OCTOBER 23, 2018

UNIT 3: SQUARE ROOTS AND SURFACE AREA

SECTION 1.2:
SQUARE ROOTS OF NON-PERFECT SQUARES

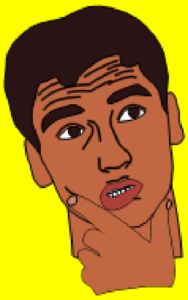
K. SEARS
MATH 9

WHAT'S THE POINT OF TODAY'S LESSON?

We will continue working on the Math 9 Specific Curriculum Outcome (SCO) "Numbers 4" OR N4 and begin working on "Numbers 6" OR "N6" which state:

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

N6: "Determine an approximate square root of positive rational numbers that are non-perfect squares."

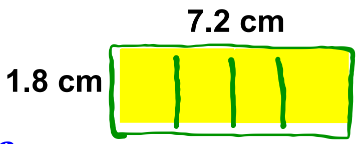


What does THAT mean???

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 N6 means that we will use calculators and "benchmarking" to estimate the square root (the number that was multiplied by itself) of non-perfect squares like 15, 7.5 and $\frac{19}{6}$.

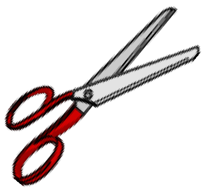
WARM-UP:

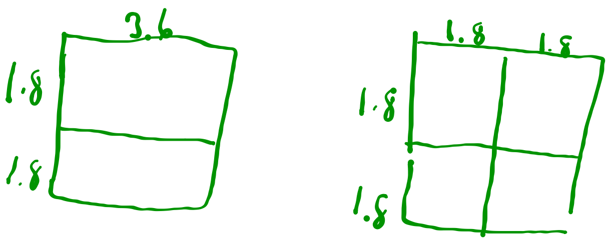


A student has a rectangular piece of paper 7.2 cm by 1.8 cm. She cuts the paper into parts that can be rearranged to form a square. Cut in 2

a) What is the side length of the square?

b) What are the fewest cuts the student could have made? Explain. One





HOMEWORK QUESTIONS?
(pgs 11 / 12 / 13, #5, 8, 9, 10, 12, 13, 14 and 17)

THE FIRST 20 PERFECT SQUARES:

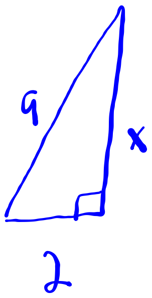
1^2	=	1 x 1	=	1	11^2	=	11 x 11	=	121
2^2	=	2 x 2	=	4	12^2	=	12 x 12	=	144
3^2	=	3 x 3	=	9	13^2	=	13 x 13	=	169
4^2	=	4 x 4	=	16	14^2	=	14 x 14	=	196
5^2	=	5 x 5	=	25	15^2	=	15 x 15	=	225
6^2	=	6 x 6	=	36	16^2	=	16 x 16	=	256
7^2	=	7 x 7	=	49	17^2	=	17 x 17	=	289
8^2	=	8 x 8	=	64	18^2	=	18 x 18	=	324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

Which numbers are between the perfect squares 1 and 4? 9 and 16? What do you think their square roots will be?

WARM UP:

Please turn to page 14 in *MMS9*.

What is the safe height up the wall for the ladder?



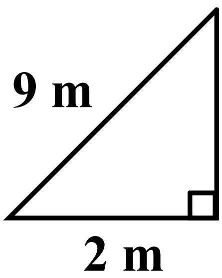
$c^2 = a^2 + b^2 \quad a^2 = c^2 - b^2$

$a^2 = c^2 - b^2$
$= 9^2 - 2^2$
$= 81 - 4$
$= 77$
$a = \sqrt{77}$
$= 8.8$

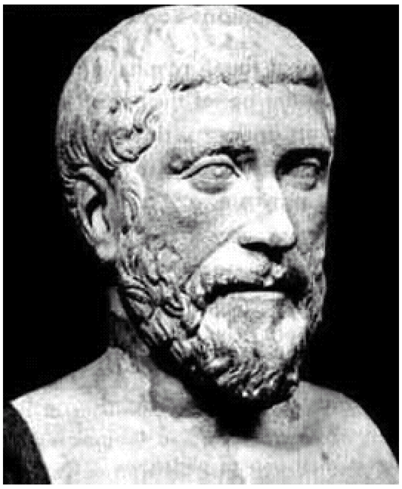
$\frac{8.8}{4} = 2.2$

ladder is too close

How could you check if the ladder is safe? Try to do this without a calculator.



