Name	Date started	Target end date

WJEC GCSE Mathematics and Numeracy (Double Award) — Question Pack

Pythagoras' theorem in right-angled triangles and its extension to 3D problems — longest diagonal of a cuboid, space diagonals of pyramids

REVISE
.wales

3.14 — Pythagoras in 2D & 3D

Spec 3.7.1, 3.7.2 — Unit 3 (calculator allowed)

Pythagoras' theorem in right-angled triangles and its extension to 3D problems — longest diagonal of a cuboid, space diagonals of pyramids and prisms. Sourced from legacy WJEC GCSE Mathematics and Mathematics-Numeracy Higher calculator-allowed papers, organised for revision under the 2025 spec.

2025 SPECIFICATION

Estimated time for entire question pack: ~1 hours 3 minutes

*Derived from the GCSE Higher pace of **~1.5 min/mark** (42 marks across 10 questions).*

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **focused single-topic practice pack**, not a single mock paper. Questions are organised against the 2025 specification. Questions are ordered chronologically by sitting, with custom-written and SAM questions at the end.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — method marks are awarded for clear setup.

A calculator is allowed on every question in this pack (Unit 3 is the calculator-allowed paper).

Pythagoras in 2D & 3D — what the new spec asks

WJEC GCSE Mathematics (first teaching 2025) · Unit 3: calculator-allowed.

Pythagoras' theorem in 2D 3.7.1

- Use $a^2 + b^2 = c^2$ where c is the hypotenuse.
- Find either the hypotenuse or a shorter side by rearranging.
- Identify the hypotenuse as the side opposite the right angle.

Pythagoras in 3D 3.7.2

- Longest diagonal of a cuboid: $\sqrt{l^2 + w^2 + h^2}$.
- Solve by finding a right-angled triangle inside the 3D shape and applying Pythagoras (often twice).
- Keep intermediate values exact; round only at the final step.

Crib sheet »

Pythagoras in 2D & 3D in one page

Quick-reference notes — revisit before each question. Don't use during the questions.

Pythagoras' theorem

$$a^2 + b^2 = c^2$$

In a right-angled triangle, c is the *hypotenuse* — the longest side, opposite the right angle.

a and b are the two shorter sides (the 'legs').

Finding the hypotenuse

Given the two legs a and b:

$$c = \sqrt{a^2 + b^2}$$

Example: legs 3 and 4 give $c = \sqrt{9 + 16} = 5$.

Finding a shorter side

If the hypotenuse is known, rearrange:

$$a = \sqrt{c^2 - b^2}$$

Subtract the squares (not add) when the unknown is a shorter side.

Spotting the hypotenuse

The hypotenuse is always opposite the right angle.

It's the longest side — if your answer for a leg comes out bigger than the hypotenuse, recheck.

Sketch and label sides before substituting.

3D Pythagoras — cuboid diagonal

Longest diagonal of an $l \times w \times h$ cuboid:

$$d = \sqrt{l^2 + w^2 + h^2}$$

Derive in two steps: first find the base diagonal $\sqrt{l^2 + w^2}$, then combine with the height.

3D problems — method

1. Identify a right-angled triangle inside the 3D shape.
2. Find any unknown side(s) of that triangle — often using Pythagoras in a horizontal plane first.
3. Apply Pythagoras again in the vertical plane to reach the target length.

Worked example — ladder

A 5 m ladder leans against a wall, foot 1.5 m from the base.

Height up the wall: $h = \sqrt{5^2 - 1.5^2} = \sqrt{22.75} \approx 4.77$ m.

The ladder is the hypotenuse here.

Common traps

- Adding squares when the unknown is a shorter side (should subtract).
- Confusing which side is the hypotenuse.
- Rounding intermediate square roots — keep exact values to the final step.
- Units: $\sqrt{\text{cm}^2 + \text{cm}^2}$ gives cm, not cm^2.

Examiner only

4. A right-angled triangle *LMN* is shown below.
LN = 16·9 cm and *LM* = 6·5 cm.

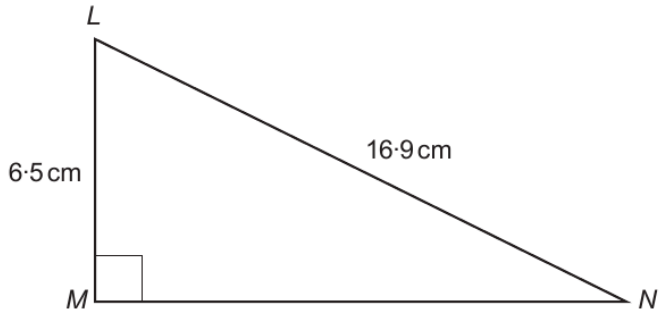
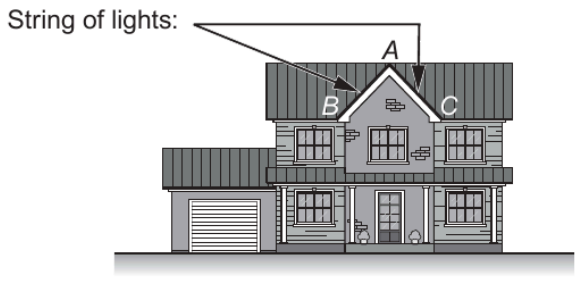


