



eClassroom

GCSE MATHEMATICS • GEOMETRY

Pythagoras

Worksheet

Pearson Edexcel GCSE (1MA1) & International GCSE (4MA1) • Calculator allowed

Free Pythagoras worksheet for GCSE and iGCSE Maths, with full worked solutions



Tap a section to jump straight to it

By the end of this worksheet you can: find the hypotenuse and a shorter side of a right-angled triangle • use Pythagoras in real-life problems • find the distance between two points • decide whether a triangle is right-angled • *Higher:* 3D Pythagoras, exact surd answers, algebra and circles.

Which questions are for me?

FOUNDATION Everyone starts here. These skills appear on both tiers.

HIGHER Higher only: Pythagoras in 3D, exact answers in surd form, algebra with Pythagoras and chords in circles. Grades 6 to 9.

Every section has both, clearly labelled. Questions get harder as you go, and every skill in Sections A to D is needed in Section E.

Track your progress

Section	B	C	D	E
Foundation marks	23	10	13	15
Higher marks	16	14	17	15
My score				

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Name

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Date



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A

Worked examples & Your turn

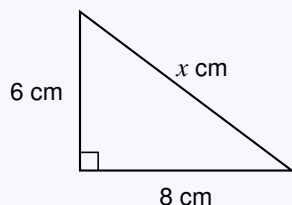
Read each example carefully. Cover it up, then answer the question beside it using the same method.

FOUNDATION

Everyone starts here

Worked example A1

Work out the value of x .

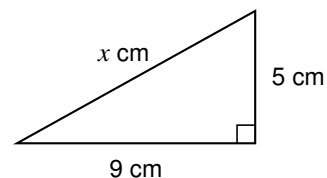


$$x^2 = 8^2 + 6^2 = 100, \text{ so } x = \sqrt{100}$$

$$x = 10$$

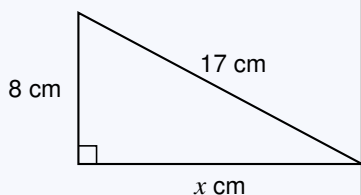
Your turn A1

Work out the value of x , to 1 decimal place.



Worked example A2

Work out the value of x .

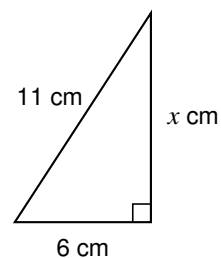


A shorter side: subtract. $x^2 = 17^2 - 8^2 = 225$

$$x = 15$$

Your turn A2

Work out the value of x , to 1 decimal place.



Worked example A3

Work out the distance between the points (2, 1) and (8, 9). Across $8 - 2 = 6$, up $9 - 1 = 8$. Distance $= \sqrt{6^2 + 8^2}$

$$10$$

Your turn A3

Work out the distance between the points $(-1, 3)$ and $(4, -2)$, to 1 decimal place.



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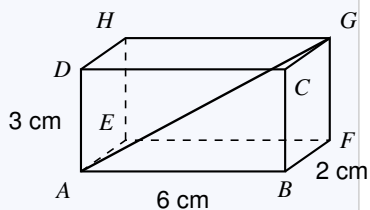
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HIGHER

Higher strategies: 3D, exact answers and algebra

Worked example A4: Pythagoras in 3D

Work out the length of the diagonal AG of the cuboid.

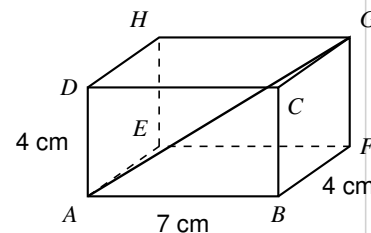


$$AG^2 = 6^2 + 3^2 + 2^2 = 49$$

7 cm

Your turn A4

Work out the length of the diagonal AG of the cuboid.

**Worked example A5: exact answers**

A right-angled triangle has shorter sides 2 cm and 4 cm. Work out the hypotenuse as a surd in its simplest form. $\sqrt{4+16} = \sqrt{20} = \sqrt{4 \times 5}$

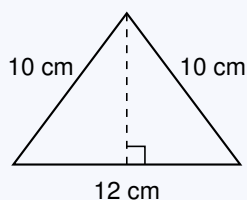
$2\sqrt{5}$ cm

Your turn A5

A right-angled triangle has shorter sides 3 cm and 6 cm. Work out the hypotenuse as a surd in its simplest form.

Worked example A6: isosceles triangles

Work out the area of the triangle.

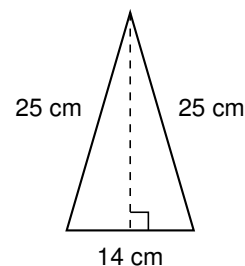


$$\text{Height: } \sqrt{10^2 - 6^2} = 8. \text{ Area} = \frac{1}{2} \times 12 \times 8$$

48 cm²

Your turn A6

Work out the area of the triangle.