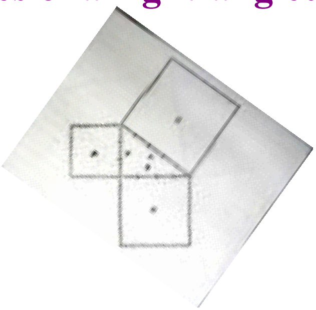
$$a^2 + b^2 = c^2$$
$$2^2 + b^2 = 9^2$$
$$4 + b^2 = 81$$
$$b^2 = 81 - 4$$
$$b^2 = 77$$
$$\sqrt{b^2} = \sqrt{77}$$
$$b \doteq 8.8 \text{ m}$$

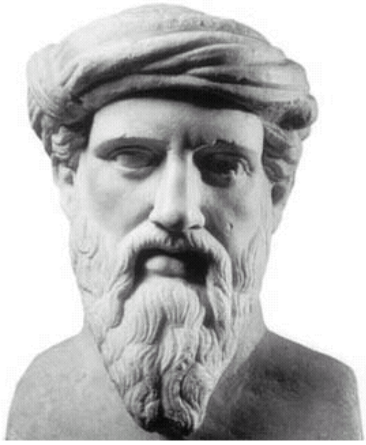


Pythagoras of Samos
(about 569 BC - about 475 BC)

Pythagoras was a Greek philosopher who made important developments in mathematics, astronomy and the theory of music. The theorem now known as Pythagoras' theorem was known to the Babylonians 1000 years earlier, but he may have been the first to prove it.

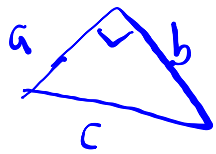
Pythagoras discovered a relationship between the areas of the squares drawn on the sides of a right-angled triangle.

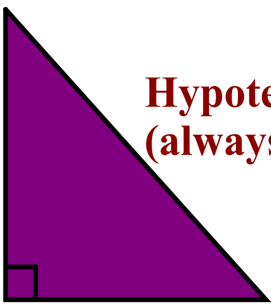




PYTHAGOREAN THEOREM:

We know that a right triangle is a triangle containing a 90° angle.

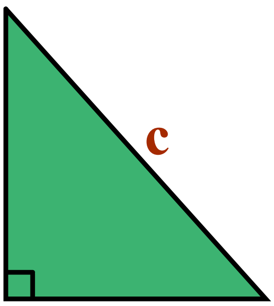




Leg

Hypotenuse
(always the longest side)

Leg



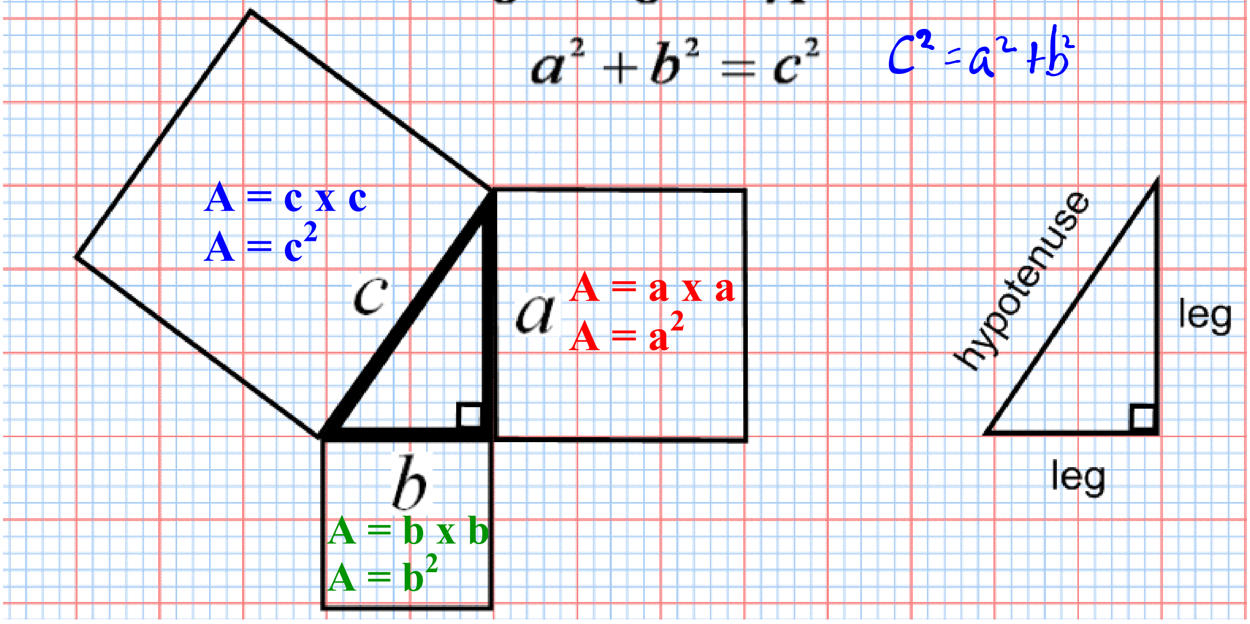
a

c

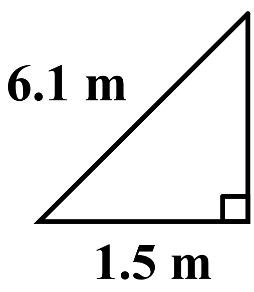
b

Pythagoras found out that when you have a right triangle, $leg^2 + leg^2 = hypotenuse^2$

$$a^2 + b^2 = c^2 \qquad c^2 = a^2 + b^2$$



Estimate how far up a wall a 6.1 m long ladder will reach if its base is 1.5 m from the wall.