Diagram not drawn to scale

Calculate the length *MN*. [3]

Examiner only

8. The diagram below shows where Levi wants to attach a string of lights to his house.



Levi wants to attach a single string of lights from *B* to *A* and then from *A* to *C*.
The diagram below shows the measurements Levi has taken.

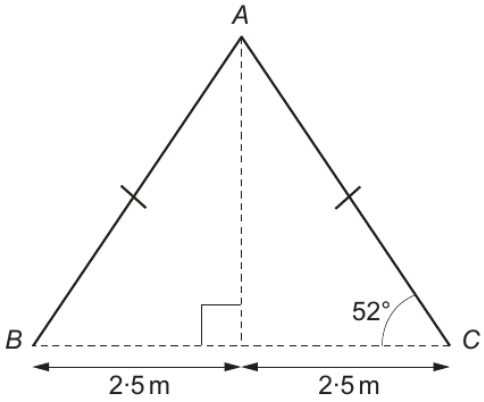


Diagram not drawn to scale

He spends £410 at the electrical store buying a string of lights.
After putting up the lights, Levi finds he has 6 metres of the string of lights left over at one end.

How much did the electrical store charge Levi, per metre, for the string of lights? [6]

Examiner only

8. A baker makes cake slices to sell in her shop.
All of the cake slices are identical. They have been cut from a cylindrical cake of radius 10 cm and depth 4 cm.

Piped icing is placed on the curved surface of each cake slice, as shown in the diagram.
It connects opposite vertices of this curved surface, and follows the shortest path between these vertices.

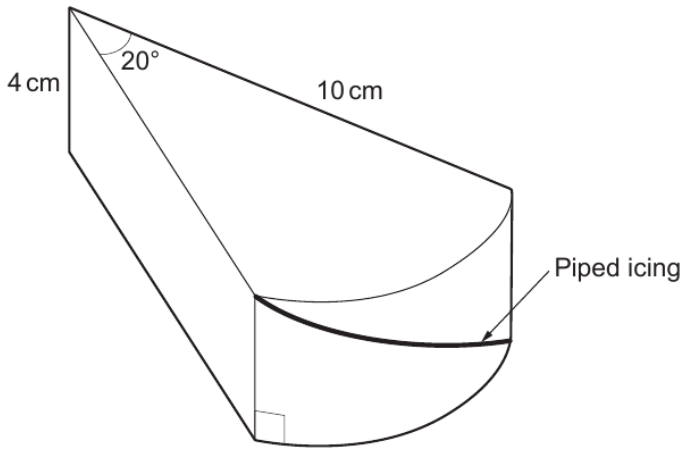


Diagram not drawn to scale

What length of piped icing will be needed to decorate all the slices that make up a whole cylindrical cake? [7]

Length of piped icing needed for a whole cake = ... cm

Examiner only

8. (a) Which complete method, using Pythagoras's Theorem, can be used to find x?
Circle your answer. [1]

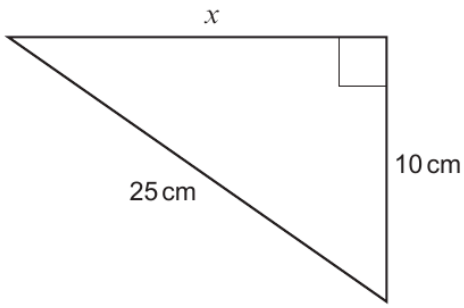


Diagram not drawn to scale

$x = 25^2 + 10^2$ $x = \sqrt{25^2 + 10^2}$ $x = 25^2 - 10^2$

$x = \sqrt{25^2 - 10^2}$ $x = \sqrt{(25 - 10)^2}$

(b) Which of the following calculations can be used to find y?
Circle your answer. [1]

