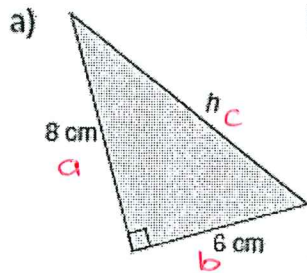


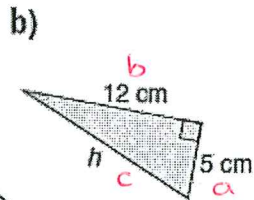
Math 8**Lesson S3 ~ The Pythagorean Theorem****Developing:**

5. Find the length of each hypotenuse.
Give your answers to one decimal place where needed.



$$\begin{aligned} 8^2 + 6^2 &= c^2 \\ 64 + 36 &= c^2 \\ 100 &= c^2 \\ \sqrt{100} &= c \end{aligned}$$

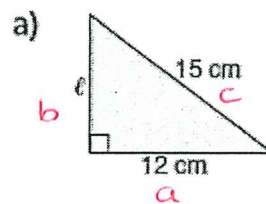
$$\boxed{10 \text{ cm} = c}$$



$$\begin{aligned} 5^2 + 12^2 &= c^2 \\ 25 + 144 &= c^2 \\ 169 &= c^2 \\ \sqrt{169} &= c \end{aligned}$$

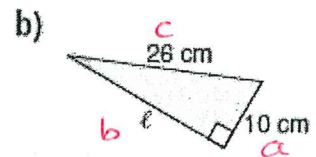
$$\boxed{13 \text{ cm} = c}$$

6. Find the length of each leg labelled ℓ .
Give your answers to one decimal place where needed.



$$\begin{aligned} 12^2 + b^2 &= 15^2 \\ 144 + b^2 &= 225 \\ b^2 &= 225 - 144 \\ b^2 &= 81 \\ b &= \sqrt{81} \end{aligned}$$

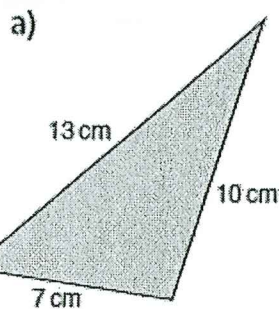
$$\boxed{b = 9 \text{ cm}}$$



$$\begin{aligned} 10^2 + b^2 &= 26^2 \\ 100 + b^2 &= 676 \\ b^2 &= 676 - 100 \\ b^2 &= 576 \\ b &= \sqrt{576} \end{aligned}$$

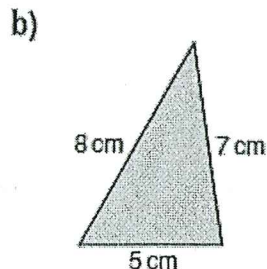
$$\boxed{b = 24 \text{ cm}}$$

4. Which of these triangles appears to be a right triangle? Determine whether each triangle is a right triangle. (R.A.T.)
Justify your answers.



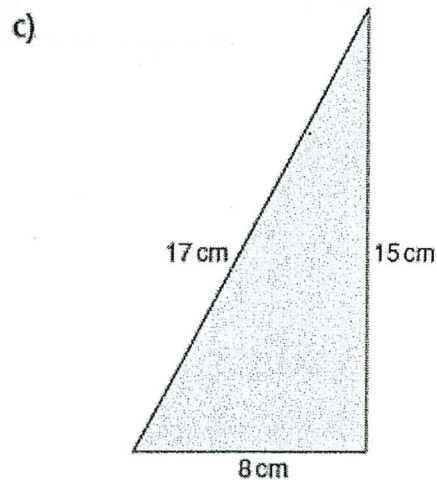
$$\begin{aligned} 7^2 + 10^2 &= 13^2? \\ 49 + 100 &= 169? \\ 149 &\neq 169 \end{aligned}$$

Not a R.A.T.



$$\begin{aligned} 5^2 + 7^2 &= 8^2? \\ 25 + 49 &= 64? \\ 74 &\neq 64 \end{aligned}$$

Not a R.A.T.



$$\begin{aligned} 8^2 + 15^2 &= 17^2? \\ 64 + 225 &= 289? \\ 289 &= 289 \checkmark \end{aligned}$$

This is a R.A.T.

