

Pythagoras

Solutions

For Pearson Edexcel GCSE Mathematics (1MA1) • Foundation tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

ABC is a right-angled triangle.

$AB = 5.2$ cm and $BC = 7.1$ cm.

Angle $ABC = 90^\circ$

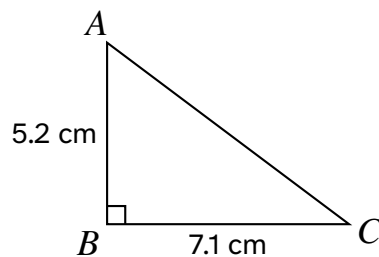


Diagram **NOT** accurately drawn

Work out the length of AC .

Give your answer correct to 1 decimal place.

Pythagoras' theorem: $a^2 + b^2 = c^2$, where c is the hypotenuse (opposite the right angle).

AC is opposite the right angle at B , so AC is the hypotenuse.

$$AC^2 = 5.2^2 + 7.1^2$$

$$AC^2 = 27.04 + 50.41 = 77.45$$

$$AC = \sqrt{77.45} = 8.800 \dots = 8.8 \text{ cm (1 d.p.)}$$

Answer: 8.8 cm

Marks: 1 mark for $5.2^2 + 7.1^2$. 1 mark for 8.8.

2 (3 marks)

Here is a right-angled triangle.

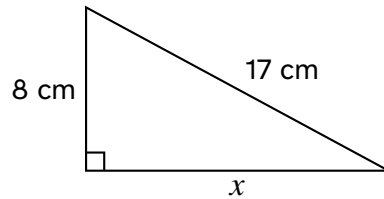


Diagram **NOT** accurately drawn

Work out the length x .

The hypotenuse is 17 cm.

x is a shorter side, so subtract the squares.

$$x^2 = 17^2 - 8^2$$

$$x^2 = 289 - 64 = 225$$

$$x = \sqrt{225} = 15$$

Answer: 15 cm

Tip: Adding the squares ($8^2 + 17^2$) is the most common mistake here. A shorter side must come out less than 17 cm.

Marks: 1 mark for $17^2 - 8^2$. 1 mark for $\sqrt{225}$. 1 mark for 15.

3 (4 marks)

The diagram shows an isosceles triangle.

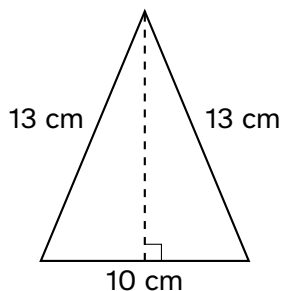


Diagram **NOT** accurately drawn

Work out the area of the triangle.

To find the area you need the perpendicular height (the dashed line).

The height cuts the base in half: $10 \div 2 = 5$ cm.

This gives a right-angled triangle with hypotenuse 13 cm and base 5 cm.

$$\text{Height}^2 = 13^2 - 5^2 = 169 - 25 = 144$$

$$\text{Height} = \sqrt{144} = 12 \text{ cm}$$

$$\text{Area} = \frac{1}{2} \times \text{base} \times \text{height} = \frac{1}{2} \times 10 \times 12 = 60 \text{ cm}^2$$

Answer: 60 cm²

Tip: The sloping side (13 cm) is not the height. Use Pythagoras to find the perpendicular height, then use $\frac{1}{2} \times \text{base} \times \text{height}$.

Marks: 1 mark for 5. 1 mark for $13^2 - 5^2$. 1 mark for the height 12. 1 mark for 60.

4 (3 marks)

A football pitch is a rectangle 100 m long and 64 m wide.

Ellie wants to get from one corner of the pitch to the opposite corner.

She can walk along two sides of the pitch or walk straight across the diagonal.

How much shorter is the walk across the diagonal?

Give your answer correct to 1 decimal place.

The diagonal is the hypotenuse of a right-angled triangle with shorter sides 100 m and 64 m.

$$d^2 = 100^2 + 64^2 = 10\,000 + 4096 = 14\,096$$

$$d = \sqrt{14\,096} = 118.726 \dots \text{ m}$$

Along two sides: $100 + 64 = 164 \text{ m}$

Difference: $164 - 118.726 \dots = 45.273 \dots$

Correct to 1 decimal place: 45.3 m

Answer: 45.3 m

Tip: The question asks how much **shorter**, so finish by subtracting the diagonal from $100 + 64$.