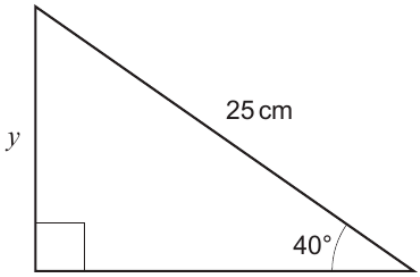


Diagram not drawn to scale

$\sin 25^\circ = y \times 40$ $\sin 40^\circ = \frac{25}{y}$ $\sin 25^\circ = \frac{y}{40}$

$\sin 40^\circ = \frac{y}{25}$ $\sin 40^\circ = y \times 25$

Examiner only

14. The cube shown below has a volume of 10 648 cm^3.

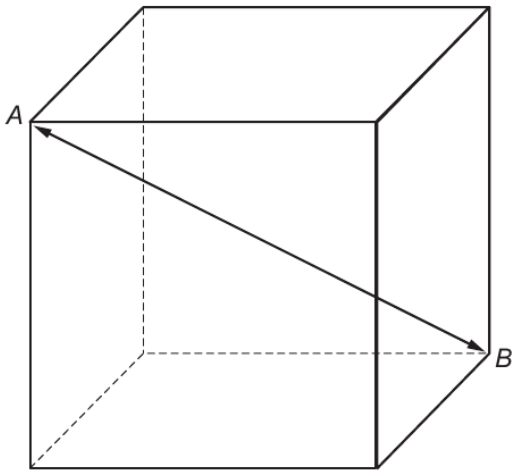


Diagram not drawn to scale

Calculate the length of the internal diagonal *AB*. [4]

Examiner only

4.

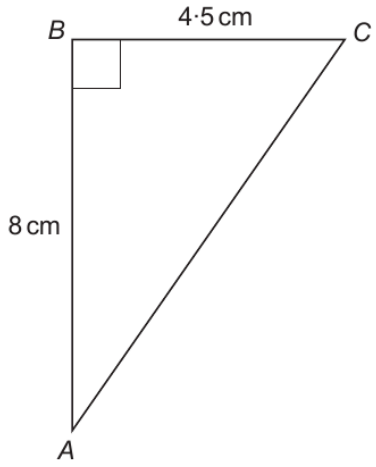


Diagram not drawn to scale

Calculate the length of the side *AC*. [3]

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Examiner only

10. The diagram below shows the dimensions of a goal in football.
Players take a penalty kick from the penalty spot.
The penalty spot is 10·97 m from the goal line and central to the goal.

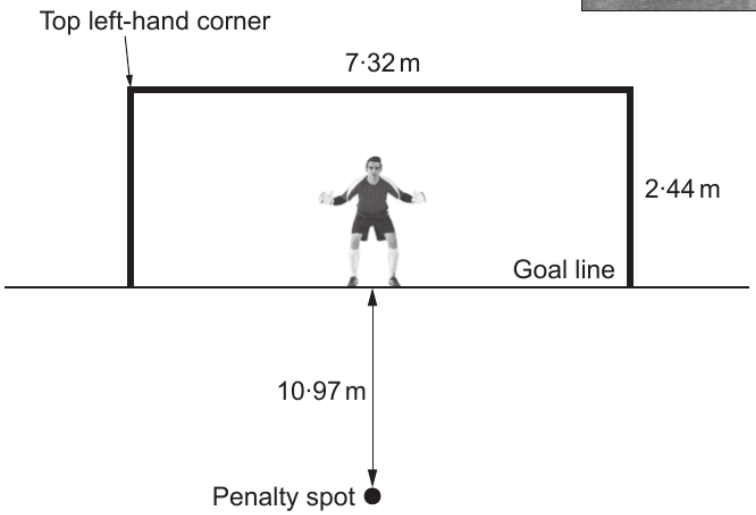


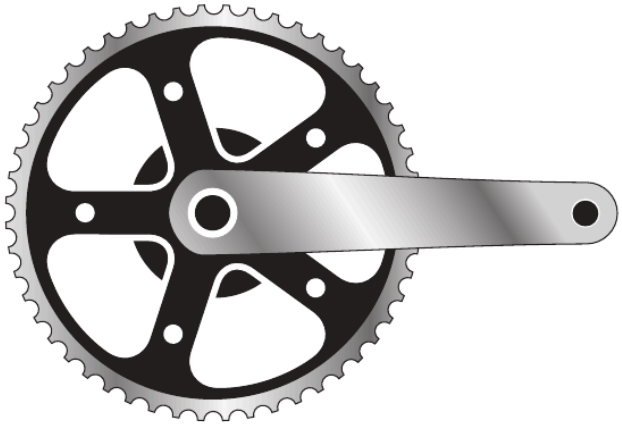
Diagram not drawn to scale

Mark takes a penalty kick.
He misses, and the ball hits the top left-hand corner of the goal.