6. Determine whether a triangle with each set of side lengths is a right triangle.

Justify your answers.

a) 16 cm, 30 cm, 34 cm

b) 8 cm, 10 cm, 12 cm

c) 20 m, 25 m, 15 m

a) $16^2 + 30^2 = 34^2?$

$256 + 900 = 1156?$

$1156 = 1156 \checkmark$

b) $8^2 + 10^2 = 12^2?$

$64 + 100 = 144?$

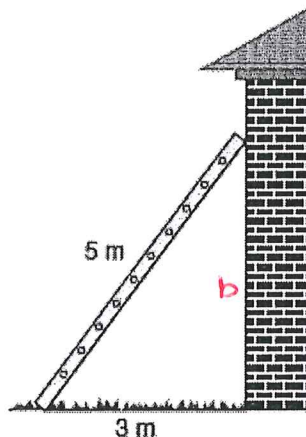
$164 = 144 \times$

c) $15^2 + 20^2 = 25^2?$

$225 + 400 = 625?$

$625 = 625 \checkmark$

6. A 5-m ladder leans against a house. It is 3 m from the base of the wall. How high does the ladder reach?



$3^2 + b^2 = 5^2$

$9 + b^2 = 25$

$b^2 = 25 - 9$

$b^2 = 16$

$b = \sqrt{16}$

$b = 4 \text{ m}$

The ladder reaches 4 m up the wall

7. Which sets of numbers below are Pythagorean triples?

How did you decide?

a) 16, 30, 34

b) 6, 8, 9

a) $16^2 + 30^2 = 34^2?$

$256 + 900 = 1156?$

$1156 = 1156 \checkmark$

b) $6^2 + 8^2 = 9^2?$

$36 + 64 = 81?$

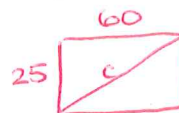
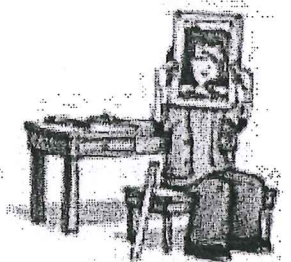
$100 = 81 \times$

9. Alyssa has made a picture frame for the painting she just finished. The frame is 60 cm long and 25 cm wide.

To check that the frame has square corners, Alyssa measures a diagonal.

How long should the diagonal be?

Sketch a diagram to illustrate your answer.



$25^2 + 60^2 = c^2$

$625 + 3600 = c^2$

$4225 = c^2$

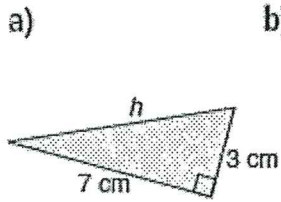
$\sqrt{4225} = c$

$65 = c$
cm

The diagonal should be 65 cm long.

Proficient:

7. Find the length of each side labelled with a variable.
Give your answers to one decimal place where needed.



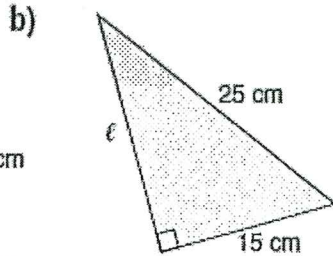
$$3^2 + 7^2 = h^2$$

$$9 + 49 = h^2$$

$$\sqrt{58} = \sqrt{h^2}$$

$$h = \sqrt{58}$$

$$h \approx 7.6 \text{ cm}$$



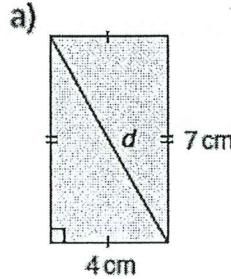
$$15^2 + x^2 = 25^2$$

$$225 + x^2 = 625$$

$$\sqrt{x^2} = \sqrt{400}$$

$$x = 20 \text{ cm}$$

8. Find the length of the diagonal, d , in each rectangle.
Give your answers to two decimal places where needed.



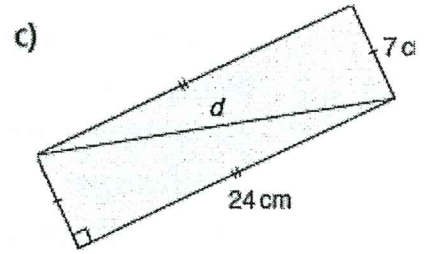
$$4^2 + 7^2 = d^2$$

$$16 + 49 = d^2$$

$$\sqrt{65} = \sqrt{d^2}$$

$$d = \sqrt{65}$$

$$d \approx 8.06 \text{ cm}$$



$$7^2 + 24^2 = d^2$$

$$49 + 576 = d^2$$

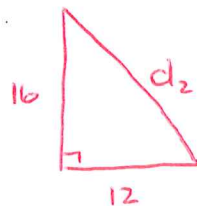
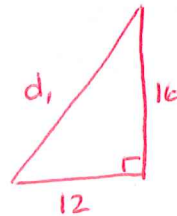
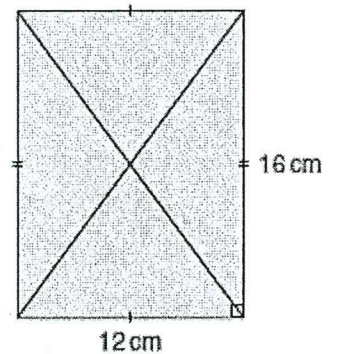
$$\sqrt{625} = \sqrt{d^2}$$

$$d = 25 \text{ cm}$$

10. Suppose you are given the side lengths of a right triangle.
Which length is the length of the hypotenuse?
Explain how you know.

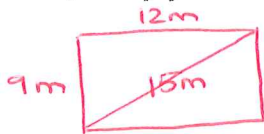
The hypotenuse is always the longest side.

11. Use the rectangle on the right. Explain why the diagonals of a rectangle have the same length.



$d_1 = d_2$ because the legs of the right triangles are equal to each other.

8. An elder and his granddaughter, Kashala, are laying a plywood floor in a cabin. The floor is rectangular, with side lengths 9 m and 12 m. Kashala measures the diagonal of the floor as 15 m. Is the angle between the two sides a right angle? Justify your answer.



$$9^2 + 12^2 = 15^2 ?$$

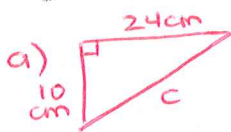
$$81 + 144 = 225 ?$$

$$225 = 225 \checkmark$$

Yes, the angle is a right angle because $a^2 + b^2 = c^2$.

7. As part of a design for a book cover, Brandon constructed a right triangle with sides 10 cm and 24 cm.

- a) How long is the third side?
b) Why are two answers possible to part a?



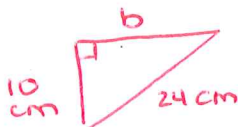
$$10^2 + 24^2 = c^2$$

$$100 + 576 = c^2$$

$$\sqrt{676} = \sqrt{c^2}$$

$$26 \text{ cm} = c$$

OR



$$10^2 + b^2 = 24^2$$

$$b^2 = 24^2 - 10^2$$

$$\sqrt{b^2} = \sqrt{476}$$

$$b = 21.8 \text{ cm}$$

b) we are not told if 24 cm is a leg or the hypotenuse.