Marks: 1 mark for $100^2 + 64^2$. 1 mark for 118.7.... 1 mark for 45.3

5 (2 marks)

A triangle has sides of length 7 cm, 24 cm and 25 cm.

Show that the triangle is right-angled.

If it is right-angled, the longest side (25 cm) is the hypotenuse.

$$7^2 + 24^2 = 49 + 576 = 625$$

$$25^2 = 625$$

These are equal, so by Pythagoras' theorem the triangle is right-angled.

Answer: $49 + 576 = 625$

Marks: 1 mark for $7^2 + 24^2$ and 25^2 . 1 mark for a conclusion from correct working.

6 (2 marks)

A square has sides of length 6 cm.

Work out the length of a diagonal of the square.

Give your answer correct to 1 decimal place.

The diagonal splits the square into two right-angled triangles.

The diagonal is the hypotenuse, with shorter sides 6 cm and 6 cm.

$$d^2 = 6^2 + 6^2 = 36 + 36 = 72$$

$$d = \sqrt{72} = 8.485 \dots = 8.5 \text{ cm (1 d.p.)}$$

Answer: 8.5 cm

Tip: Don't forget to square root: 72 is d^2 , not d .

Marks: 1 mark for $6^2 + 6^2$. 1 mark for 8.5.

7 (4 marks)

Sam makes a wooden frame with four straight sides. Opposite sides are equal in length.

The perimeter of the frame is 280 cm and one side is 80 cm long.

One diagonal of the frame is 99 cm long.

Sam says,

‘The corners of my frame are right angles.’

Is Sam correct?

You must show how you get your answer.

Opposite sides are equal, so two sides are 80 cm and two sides are the same unknown length.

$$\text{Other side: } (280 - 80 - 80) \div 2 = 60 \text{ cm}$$

If the corners were right angles, the diagonal would be the hypotenuse of a right-angled triangle with shorter sides 80 cm and 60 cm.

$$80^2 + 60^2 = 6400 + 3600 = 10\,000$$

$$\sqrt{10\,000} = 100 \text{ cm}$$

The diagonal is 99 cm, not 100 cm.

So the corners are **not** right angles. Sam is not correct.

Answer: No: with right angles the diagonal would be 100 cm, not 99 cm

Tip: Work out the missing side from the perimeter first. Then compare the diagonal with what Pythagoras' theorem says it should be.

Marks: 1 mark for 60. 1 mark for $80^2 + 60^2$ (= 10 000). 1 mark for 100 (or $99^2 = 9801$). 1 mark for “No” from correct working.

8 (4 marks)

ABC and ACD are right-angled triangles.

$AB = 6\text{ cm}$, $BC = 8\text{ cm}$, $AD = 4\text{ cm}$

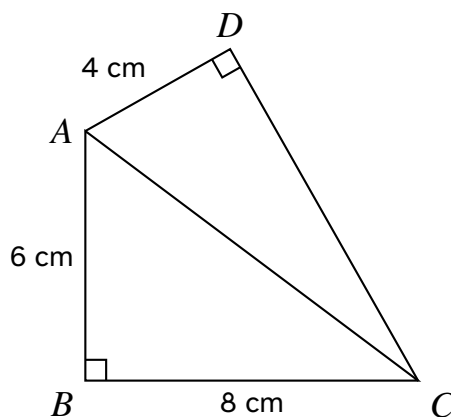


Diagram **NOT** accurately drawn

Work out the length of CD .

Give your answer correct to 1 decimal place.

Step 1: find AC in triangle ABC .

AC is opposite the right angle at B , so it is the hypotenuse.

$$AC^2 = 6^2 + 8^2 = 36 + 64 = 100$$

$$AC = \sqrt{100} = 10\text{ cm}$$

Step 2: use triangle ACD .

The right angle is at D , so AC is the hypotenuse and CD is a shorter side.

$$CD^2 = 10^2 - 4^2 = 100 - 16 = 84$$

$$CD = \sqrt{84} = 9.165 \dots = 9.2\text{ cm (1 d.p.)}$$

Answer: 9.2 cm

Tip: In each triangle, find the side opposite the right angle first. That tells you whether to add or subtract.

Marks: 1 mark for $6^2 + 8^2$. 1 mark for $AC = 10$. 1 mark for $10^2 - 4^2$. 1 mark for 9.2.