Calculate the straight-line distance from the penalty spot to the top left-hand corner of the goal. [4]

Examiner only

9. (a) Geraint has bought a new front cog for his bike.



The cog has a mass of 150 g, **correct to the nearest 10 g**.
The cog has been made from a metal that has a density of 3 g/cm^3, **correct to the nearest g/cm^3**.
Calculate the maximum possible volume of the cog. [3]

Examiner only

(b) This picture shows part of Geraint's bike.

A simplified diagram of the cogs and the chain is shown below.

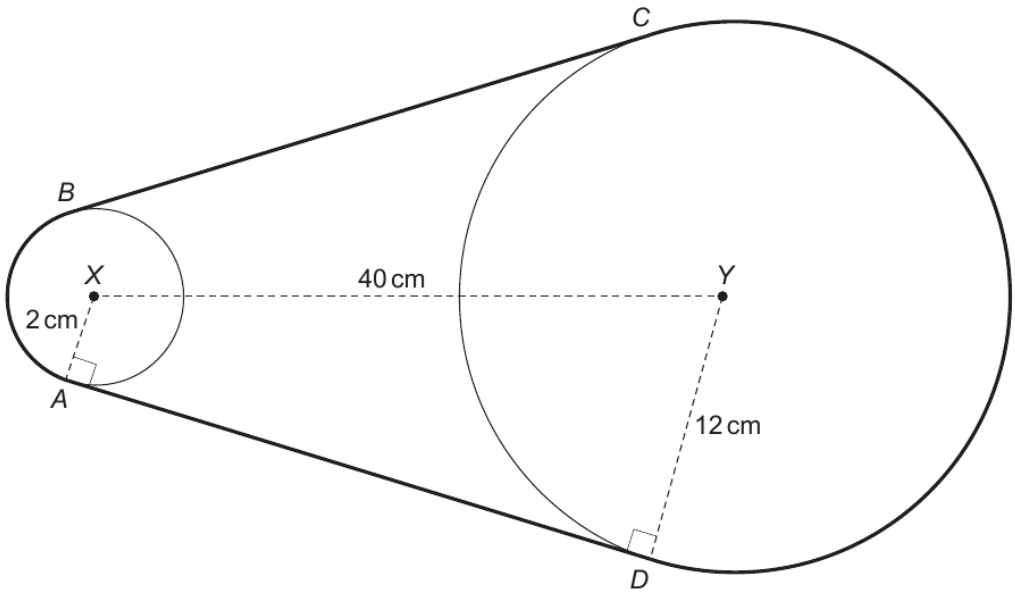


Diagram not drawn to scale

X and *Y* are the centres of the cogs and *XY* is a line of symmetry.
BC and *AD* are straight sections of the chain.

The larger cog has a radius of 12 cm.
The smaller cog has a radius of 2 cm.

(i) Use Pythagoras' theorem to show that the length of *AD* is $10\sqrt{15}$ cm.
You must show all your working. [3]

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Examiner only

(ii)

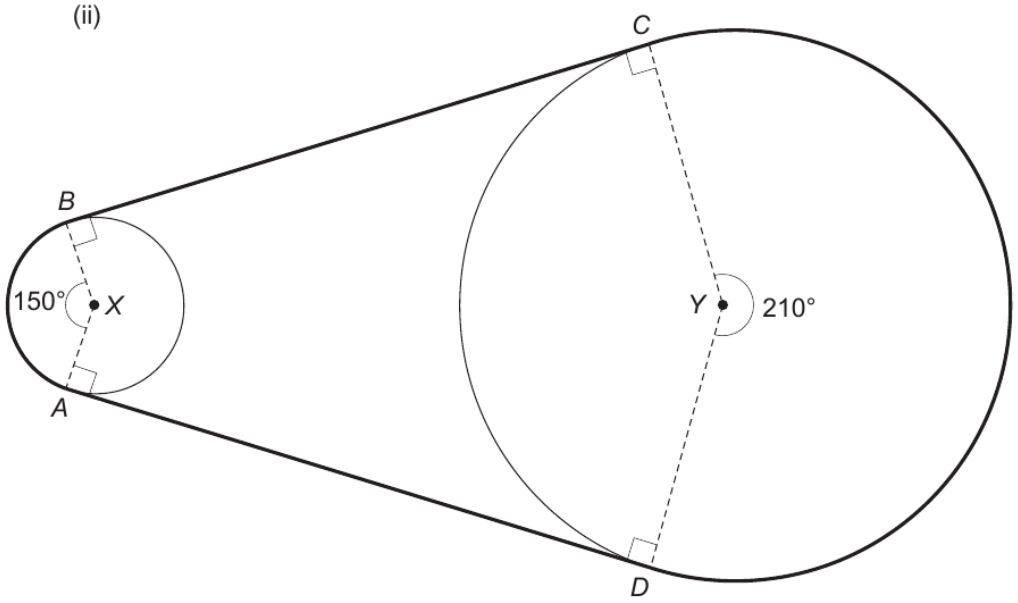

Diagram not drawn to scale

$A\hat{X}B$ = 150°, reflex $C\hat{Y}D$ = 210°, $BC = AD = 10\sqrt{15}$ cm.