$$c^2 = a^2 + b^2$$

$$a^2 = c^2 - b^2$$

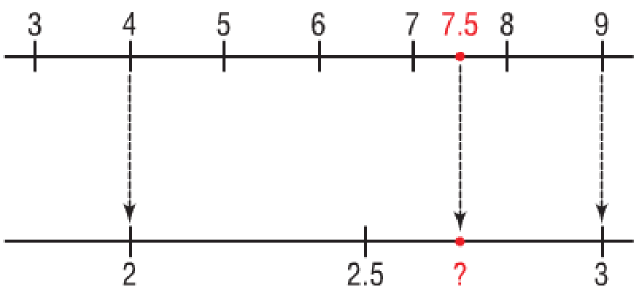
$$\begin{aligned}
a^2 + b^2 &= c^2 \\
1.5^2 + b^2 &= 6.1^2 \\
2.25 + b^2 &= 37.21 \\
b^2 &= 37.21 - 2.25 \\
b^2 &= 34.96 \\
\sqrt{b^2} &= \sqrt{34.96} \\
b &\doteq 5.9 \text{ m}
\end{aligned}$$

We will learn two strategies for estimating the square root of a decimal number that is not a perfect square:

1) benchmarks

2) using a calculator

BENCHMARKS: Estimate $\sqrt{7.5}$.



USING A CALCULATOR: Estimate $\sqrt{7.5}$.

$\sqrt{7.5} \doteq$ **2.738 612 788**

Check: $2.738\,612\,788^2$

$= 7.500\,000\,003$

Since this number is not EXACTLY equal to 7.5, the square root is an approximation.

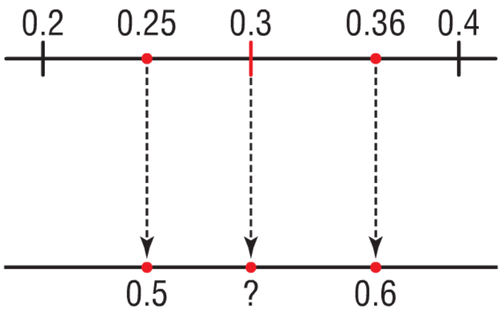
Let's look at the 4 examples on pages 15 and 16 of *MMS9* for estimating a square root of a fraction using both the benchmark and calculator methods:

a) $\sqrt{8/5}$

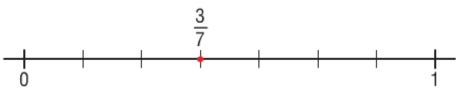
$\doteq \sqrt{\frac{9}{4}}$

$\doteq \frac{3}{2}$

b) $\sqrt{3/10}$



c) $\sqrt{3/7}$



$\doteq \sqrt{0.5}$

$\doteq \sqrt{0.49}$

$\doteq 0.7$

d) $\sqrt{19/6}$

$\sqrt{\frac{25}{9}}$

$\frac{5}{3}$

$1.\overline{6}$

Let's look at the example on page 17 of *MMS9* for finding a number with a square root between two given numbers:

Method I

$10^2 = 100$

$11^2 = 121$

(116)

$\sqrt{116} \doteq 10.7$

Method II

10

↓ → $(10.5)^2 = $ (110.25)

11

Identify a decimal number that has a square root between 10 and 11. Check the answer.

Method 1:

$10^2 = 100$

$11^2 = 121$

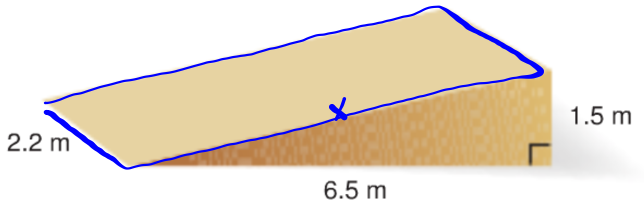
Any number between 100 and 121 has a square root between 10 and 11.

Method 2:

One decimal number between 10 and 11 is 10.4 .

$(10.4)^2 = 108.16$

Let's practice some more with the Pythagorean Theorem. Calculate the area of carpet needed to cover this ramp.



$A = b \times h$

$c^2 = a^2 + b^2$

$x^2 = 6.5^2 + 1.5^2$

$= 42.25 + 2.25$

$= 44.50$

$= \sqrt{44.5}$

$= 6.7m$

$A = b \times h$

$= 2.2 \times 6.7$

$= 14.74 m^2$

MMS9, page 18: DISCUSS THE IDEAS

1. Non-perfect square - # that does not end or repeat

2. Perfect
1 0.49 9

Non-perfect
2 3 5

3. Square root could continue past the screen.

CONCEPT REINFORCEMENT:

MMS9
Page 18: #4, 5 (change to decimal numbers first)
Page 19: #9 (use your calculator), 10, 11, 13, and 16
Page 20: #17, 19, 20 and 21

MID-UNIT REVIEW:

MMS9
Page 21: #1 to #11