

Helping Your Child with Pythagoras' Theorem

Measurement & Space · Year 7 to Year 10 · Australian Curriculum Mathematics

Pythagoras' theorem is one of the most famous ideas in mathematics. It describes a special relationship between the three sides of any right-angled triangle. Your child first learns the theorem in **Year 8** and then uses it in more complex situations in Years 9 and 10. Builders use it to make sure corners are square. Architects use it to calculate heights. Even phone apps use it to find distances.

Year	What your child learns	What this looks like at home
Year 7	Prior knowledge — squares, square roots and right angles This shaded section shows earlier learning your child draws on. square number — a whole number multiplied by itself: $3^2 = 9$, $5^2 = 25$ square root — the reverse: $\sqrt{25} = 5$ (because $5 \times 5 = 25$) right angle — a 90° angle (like the corner of a square) right-angled triangle — a triangle with one 90° angle Your child becomes comfortable with: Finding squares: $7^2 = 49$ $12^2 = 144$ Finding square roots: $\sqrt{81} = 9$ $\sqrt{144} = 12$ Identifying right angles in real shapes and buildings	'What is 8^2?' (64) 'What is $\sqrt{100}$?' (10, because $10 \times 10 = 100$) 'Find a right angle in the room. How do you know it is 90°?'
Year 8	Pythagoras' theorem — introduced in Year 8 (AC9M8M06) hypotenuse — the longest side of a right-angled triangle, always opposite the right angle Pythagoras' theorem: $a^2 + b^2 = c^2$ a and b are the two shorter sides (called legs) c is the hypotenuse (longest side) Finding the hypotenuse: $c = \sqrt{a^2 + b^2}$ e.g. legs 3 and 4: $c = \sqrt{9 + 16} = \sqrt{25} = 5$ Finding a shorter side: $a = \sqrt{c^2 - b^2}$ e.g. hypotenuse 13, one leg 5: $a = \sqrt{169 - 25} = \sqrt{144} = 12$ Pythagorean triple — whole-number solutions: (3,4,5), (5,12,13), (8,15,17)	'A ramp rises 6 m over 8 m. How long is the ramp?' ($c = \sqrt{36+64} = \sqrt{100} = 10$ m) 'A ladder 13 m long has its base 5 m from a wall. How high up the wall does it reach?' ($a = \sqrt{169-25} = \sqrt{144} = 12$ m) Check a corner with a tape measure: 3 units along each wall, 5 units diagonal = right angle!
Year 9	Using Pythagoras in more complex problems (AC9M9M04) Your child now applies Pythagoras' theorem in more complex situations: Using Pythagoras alongside similarity and scale — when shapes are enlarged Confirming whether a triangle is right-angled: If $a^2 + b^2 = c^2$, the angle opposite c must be 90° Solving problems that combine multiple steps Applying Pythagoras in coordinate geometry — distance on a grid: $d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$ e.g. from (1,2) to (4,6): $d = \sqrt{9+16} = \sqrt{25} = 5$ Your child also begins using Pythagoras together with trigonometry (SOH CAH TOA).	'Are sides 7, 24, 25 a right-angled triangle?' ($7^2+24^2 = 49+576 = 625 = 25^2$ ✓ Yes!) 'Two towns are at (0,0) and (5,12). How far apart are they?' ($d = \sqrt{25+144} = \sqrt{169} = 13$ km) 'A building casts a shadow 8 m long. The diagonal from shadow tip to roof is 10 m. How tall is the building?' ($h = \sqrt{100-64} = \sqrt{36} = 6$ m)
Year 10	Pythagoras in 3D and real-world applications (AC9M10M03) Your child solves practical problems with Pythagoras including: 3D diagonals — finding the longest diagonal inside a rectangular box: Step 1: base diagonal: $d_1 = \sqrt{l^2 + w^2}$ Step 2: space diagonal: $d = \sqrt{d_1^2 + h^2} = \sqrt{l^2 + w^2 + h^2}$ Angles of elevation — looking up to the top of a tower or cliff Angles of depression — looking down from a height to an object below Problems involving direction and bearings (where north is 0°) Pythagoras and trigonometry (SOH CAH TOA) are used together to solve all of these.	'A room is 6 m $\times$ 4 m $\times$ 3 m. How long is the longest diagonal?' ($d = \sqrt{36+16+9} = \sqrt{61} \approx 7.81$ m) 'You stand 20 m from a tree. The angle of elevation to the top is 30°. How tall is the tree?' (tree height = $20 \times \tan 30^\circ \approx 11.5$ m) 'A plane flies north 60 km then east 80 km. How far from start?' ($d = \sqrt{3600+6400} = \sqrt{10000} = 100$ km)

★ Pythagoras' theorem — the big idea (first learned in Year 8)

In a right-angled triangle:

The two shorter sides are called **legs** (a and b).
The longest side is the **hypotenuse** (c) — always opposite the right angle.

The theorem: $a^2 + b^2 = c^2$

Famous example — the 3-4-5 triangle:

$$3^2 + 4^2 = 9 + 16 = 25 = 5^2 \quad \checkmark$$

To find the hypotenuse: $c = \sqrt{a^2 + b^2}$

To find a leg: $a = \sqrt{c^2 - b^2}$

Common Pythagorean triples

Side a	Side b	Hypotenuse c
3	4	5
5	12	13
8	15	17
7	24	25

Tip: recognising these triples saves time — no calculator needed!