9. A triangle has side lengths 6 cm, 7 cm, and $\sqrt{13}$ cm.

Is this triangle a right triangle?

Do these side lengths form a Pythagorean triple? Explain.

$\sqrt{13} \approx 3.6$, so 7 is the hypotenuse

$$6^2 + \sqrt{13}^2 = 7^2 ?$$

$$36 + 13 = 49 ?$$

$$49 = 49 \checkmark$$

Yes, this is a R.A.T., but a Pythagorean Triple cannot have a $\sqrt{\quad}$.

12. Two numbers in a Pythagorean triple are given.

Find the third number.

How did you find out?

a) 14, 48,

b) 32, 24,

c) 12, 37,

d) 20, 101,

a) $14^2 + 48^2 = c^2$

$$2500 = c^2$$

$$c = 50$$

b) 40 or ~~48~~

c) ~~13~~ or 35

OR
 ~~$14^2 + b^2 = 48^2$~~

~~$$b^2 = 2108$$~~

~~$$b = \sqrt{2108}$$~~

d) 10601 or 99

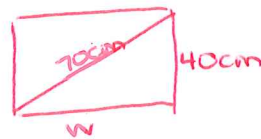
13. The size of a TV set is described by the length of a diagonal of the screen.

One TV is labelled 27 inches, which is about 70 cm. The screen is 40 cm high.

What is the width of the screen?

Give your answer to one decimal place.

Draw a diagram to illustrate your answer.



$$40^2 + w^2 = 70^2$$

$$w^2 = 70^2 - 40^2$$

$$\sqrt{w^2} = \sqrt{3300}$$

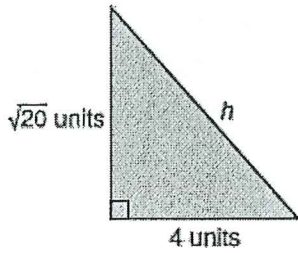
$$w = 57.4 \text{ cm}$$

The width of the TV is about 57.4 cm.

Extending:

13. Find the length of each side labelled with a variable.

a)



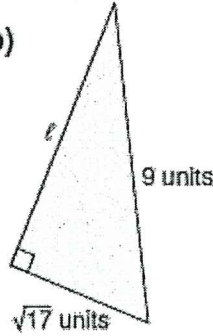
$$4^2 + \sqrt{20}^2 = h^2$$

$$16 + 20 = h^2$$

$$\sqrt{36} = \sqrt{h^2}$$

6 units = h

b)



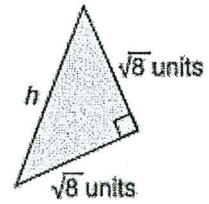
$$l^2 + \sqrt{17}^2 = 9^2$$

$$l^2 = 81 - 17$$

$$\sqrt{l^2} = \sqrt{64}$$

l = 8 units

c)



$$\sqrt{8}^2 + \sqrt{8}^2 = h^2$$

$$8 + 8 = h^2$$

$$\sqrt{16} = \sqrt{h^2}$$

h = 4 units

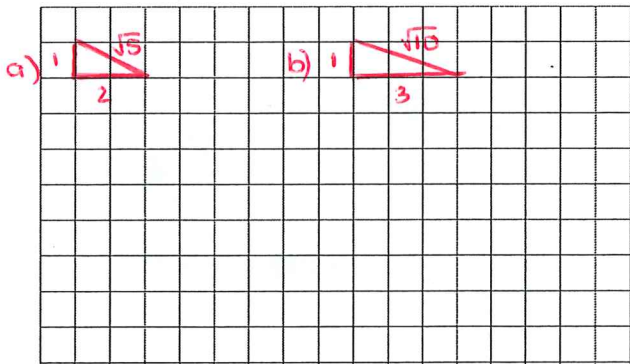
14. Use what you know about the Pythagorean Theorem. On grid paper, draw a line segment with each length. Explain how you did it.

