

The Pythagorean Theorem

Key ideas

Pythagorean theorem: in a right triangle, $a^2 + b^2 = c^2$, where c is the **hypotenuse** (the longest side, across from the right angle) and a and b are the **legs**.

Find the hypotenuse: $c = \sqrt{a^2 + b^2}$ · **Find a leg:** $a = \sqrt{c^2 - b^2}$

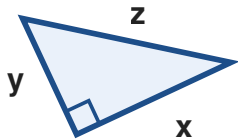
Is it a right triangle? If the two shorter sides squared add up to the longest side squared, yes. Round answers to one decimal place.

A Find the hypotenuse side

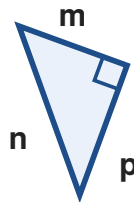
3 marks

Write the letter of the hypotenuse in each triangle.

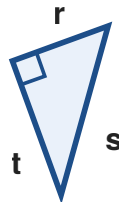
1.



2.



3.

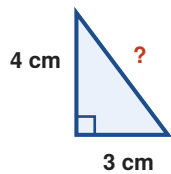


B Find the length of the hypotenuse

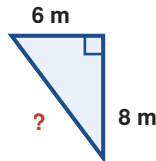
4 marks

Show your work. Round to one decimal place where needed.

4.



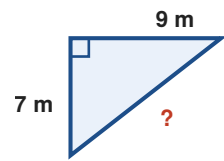
5.



6.



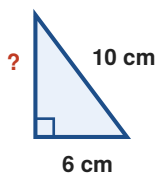
7.



C Find the missing leg

4 marks

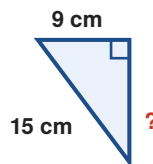
8.



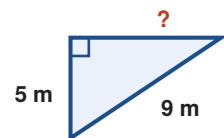
9.



10.



11.



D Is it a right triangle?

2 marks

Use the Pythagorean theorem to check each set of side lengths. $\frac{1}{2}$ mark each.

	Side lengths	Working	Right triangle?
12.	9, 12, 15		
13.	5, 6, 8		
14.	8, 15, 17		
15.	7, 10, 12		

E Word problems

10 marks

Draw a sketch, write the equation and solve. 2 marks each.

16. A 5 m ladder leans against a wall. Its foot is 1.4 m from the wall. How high up the wall does the ladder reach?

17. A TV screen is 48 inches wide and 27 inches tall. TV sizes are measured along the diagonal. What size is this TV, to the nearest tenth of an inch?

18. A rectangular park is 80 m long and 60 m wide. How much shorter is walking diagonally across the park than walking along two sides?

19. A kite is flying on a 50 m string. The kite is directly above a point 30 m from the person holding the string. How high is the kite?

20. A wheelchair ramp rises 1.2 m over a horizontal distance of 5 m. How long is the ramp's surface, to the nearest tenth of a metre?

F Spot the mistake

2 marks

21. To find the hypotenuse of a triangle with legs 6 and 8, a student writes $6 + 8 = 14$. Explain the error and correct it.

22. To find a missing leg when the hypotenuse is 10 and the other leg is 6, a student writes $b^2 = 6^2 + 10^2 = 136$. Explain the error and correct it.

The Pythagorean Theorem

ANSWER KEY

Key ideas

Pythagorean theorem: in a right triangle, $a^2 + b^2 = c^2$, where c is the **hypotenuse** (the longest side, across from the right angle) and a and b are the **legs**.

Find the hypotenuse: $c = \sqrt{a^2 + b^2}$ · **Find a leg:** $a = \sqrt{c^2 - b^2}$

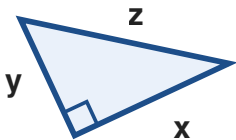
Is it a right triangle? If the two shorter sides squared add up to the longest side squared, yes. Round answers to one decimal place.

A Find the hypotenuse side

3 marks

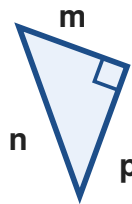
Write the letter of the hypotenuse in each triangle.

1.



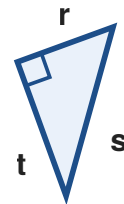
Hypotenuse: z

2.



Hypotenuse: n

3.



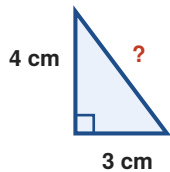
Hypotenuse: s

B Find the length of the hypotenuse

4 marks

Show your work. Round to one decimal place where needed.

