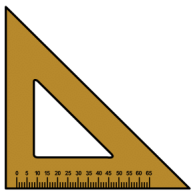
Name & Surname: _____ Class: _____ Date: _____

RIGHT-ANGLED TRIANGLES

Pythagoras and trig ratios in similar triangles



About 50 minutes Level ★★★☆☆

PYTHAGORAS AND TRIG

For a **right-angled** triangle, the **hypotenuse** is the longest side, opposite the right angle.

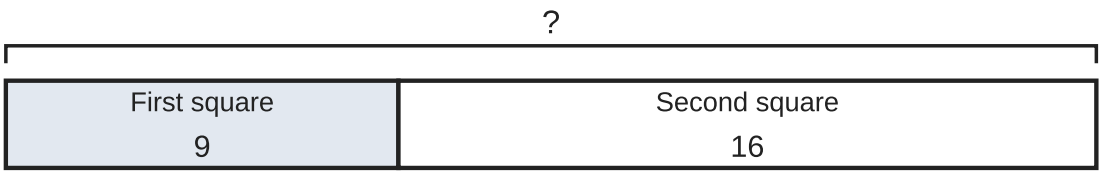
- Pythagoras: $a^2 + b^2 = c^2$. Square the two **short sides**, add, then take the square root for the hypotenuse.
- To find a short side, subtract: $b^2 = c^2 - a^2$, then take the square root.
- In **similar** triangles the angles match, so sin(θ) = opposite ÷ hypotenuse, cos(θ) = adjacent ÷ hypotenuse and tan(θ) = opposite ÷ adjacent stay the same.

TASK A

/4

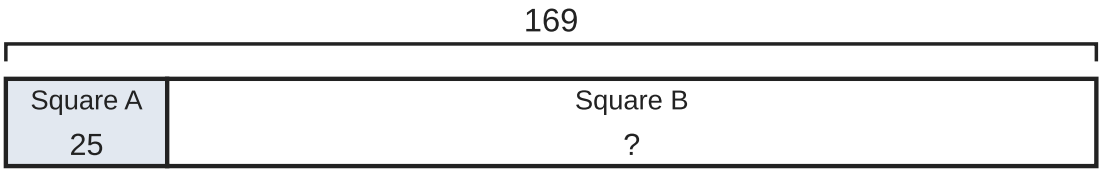
Use the area bars to show the squares on the sides.

1 A right-angled triangle has squares on its two shorter sides with areas 9 cm² and 16 cm². Together they make the **area** of the square on the **hypotenuse**. What is that area?



Answer: _____ **cm²**

2 The square on the **hypotenuse** has **area** 169 cm². It equals the two squares on the shorter sides put together. One is 25 cm². What is the other area?



Answer: _____ **cm²**

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MASTER PYTHAGORAS QUICKLY

Practise finding sides and checking right angles.

KEY WORDS

hypotenuse: longest side, opposite the right angle

adjacent: side next to angle θ, not the hypotenuse

sine: ratio opposite ÷ hypotenuse

tangent: ratio opposite ÷ adjacent

opposite: side across from angle θ

similar: same angles, sides in proportion

cosine: ratio adjacent ÷ hypotenuse

TASK B

/12

Practise Pythagoras facts and hypotenuse problems.

WARM UP

1 Work out c^2 if a = 3 cm, b = 4 cm and $c^2 = a^2 + b^2$ with **squares**.

Answer: _____

2 A **right-angled** triangle has legs 6 cm and 8 cm. Work out the **hypotenuse**.

Answer: _____

3 A **right-angled** triangle has legs 5 cm and 12 cm. Work out the **hypotenuse**.

Answer: _____

4 A **right-angled** triangle has **hypotenuse** 13 cm and one short side 5 cm. Work out the other **short side**.

Answer: _____

PRACTISE

5 A **right-angled** triangle has **hypotenuse** 25 cm and one short side 7 cm. Work out the other **short side**.

Answer: _____

6 A **right-angled** triangle has legs 9 m and 12 m. Work out the **hypotenuse**.

Answer: _____

7 Is a triangle with sides 9 cm, 12 cm and 15 cm **right-angled**? Explain how you know.

Answer: _____

8 A **right-angled** triangle has legs 4 cm and 7 cm. Work out the **hypotenuse** to 1 d.p.

Answer: _____

PROBLEM SOLVING

9 A 5 m ladder leans against a wall. Its foot is 3 m from the wall on **flat** ground. How high up the **wall** is the top?

Answer: _____

10 A rectangle is 8 cm by 6 cm. Work out the **diagonal** length.

Answer: _____

11 A square has side 12 cm. A **diagonal** cuts it into two **right-angled** triangles. Work out the diagonal to 1 d.p.

Answer: _____

12 Explain how you know you must subtract to find a missing **short side**.

Answer: _____

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SPOT THE MISTAKES

Find the wrong step and correct each solution.

TASK C

/6

Find the wrong step and give the correct answer.



Student A

Work out the hypotenuse of a right-angled triangle with legs 5 cm and 12 cm.

1. $5^2 + 12^2 = c^2$
2. $= 25 + 144 = 169$
3. So c = 169 cm

The mistake is in step: _____

What went wrong?

.....

Correct answer: _____



Student B

Work out missing short side x with hypotenuse 10 cm and one side 6 cm.

1. $10^2 + 6^2 = x^2$
2. $= 100 + 36 = 136$
3. x = sqrt(136) = 11.7 cm to 1 d.p.

The mistake is in step: _____

What went wrong?

.....