Helping at Home — Pythagoras' Theorem

Worked examples and questions to ask · Year 7 to Year 10

How it works — worked examples

Year 8 — Finding the hypotenuse

A ramp rises 6 m over a horizontal distance of 8 m. How long is the ramp?

Label it	Legs: $a = 6$ m, $b = 8$ m. Find the hypotenuse c .
Apply theorem	$c^2 = a^2 + b^2 = 6^2 + 8^2 = 36 + 64 = 100$
Square root	$c = \sqrt{100} = 10$
Answer	The ramp is 10 m long. (This is a 6-8-10 triple — a 3-4-5 scaled up by 2!)

Year 8 — Finding a shorter side (a leg)

A ladder 13 m long leans against a wall. The base is 5 m from the wall. How high up the wall does it reach?

Known	Hypotenuse $c = 13$ m, one leg $b = 5$ m. Find leg a .
Rearrange	$a^2 = c^2 - b^2 = 13^2 - 5^2 = 169 - 25 = 144$
Square root	$a = \sqrt{144} = 12$
Answer	The ladder reaches 12 m up the wall. (5-12-13 triple!)

Year 10 — Diagonal of a rectangular room

A room is 6 m long, 4 m wide, 3 m high. Find the longest diagonal (corner to corner through the air).

Step 1	Find the base diagonal: $d_1 = \sqrt{6^2 + 4^2} = \sqrt{36 + 16} = \sqrt{52}$
Step 2	Find the space diagonal: $d = \sqrt{(\sqrt{52})^2 + 3^2} = \sqrt{52 + 9} = \sqrt{61}$
Calculate	$\sqrt{61} \approx 7.81$ m
Shortcut	$d = \sqrt{l^2 + w^2 + h^2} = \sqrt{36 + 16 + 9} = \sqrt{61} \approx 7.81$ m

Questions to ask your child

You don't need to solve these. Ask them and let your child explain their thinking!

7 Year 7

- What is 9^2 ? What is $\sqrt{144}$?
- How do you know if an angle is a right angle?
- Name two places in the house where you see a right angle.
- What is special about the corner of a door frame?

8 Year 8

- What is the hypotenuse? How do you find it in a triangle?
- A right-angled triangle has legs 9 cm and 12 cm. How long is the hypotenuse? (15 cm)
- Hypotenuse is 17, one leg is 8. Find the other leg. (15)
- Is a triangle with sides 6, 8, 10 a right-angled triangle? How do you check?

9 Year 9

- Are sides 7, 24, 25 a Pythagorean triple? ($7^2 + 24^2 = 625 = 25^2$ ✓)
- Two points: (2, 3) and (6, 6). How far apart are they? ($d = \sqrt{(16+9)} = 5$)
- A path cuts diagonally across a 20 m × 20 m park. How long is the path? (≈ 28.3 m)
- A TV screen is 55 inches diagonally, 48 inches wide. How tall is it? ($\sqrt{(3025-2304)} \approx 26.8$ in)

10 Year 10

- A suitcase is 60 cm × 40 cm × 25 cm. How long is the longest diagonal?
- From the top of a 15 m cliff, you look down at a boat 20 m out to sea. What angle are you looking down at?
- A plane flies north 60 km then east 80 km. How far from the start? (100 km)
- Why do builders check diagonals to make sure walls are square?

Things to try at home

Year 7: Squares practice: take turns calling numbers 1–15 and squaring them. Then reverse — call squares and find the root.	Year 8: Check a corner is square: measure 3 units along one wall, 4 units along the other. The diagonal should be 5 units exactly.
Year 8: Ladder problem: look at a ladder leaning on a wall. 'If I know the ladder length and wall height, how far is the base from the wall?'	Year 9: Map problem: use a local street map. Pick two landmarks and find the straight-line distance using Pythagoras.
Year 9: Check any triangle with a ruler. Does $a^2 + b^2 = c^2$? If yes, one angle must be exactly 90° .	Year 10: Measure your room. Calculate the longest diagonal from corner to corner. Could you fit a long piece of timber inside?

Key words to learn together

right angle: a 90° angle — like the corner of a square or the corner of a room	right-angled triangle: a triangle with one 90° angle
hypotenuse: the longest side — always opposite the right angle	leg: one of the two shorter sides of a right-angled triangle
square number: a number multiplied by itself: $4^2 = 16$, $5^2 = 25$, $12^2 = 144$	square root: the reverse of squaring: $\sqrt{144} = 12$ because $12 \times 12 = 144$
Pythagoras' theorem: $a^2 + b^2 = c^2$ — the relationship between sides of a right-angled triangle	Pythagorean triple: three whole numbers that satisfy $a^2 + b^2 = c^2$: (3,4,5), (5,12,13), (8,15,17)
converse of Pythagoras: if $a^2 + b^2 = c^2$, the triangle MUST have a right angle	3D diagonal: the longest distance inside a rectangular prism: $d = \sqrt{l^2 + w^2 + h^2}$
angle of elevation: the angle you look UP from horizontal to see something above you	angle of depression: the angle you look DOWN from horizontal to see something below you