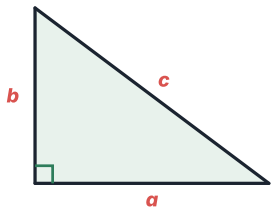
JUNIOR CYCLE MATHS · FREE REVISION SHEET

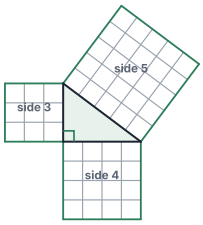
Pythagoras' theorem

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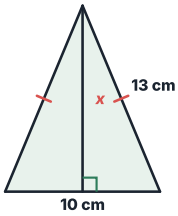
Learning outcomes (2018 specification): GT.3b, GT.3e, U.6. Play the game: **leim.ie/ladder-lab.html**



The hypotenuse c is opposite the right angle: $c^2 = a^2 + b^2$



$3^2 + 4^2 = 9 + 16 = 25 = 5^2$



Isosceles: use HALF the base. $x^2 = 13^2 - 5^2$, x = 12 cm

1. The theorem (Theorem 14)

In a right-angled triangle, the square of the **hypotenuse** (the side opposite the right angle, always the longest) is the sum of the squares of the other two sides: **$c^2 = a^2 + b^2$**.

2. Finding a side

Hypotenuse: ADD	**Shorter side: SUBTRACT**	**Then √**
$5^2 + 12^2 = 169$ $\sqrt{169} = 13$	$13^2 - 5^2 = 144$ $\sqrt{144} = 12$	$\sqrt{52} = 7.21...$ = 7.2 (1 d.p.)

Sense check: the hypotenuse is longer than both other sides; a shorter side is shorter than the hypotenuse.

3. Square roots

Know 1^2 ... 15^2. $\sqrt{50}$ lies between 7 ($7^2 = 49$) and 8 ($8^2 = 64$).

4. Is it right-angled? (Theorem 15)

If (longest side)^2 = the sum of the squares of the other two, the triangle IS right-angled, and the right angle is **opposite the longest side**. 8, 15, 17: $64 + 225 = 289 = 17^2$, yes. 6, 9, 11: $36 + 81 = 117 \neq 121$, no.

Pythagorean triples: 3, 4, 5 · 5, 12, 13 · 8, 15, 17 · 7, 24, 25 · 20, 21, 29, and their multiples (6, 8, 10).

5. Real life

Ladder = hypotenuse · diagonal of a rectangle = hypotenuse · north then east: the distance back is the hypotenuse · builder's check: 3 m, 4 m, gap 5 m.

Classic mistakes: adding the sides (5 + 12) instead of the squares · forgetting the √ · adding when you need a shorter side · the whole base of an isosceles triangle instead of half · rounding too early.

Exam tip: write the formula with the numbers in it ($x^2 = 6.5^2 - 2.5^2$), round only at the end, and give the units.

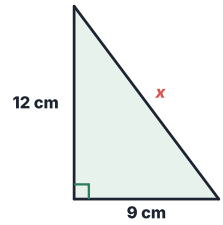
PRACTICE · 34 QUESTIONS

Have a go

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A. The hypotenuse

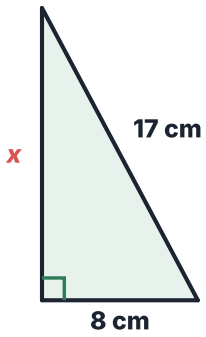
Diagram A



1. Use diagram A. Find x. _____
2. Legs 7 cm and 24 cm. Find the hypotenuse. _____
3. Legs 1.5 m and 2 m. Find the hypotenuse. _____
4. Legs 6 cm and 9 cm. Find the hypotenuse to 1 d.p. _____
5. Legs 4 m and 7 m. Find the hypotenuse to 1 d.p. _____
6. √40 lies between which two whole numbers? _____
7. √90 lies between which two whole numbers? _____
8. A ladder reaches 6.3 m up a wall with its foot 1.6 m from the wall. How long is it? _____

B. A shorter side

Diagram B



9. Use diagram B. Find x. _____
10. Hypotenuse 26 cm, one side 10 cm. Find the other side. _____
11. Hypotenuse 6.5 m, one side 2.5 m. Find the other side. _____
12. Hypotenuse 12 cm, one side 7 cm. Find the other side to 1 d.p. _____
13. Hypotenuse 9.5 m, one side 4 m. Find the other side to 1 d.p. _____
14. A 5 m ladder has its foot 1.4 m from a wall. How high does it reach? _____
15. A 4 m ladder has its foot 1.1 m from a wall. How high does it reach (1 d.p.)? _____
16. An isosceles triangle has a base of 10 cm and two sides of 13 cm. Find its height. _____

