example : What is $\sqrt{14}$?

Since 14 is not a perfect square we must estimate.   Between what two perfect squares does 14 fall between?

14 falls between 9 and 16, so $\sqrt{14}$ falls between $\sqrt{9}$ and $\sqrt{16}$ or 3 and 4. So

$\sqrt{14}$ ~ 3.7
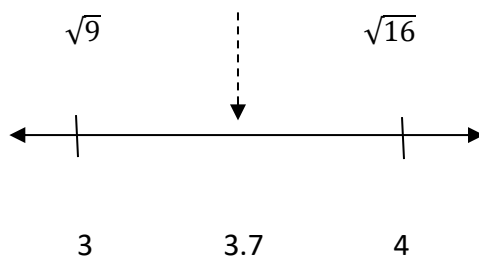
Name: _____

1) Estimate each square root. SHOW YOUR WORK!

a) $\sqrt{55}$ b) $\sqrt{100}$

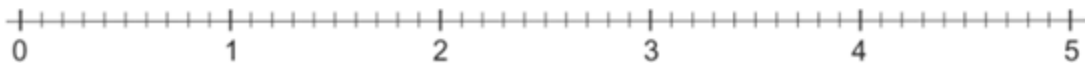c) $\sqrt{37}$ d) $\sqrt{62}$

e) $\sqrt{136}$ f) $\sqrt{4 \times 4}$

2. Place each square root on the number line below

$\sqrt{2}$ $\sqrt{24}$ $\sqrt{9}$ $\sqrt{11}$ $\sqrt{4}$ $\sqrt{18}$ $\sqrt{16}$

```
+++++++++++++++++++++++++++++++++++++++++++++++++++++++++++
0         1         2         3         4         5
```

3. A fridge magnet has an area of $54mm^2$. Is 54 a perfect square? If not, what perfect square number is closest?

4. A square floor mat is used for gymnastics has a side length of 17m. What is the area of the mat in meters?

5. Mr. Davenport told his students to run around the perimeter of the school field. The area of the square field is $29\ 900m^2$. What distance did the students run?

Name: _____

<u>Pythagorean Theorem</u>
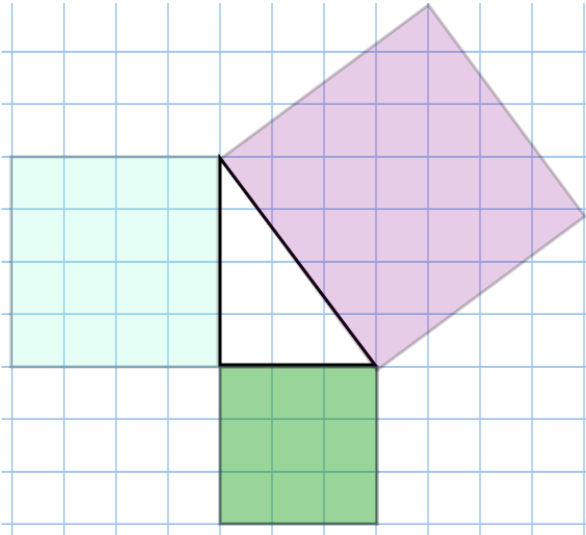
The Pythagorean theorem states that the sum of the squares on the legs of a right triangle is equal to the square of the hypotenuse
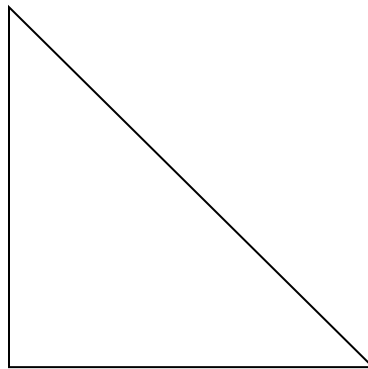
Or

When a triangle has a right angle and square made on each of the three sides, then the biggest square has the exact same area as the other two squares put together.

The legs of the triangle are considered the shorter sides and the hypotenuse is the longest side is located across from the right angle.

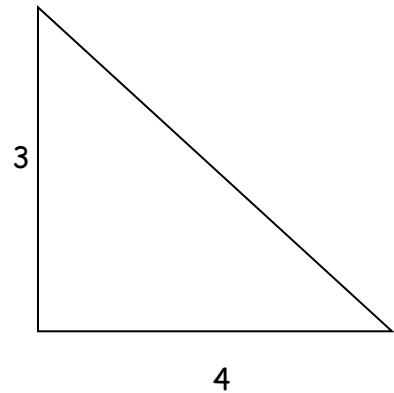The algebraic expression for the Pythagorean Theorem is :
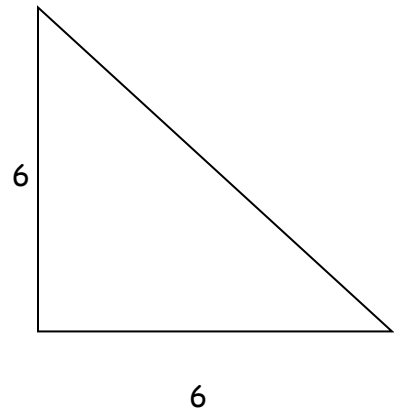
$$a^2 + b^2 = c^2$$

Name: _____

A triangle has legs of 3 units and 4 units. What is the length of the hypotenuse?

```
|\
| \
3|  \
|   \
|____\
  4
```