a) $\sqrt{5}$

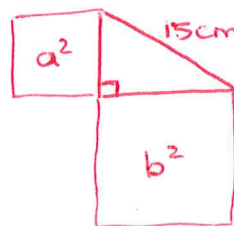
b) $\sqrt{10}$

$$1^2 + 2^2 = 5^2$$

$$1^2 + 3^2 = 10^2$$



15. Take It Further The length of the hypotenuse of a right triangle is 15 cm. The lengths of the legs are whole numbers of centimetres. Find the sum of the areas of the squares on the legs of the triangle. What are the lengths of the legs? Show your work.



$$a^2 + b^2 = 15^2$$

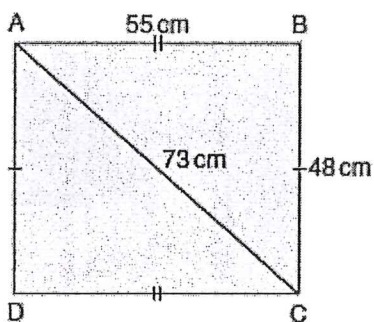
$$a^2 + b^2 = 225$$

Sum of the areas of the squares on the legs is 225.

$$81 + 144 = 225$$

so $a = 9$ cm
and $b = 12$ cm

14. Is quadrilateral ABCD a rectangle?
Justify your answer.



$$55^2 + 48^2 = 73^2 ?$$

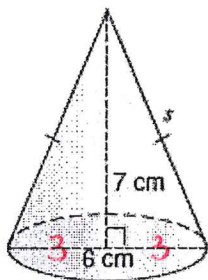
$$3025 + 2304 = 5329 ?$$

$$5329 = 5329 \checkmark$$

Yes, ABCD is a rectangle
since $\angle B$ is a right angle.

19. Take It Further A Powwow is a traditional practice in some First Nations cultures. Women dancers have small cone-shaped tin jingles sewn onto their dresses, one for each day of the year. A typical jingle has a triangular cross-section. Suppose the triangle has base 6 cm and height 7 cm.

Use the diagram to help you find the slant height, s , of the jingle. Give your answer to one decimal place.



$$3^2 + 7^2 = s^2$$

$$9 + 49 = s^2$$

$$\sqrt{58} = \sqrt{s^2}$$

$$s \approx 7.6 \text{ cm}$$

The slant height of the jingle is about 7.6 cm.

15. Take It Further The perimeter of a right triangle is 90 m. The length of the longest side of the triangle is 41 m. Find the lengths of the other two sides. How did you find out?

$$a + b + 41 = 90$$

$$\text{so } a + b = 49 \text{ m}$$

$$a^2 + b^2 = 41^2$$

$$a^2 + b^2 = 1681$$

$$9^2 + 40^2 = 1681$$

Guess & check using

Sides are 9 m & 40 m.

a	b
1	48
2	47
3	46
4	45
	etc.

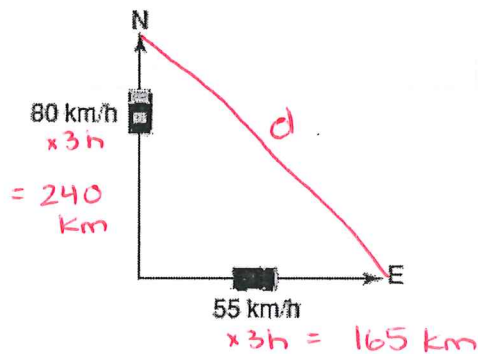
22. Take It Further Two cars meet at an intersection.

One travels north at an average speed of 80 km/h.

The other travels east at an average speed of 55 km/h.

How far apart are the cars after 3 h?

Give your answer to one decimal place.



$$240^2 + 165^2 = d^2$$

$$\sqrt{84825} = \sqrt{d^2}$$

$$d \approx 291.2 \text{ km}$$

The cars are about 291.2 km apart after 3 hours.