C. Is it right-angled?

17. Is a triangle with sides 9, 40, 41 right-angled? _____
18. Sides 7, 10, 12? _____
19. Sides 12, 35, 37? _____
20. Sides 0.9 m, 1.2 m, 1.5 m? _____
21. Triangle ABC has |AB| = 24, |BC| = 7, |AC| = 25. Which angle is a right angle? _____
22. A builder marks 0.6 m and 0.8 m along two walls and measures 1.02 m between the marks. Is the corner square? _____
23. 5, 12, 13 is a Pythagorean triple. Complete the triple 10, 24, … _____

D. Real life

24. A TV screen is 80 cm wide and 45 cm high. Find its diagonal to 1 d.p. _____
25. A rectangle has a diagonal of 13 m and one side of 5 m. Find the other side. _____
26. A boat sails 9 km north, then 12 km east. How far is it from the start? _____
27. A field is 40 m by 30 m. How much shorter is the diagonal than walking along two sides? _____
28. An isosceles triangle has a base of 16 cm and two sides of 10 cm. Find its height and its area. _____
29. A 5.2 m ladder reaches 4.8 m up a wall. The top slides down to 4.4 m. How far is the foot from the wall now (1 d.p.)? _____
30. Find the diagonal of a square of side 6 cm, to 1 d.p. _____

Questions 31–34 are on the next page.

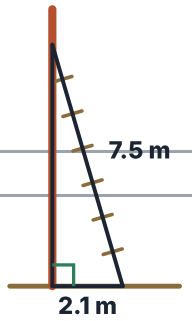
EXAM-STYLE · THEN CHECK

Exam corner + answers

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E. Exam-style questions (show your work)

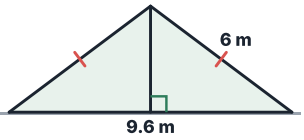
31. **A ladder.** A 7.5 m ladder leans against a wall with its foot 2.1 m from the wall. (a) How high up the wall does it reach? (b) The foot is moved so it is 2.5 m from the wall. How high does the ladder reach now, to 1 d.p.?



32. **Right-angled?** Triangle PQR has |PQ| = 20 cm, |QR| = 48 cm and |PR| = 52 cm. (a) Show that it is right-angled. (b) Which angle is 90°? (c) Cian says a triangle with sides 6, 7 and 9 is right-angled. Is he right?

33. **A ramp.** A ramp covers a horizontal distance of 3.6 m and rises 0.8 m. Find the length of the sloping surface, to 1 d.p.

34. **A roof.** The gable end of a roof is an isosceles triangle with a base of 9.6 m and sloping sides of 6 m. (a) Find its height. (b) Find its area.



Answers

A	1. 15 cm · 2. 25 cm · 3. 2.5 m · 4. 10.8 cm · 5. 8.1 m · 6. 6 and 7 · 7. 9 and 10 · 8. 6.5 m
B	9. 15 cm · 10. 24 cm · 11. 6 m · 12. 9.7 cm · 13. 8.6 m · 14. 4.8 m · 15. 3.8 m · 16. 12 cm
C	17. Yes ($81 + 1600 = 1681 = 41^2$) · 18. No ($49 + 100 = 149$, $12^2 = 144$) · 19. Yes ($144 + 1225 = 1369 = 37^2$) · 20. Yes ($0.81 + 1.44 = 2.25 = 1.5^2$) · 21. ∠ABC (opposite the longest side [AC]) · 22. No: 1.02 > 1, so the angle is more than 90° · 23. 26
D	24. 91.8 cm · 25. 12 m · 26. 15 km · 27. 20 m · 28. 6 cm, 48 cm² · 29. 2.8 m · 30. 8.5 cm
E	31. (a) $\sqrt{(7.5^2 - 2.1^2)} = \sqrt{51.84} =$ **7.2 m** (b) $\sqrt{(7.5^2 - 2.5^2)} = \sqrt{50} =$ **7.1 m** · 32. (a) $20^2 + 48^2 = 400 + 2304 = 2704 = 52^2$ (b) **∠PQR**, opposite the longest side (c) **No**: $6^2 + 7^2 = 85$ but $9^2 = 81$ · 33. $\sqrt{(3.6^2 + 0.8^2)} = \sqrt{13.6} =$ **3.7 m** · 34. (a) Half the base = 4.8 m: $\sqrt{(6^2 - 4.8^2)} = \sqrt{12.96} =$ **3.6 m** (b) ½ × 9.6 × 3.6 = **17.28 m²**

Got one wrong? Did you find the hypotenuse first? Add for the hypotenuse, subtract for a shorter side, and take the square root at the end. Then play **Ladder Lab** at leim.ie/ladder-lab.html: the "Go back over these" list at the end shows the working for each mistake.

All questions written by Léim. Léim is independent and not connected with the State Examinations Commission or the NCCA.