A right isosceles triangle has legs of 6 meters each. What is the length of the hypotenuse to the nearest tenth of a meter?

```
|\
| \
6|  \
|   \
|____\
  6
```

A flagpole casts a 5 meter shadow. The pole is 7 meters tall. How far is the top of the flag pole to the edge of the shadow? Round to the nearest tenth of a meter.
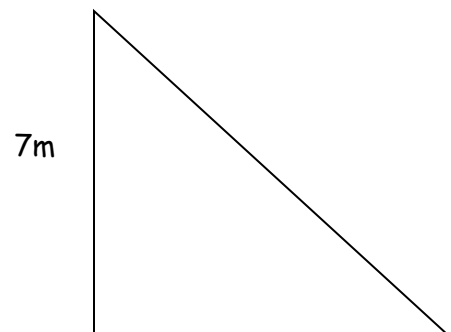
```
|\
| \
7m|  \
|   \
|____\
```

Name: _____

5m

The Pythagorean theorem is not only used to find the hypotenuse of a right angled triangle. It can also be used to find the legs of the same triangle as long as one of the legs and hypotenuse is known. Or in other terms you can use the theorem to find "a" as long as you know 'b' and 'c'

A triangle with hypotenuse length of 10cm and one leg length of 6cm is drawn. What is the length of the second leg?

6cm   10cm

???
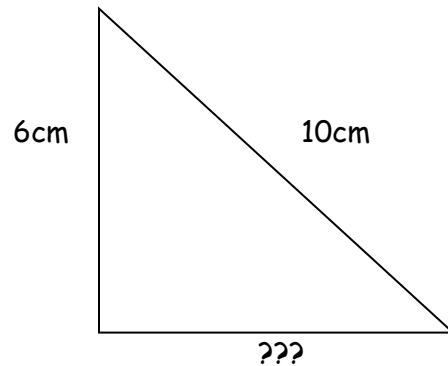
A triangle with hypotenuse of length 15cm and one leg length of 12cm is drawn. What is the length of the second leg?

??   15

12
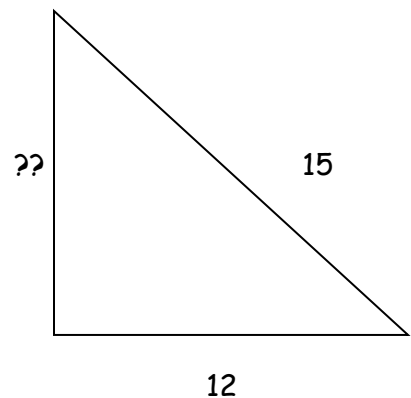
Grade 8 - Unit 1 Square roots & Pythagorean Theorem

Name: _____

One of the best parts of the Pythagorean Theorem is that it works both ways! This means that if a triangle is a right angle $a^2 + b^2 = c^2$, and if $a^2 + b^2 = c^2$ then the triangle is a right triangle.

A triangle has measures of 8cm, 10cm, and 16cm. Is it a right triangle?

The height of a triangle is 4cm and the base of the same triangle is 10cm. What is the length of the hypotenuse to the nearest tenth?

A cruise ship travels from Port Cassett north at a speed of 34km/h for 2.5 hours. Then it turns 90 and travels west at 30km/h for 7.3 hours. When it reaches Green Sea Island, how far is the ship from Port Cassett. Express your answer to the nearest kilometer.
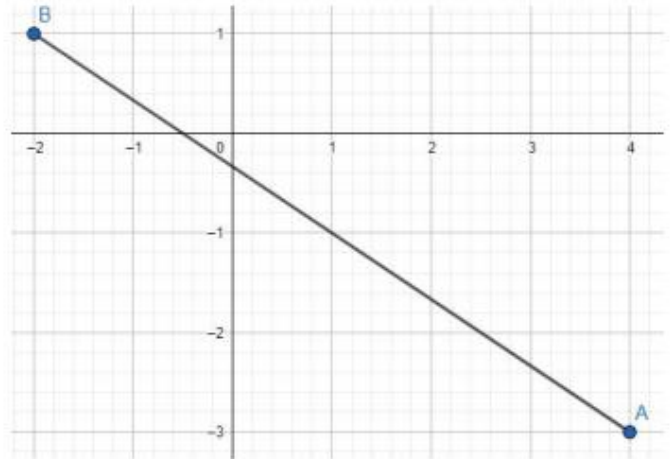

Green Sea Island

■ km

Port Cassett
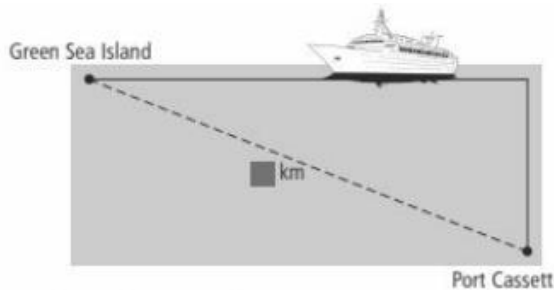
Name: _____

Find the distance between point (4,-3) and (-2,1)

Practice makes Perfect! (in this case – perfect squares)

Pages 8-9 Questions #1, 2, 6, 7, 10, 15

Pages 13-14 Questions # 2, 4, 7, 8, 9, 10, 11

Page 18 #1, 2, 4, 5, 13, 14

Page 23 Questions # 1 - 9

Pages 29-31 Questions #1, 2, 5, 7, 9, 10

Page 35 all questions

Chapter Self Test and Chapter Review