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:** $\mathbf{a^2 + b^2 = c^2}$ a and b are the two shorter sides (called legs) c is the hypotenuse (longest side) **Finding the hypotenuse: start with $a^2 + b^2 = c^2$** e.g. legs 3 and 4: $3^2 + 4^2 = c^2$, so $c^2 = 9 + 16 = 25$, $c = \sqrt{25} = 5$ **Finding a shorter side: start with $a^2 + b^2 = c^2$, rearrange to $a^2 = c^2 - b^2$** e.g. hypotenuse 13, one leg 5: $a^2 = 13^2 - 5^2 = 169 - 25 = 144$, $a = \sqrt{144} = 12$ **Pythagorean triple** — whole-number solutions: (3,4,5), (5,12,13), (8,15,17)	**'A ramp rises 10 m over 18 m. How long is the ramp?'** ($a^2 + b^2 = c^2$: $10^2 + 18^2 = 424$, $c = \sqrt{424} = 20.6$ m) **'A ladder 13 m long has its base 5 m from a wall. How high up the wall does it reach?'** ($a^2 = c^2 - b^2$: $13^2 - 5^2 = 144$, $a = \sqrt{144} = 12$ m) **Check a corner with a tape measure: 3 units along one wall, 4 units along the other wall, 5 units diagonal = right angle!**
Year 9	**Using Pythagoras in more complex problems (AC9M9M03)** 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: **the horizontal and vertical gaps between the points form the two legs of a right triangle — so $\text{distance}^2 = (\text{horizontal gap})^2 + (\text{vertical gap})^2$** e.g. from (1,2) to (4,6): horizontal gap = 3, vertical gap = 4, $\text{distance}^2 = 9 + 16 = 25$, distance = 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?'** (horizontal gap = 5, vertical gap = 12: $\text{distance}^2 = 25 + 144 = 169$, distance = 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?'** ($h^2 = 10^2 - 8^2 = 100 - 64 = 36$, $h = \sqrt{36} = 6$ m) ***Year 10 on next page***

	Year 10	Pythagoras in 3D (AC9M10M03)	
	Year 10	**Pythagoras in 3D (AC9M10M03)** Your child extends Pythagoras' theorem into three dimensions: **3D diagonals** — finding the longest diagonal inside a rectangular box, by applying Pythagoras' theorem twice: Step 1: $l^2 + w^2 = d_1^2$, so $d_1 = \sqrt{(l^2 + w^2)}$ (diagonal of the base) **Step 2: $d_1^2 + h^2 = d^2$, so $d = \sqrt{(d_1^2 + h^2)} = \sqrt{(l^2 + w^2 + h^2)}$** *(Trigonometry — angles of elevation/depression and direction — is covered in a separate resource.)*	**'A room is 6 m × 4 m × 3 m. How long is the longest diagonal?'** ($6^2+4^2=52$, $52+3^2=61$, $d=\sqrt{61} \approx 7.81$ m) **'Our fish tank is 80 cm × 40 cm × 50 cm. What is the longest diagonal inside it?'** ($d = \sqrt{(80^2+40^2+50^2)} = \sqrt{10{,}500} \approx 102.5$ cm) **'A plane flies north 60 km then east 80 km. How far from start?'** ($60^2+80^2 = 10{,}000$, $d = \sqrt{10{,}000} = 100$ 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:
$3^2 + 4^2 = 9 + 16 = 25 = 5^2$ ✓

To find the hypotenuse: $a^2 + b^2 = c^2$, so $c = \sqrt{(a^2 + b^2)}$
To find a leg: $a^2 + b^2 = c^2 \rightarrow a^2 = c^2 - b^2$, so $a = \sqrt{(c^2 - b^2)}$

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.
Theorem	$a^2 + b^2 = c^2$
Substitute	$6^2 + 8^2 = c^2$
Calculate	$36 + 64 = c^2$, so $c^2 = 100$
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.
Theorem	$a^2 + b^2 = c^2$
Rearrange	$a^2 = c^2 - b^2$
Substitute	$a^2 = 13^2 - 5^2$
Calculate	$a^2 = 169 - 25 = 144$
Square root	$a = \sqrt{144} = 12$
Answer	**The ladder reaches 12 m up the wall. (5-12-13 triple!)**

Year 9 — Distance between two points

Town A is at (1, 2), Town B is at (7, 10) coordinates in km. How far apart are they in a straight line?

Apply distance formula	$d = \sqrt{(7-1)^2 + (10-2)^2}$ $d = \sqrt{6^2 + 8^2}$
Square root	$d = \sqrt{100}$
Answer	**The towns are 10 km apart in a straight line. (This is a 6-8-10 triple — a 3-4-5 scaled up by 2!)**

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, 7, 12 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?
($d = \sqrt{(6-2)^2 + (6-3)^2} = \sqrt{16+9} = \sqrt{25} = 5$)
→ 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)

Year 10 on next page

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**

10 **Year 10**

→ A suitcase is 60 cm × 40 cm × 25 cm. How long is the longest diagonal?
→ A fish tank is 80 cm × 40 cm × 50 cm. What is the length of the longest diagonal inside it? ($\sqrt{(6400+1600+2500)} = \sqrt{10{,}500} \approx 102.5$ cm)
→ 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 7:** Check corners around the house with a piece of paper folded into a right angle (90°). Are door frames and windows exactly square?
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?	**Year 10:** Measure a shoebox or cereal box (length, width, height). Calculate the longest diagonal running from one bottom corner to the opposite top corner, using two steps of Pythagoras' theorem.

💬 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: $d = \sqrt{(l^2+w^2+h^2)}$

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