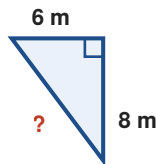
4.



$$c^2 = 3^2 + 4^2 = 25$$

$$c = 5 \text{ cm}$$

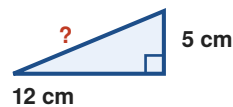
5.



$$c^2 = 6^2 + 8^2 = 100$$

$$c = 10 \text{ m}$$

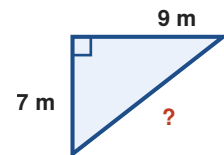
6.



$$c^2 = 5^2 + 12^2 = 169$$

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

7.



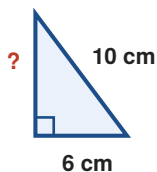
$$c^2 = 7^2 + 9^2 = 130$$

$$c = 11.4 \text{ m}$$

C Find the missing leg

4 marks

8.



$$b^2 = 10^2 - 6^2 = 64$$

$$b = 8 \text{ cm}$$

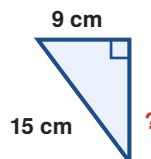
9.



$$b^2 = 25^2 - 7^2 = 576$$

$$b = 24 \text{ m}$$

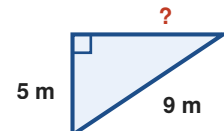
10.



$$b^2 = 15^2 - 9^2 = 144$$

$$b = 12 \text{ cm}$$

11.



$$b^2 = 9^2 - 5^2 = 56$$

$$b = 7.5 \text{ m}$$

D Is it a right triangle?

2 marks

Use the Pythagorean theorem to check each set of side lengths. $\frac{1}{2}$ mark each.

	Side lengths	Working	Right triangle?
12.	9, 12, 15	$9^2 + 12^2 = 225$; $15^2 = 225$	Yes
13.	5, 6, 8	$5^2 + 6^2 = 61$; $8^2 = 64$	No
14.	8, 15, 17	$8^2 + 15^2 = 289$; $17^2 = 289$	Yes
15.	7, 10, 12	$7^2 + 10^2 = 149$; $12^2 = 144$	No

E Word problems

10 marks

Draw a sketch, write the equation and solve. 2 marks each.

16. A 5 m ladder leans against a wall. Its foot is 1.4 m from the wall. How high up the wall does the ladder reach?

$$h^2 = 5^2 - 1.4^2 = 25 - 1.96 = 23.04, \text{ so } h = \sqrt{23.04} = 4.8 \text{ m}$$

17. A TV screen is 48 inches wide and 27 inches tall. TV sizes are measured along the diagonal. What size is this TV, to the nearest tenth of an inch?

$$d^2 = 48^2 + 27^2 = 2304 + 729 = 3033, \text{ so } d = 55.1 \text{ in (sold as a 55-inch TV)}$$

18. A rectangular park is 80 m long and 60 m wide. How much shorter is walking diagonally across the park than walking along two sides?

$$\text{Diagonal} = \sqrt{(80^2 + 60^2)} = \sqrt{10\,000} = 100 \text{ m. Two sides} = 140 \text{ m. You save } 40 \text{ m.}$$

19. A kite is flying on a 50 m string. The kite is directly above a point 30 m from the person holding the string. How high is the kite?

$$h^2 = 50^2 - 30^2 = 2500 - 900 = 1600, \text{ so } h = 40 \text{ m}$$

20. A wheelchair ramp rises 1.2 m over a horizontal distance of 5 m. How long is the ramp's surface, to the nearest tenth of a metre?

$$L^2 = 5^2 + 1.2^2 = 25 + 1.44 = 26.44, \text{ so } L = 5.1 \text{ m}$$

F Spot the mistake

2 marks

21. To find the hypotenuse of a triangle with legs 6 and 8, a student writes $6 + 8 = 14$. Explain the error and correct it.

$$\text{The squares add, not the sides: } c^2 = 6^2 + 8^2 = 36 + 64 = 100, \text{ so } c = 10.$$

22. To find a missing leg when the hypotenuse is 10 and the other leg is 6, a student writes $b^2 = 6^2 + 10^2 = 136$. Explain the error and correct it.

$$\text{When the hypotenuse is known, subtract: } b^2 = 10^2 - 6^2 = 64, \text{ so } b = 8. \text{ A leg is always shorter than the hypotenuse.}$$