Calculate the total length of the chain.

Give your answer in the form $a\sqrt{15} + b\pi$, where a and b are rational numbers. [5]

5. Morgan is building 2 new houses on a plot of land.

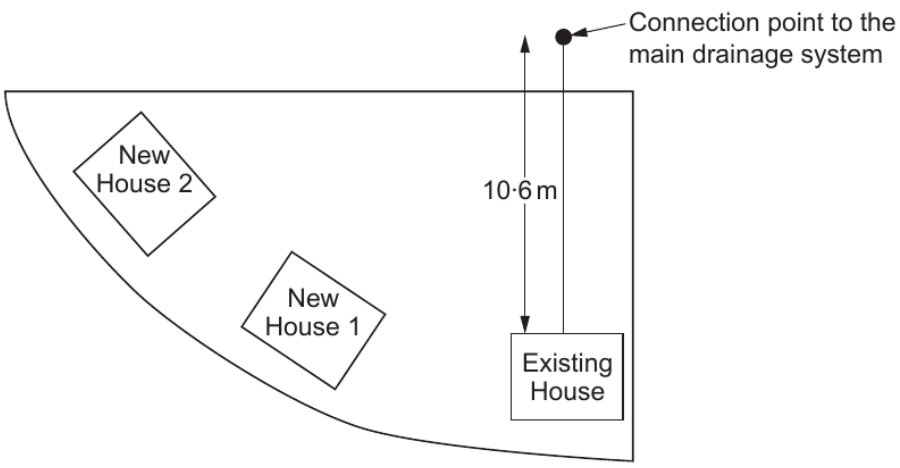

Diagram not drawn to scale

Drainage pipes need to be laid from the 2 new houses to the connection point shown on the diagram.
Morgan cannot measure the lengths of the drainage pipes needed, as he does not have access to the connection point.
He has drawn the following diagram of the drainage pipes, showing some angles and lengths that he has been able to measure.

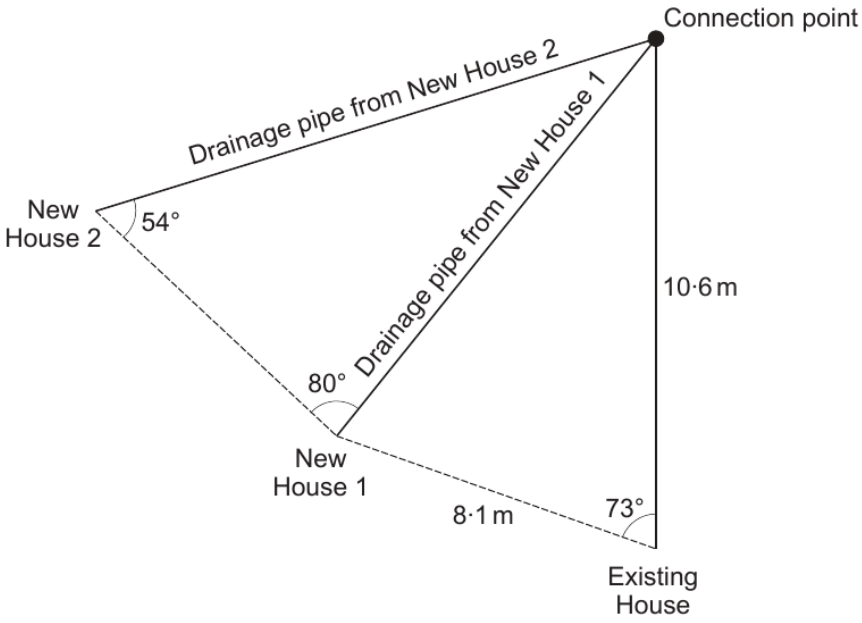

Diagram not drawn to scale

Examiner only

Use Morgan's diagram to calculate:

- the length of the drainage pipe needed from New House 1
- the length of the drainage pipe needed from New House 2. [7]

Length of the drainage pipe needed from New House 1 is ..... m

Length of the drainage pipe needed from New House 2 is ..... m