Correct answer: _____



Student C

Two similar right-angled triangles both have a 30° angle. Small hyp = 10 cm, small opposite = 5 cm. Large hyp = 20 cm. Find large opposite.

1. Small ratio opposite ÷ hyp = 5 ÷ 10 = 0.5
2. Large triangle is bigger so the ratio will be bigger
3. So opposite = 0.6 × 20 = 12 cm

The mistake is in step: _____

What went wrong?

.....

Correct answer: _____

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USE TRIG RATIOS

Practise sin, cos and tan in similar triangles.

TASK D

/12

Use similar triangles and trig ratios to find sides and angles.

WARM UP

1 A **right-angled** triangle has **opposite** 5 cm and **hypotenuse** 10 cm for 30°. Work out opposite ÷ hypotenuse.

Answer: _____

2 A **similar** triangle has the same 30° angle and **hypotenuse** 18 cm. Use ratio 0.5 to work out the **opposite** side.

Answer: _____

3 Work out sin(30°) for any **similar** 30° triangle.

Answer: _____

4 Work out cos(60°) for a **right-angled** triangle.

Answer: _____

PRACTISE

5 A **right-angled** triangle has angle 35° and **hypotenuse** 12 cm. Work out the **opposite** side to 1 d.p.

Answer: _____

6 A **right-angled** triangle has angle 55° and **adjacent** 7 cm. Work out the **hypotenuse** to 1 d.p.

Answer: _____

7 A **right-angled** triangle has **opposite** 9 cm and **adjacent** 12 cm. Work out the **angle** to 1 d.p.

Answer: _____

8 A **right-angled** triangle has **hypotenuse** 13 cm and **opposite** 5 cm. Work out the **angle** to 1 d.p.

Answer: _____

PROBLEM SOLVING

9 A ramp makes 20° with the ground. The ramp length (**hypotenuse**) is 4 m. Work out the **height** to 2 d.p.

Answer: _____

10 Two **similar** triangles both have angle 40°. A large triangle has **hypotenuse** 15 cm. Work out the **opposite** side to 1 d.p.

Answer: _____

11 A 5 m ladder makes 70° with the **flat** ground. Work out how high up the **wall** it reaches to 1 d.p.

Answer: _____

12 Two right-angled triangles have angles 90°, 50° and 40°. Explain how you know they are **similar** and what that means for sin(40°).

Answer: _____

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SOLVE MIXED TRIANGLES

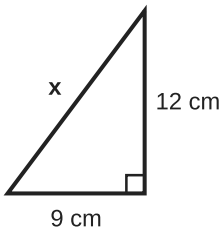
Choose Pythagoras or trig for each triangle.

△ TASK E

/8

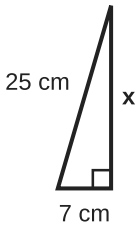
Find the missing side or missing angle for each triangle.

1



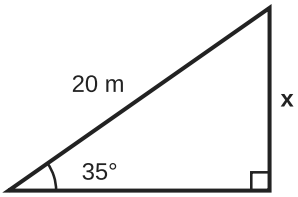
x = _____ **cm**

2



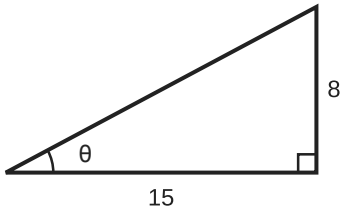
x = _____ **cm**

3



x = _____ **m**

4



θ = _____ **°**

Give answers to 1 decimal place where they are not whole numbers.

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RIGHT-ANGLED TRIANGLES

TASK F

/2

Spot the mistake and write the correct fact.



Student A

Pythagoras' theorem $a^2 + b^2 = c^2$ works for **any** triangle.

What mistake did Student A make? Write the correct fact.



Student B

If one **similar** triangle is bigger, its sin, cos and tan values are bigger too.

What mistake did Student B make? Write the correct fact.

HOW DID I DO?

Circle a face for each line.

I can use Pythagoras' theorem to find a missing side	☹	😐	☺
I can use sin, cos and tan in similar right-angled triangles	☹	😐	☺
I can solve problems with right-angled triangles	☹	😐	☺

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Answer sheet: Right-angled triangles

Task A

1. 25 cm²
2. 144 cm²

Task B

1. 25 cm²
2. 10 cm
3. 13 cm
4. 12 cm
5. 24 cm
6. 15 m
7. Yes, because $9^2 + 12^2 = 15^2$
8. 8.1 cm
9. 4 m
10. 10 cm
11. 17.0 cm
12. The hypotenuse is longest so you do short² = hyp² − other²

Task C

1. Step 3 is wrong: They added the squares but forgot to take the square root for c. Correct answer: 13 cm
2. Step 1 is wrong: They added. The hypotenuse is longest so you must subtract: $x^2 = 10^2 - 6^2$. Correct answer: 8 cm
3. Step 2 is wrong: In similar triangles the angles match so the trig ratio stays the same, 0.5. Correct answer: 10 cm

---

Task D

1. $\frac{1}{2}$
2. 9 cm
3. 0.5
4. 0.5
5. 6.9 cm
6. 12.2 cm
7. 36.9°
8. 22.6°
9. 1.37 m
10. 9.6 cm
11. 4.7 m
12. Same angles so similar, so sin(40°) is the same in both

Task E

1. x = 15 cm
2. x = 24 cm
3. x = 11.5 m
4. θ = 28.1°

Task F

1. Student A: Wrong: it only works for right-angled triangles, where c is the hypotenuse.
2. Student B: Wrong: similar triangles have the same angles so opposite ÷ hypotenuse and the other ratios stay the same.

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