**Worked example A7: algebra**

The sides of a right-angled triangle are x , $x+2$ and $x+4$ cm. Work out x . $x^2 + (x+2)^2 = (x+4)^2$ gives $x^2 - 4x - 12 = 0$, so $(x-6)(x+2) = 0$

$x = 6$

Your turn A7

The sides of a right-angled triangle are x , $x+1$ and $x+2$ cm. Work out x .



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B**Fluency**

Each question is a designed sequence. From one part to the next, ask yourself: what changed, and what did it do to the answer?

FOUNDATION*Everyone starts here*

B1 The shorter sides of a right-angled triangle are given. Work out the hypotenuse, to 1 decimal place where needed.

(a) 9 cm, 12 cm

(b) 7 cm, 24 cm

(c) 5 cm, 7 cm

(d) 2.5 cm, 6 cm

[4 marks]

B2 The hypotenuse and one shorter side are given. Work out the other side, to 1 decimal place where needed.

(a) 25 cm, 7 cm

(b) 26 cm, 10 cm

(c) 15 cm, 9 cm

(d) 9.5 cm, 4 cm

[4 marks]

B3 (a) Work out the diagonal of an 8 cm by 15 cm rectangle.

(b) Work out the diagonal of a square of side 5 cm, to 1 decimal place.

(c) A TV screen has a diagonal of 50 inches and a width of 40 inches. Work out its height.

(d) A ramp rises 5 m over a horizontal distance of 12 m. Work out the length of the ramp.

[4 marks]

B4 Work out the distance between each pair of points.

(a) (0, 0) and (3, 4)

(b) (1, 1) and (7, 9)

(c) (−2, 3) and (4, −5)

(d) (2, −1) and (5, 3)

[4 marks]



FOUNDATION*continued: right-angled or not, and isosceles triangles*

B5 Is a triangle with these sides right-angled? Show your working.

(a) 8, 15, 17

(b) 7, 8, 11

(c) 12, 16, 20

[3 marks]

B6 (a) An isosceles triangle has equal sides of 5 cm and a base of 6 cm. Work out its height.

(b) An isosceles triangle has equal sides of 13 cm and a base of 10 cm. Work out its height.

(c) Work out the area of the triangle in part (a).

(d) Work out the height of an equilateral triangle of side 10 cm, to 1 decimal place.

[4 marks]

HIGHER*Higher tier only*

B7 Work out each length, to 1 decimal place where needed.

(a) the diagonal of a 1 cm by 2 cm by 2 cm cuboid

(b) the diagonal of a 2 cm by 6 cm by 9 cm cuboid

(c) the diagonal of one face of a cube of side 5 cm

(d) the diagonal through the middle of the same cube

[4 marks]

B8 Give each answer as a surd in its simplest form, or a whole number.

(a) the hypotenuse, shorter sides 1 cm and 2 cm

(b) the hypotenuse, shorter sides 2 cm and 6 cm

(c) a shorter side, hypotenuse 6 cm and other side 2 cm

(d) a shorter side, hypotenuse $\sqrt{20}$ cm and other side 2 cm

[4 marks]



HIGHER*continued: algebra and circles*

- B9**
- (a) A right-angled triangle has shorter sides x and $2x$ and hypotenuse 10 cm. Work out x as a surd.
 - (b) A right-angled triangle has shorter sides x and 5 cm and hypotenuse $(x + 1)$ cm. Work out x .
 - (c) A right-angled isosceles triangle has hypotenuse 8 cm. Work out the length of a shorter side as a surd.
 - (d) The distance from $(1, k)$ to $(4, 5)$ is 5. Work out the two possible values of k . **[4 marks]**
- B10** O is the centre of a circle.
- (a) The radius is 10 cm and chord AB is 16 cm. Work out the distance from O to AB
 - (b) The radius is 13 cm and the chord is 5 cm from O . Work out the length of the chord.
 - (c) The radius is 6 cm and $OP = 10$ cm. A tangent from P touches the circle at T . Work out PT
 - (d) The radius is 13 cm and a chord is 10 cm long. Work out the distance from O to the chord. **[4 marks]**



C**Reasoning**

Show your working and explain your thinking. A correct answer without a reason does not score full marks.

FOUNDATION

Everyone starts here

- C1** Tom works out the hypotenuse of a triangle with shorter sides 3 cm and 4 cm as $3 + 4 = 7$ cm. Explain Tom's mistake. [2 marks]
- C2** Sam finds a shorter side of a triangle with hypotenuse 13 cm and another side 5 cm by working out $\sqrt{13^2 + 5^2}$. Explain Sam's mistake. [2 marks]
- C3** Explain why the hypotenuse is always the longest side of a right-angled triangle. [3 marks]
- C4** Show that a triangle with sides 7 cm, 24 cm and 25 cm is right-angled. [3 marks]



HIGHER*Higher tier only*

- C5** Kai works out the diagonal of a 3 cm by 4 cm by 12 cm cuboid as $\sqrt{3^2 + 4^2} = 5$ cm. Explain Kai's mistake, and find the correct length. [3 marks]
- C6** Explain why the diagonal of a square of side s is $s\sqrt{2}$ [3 marks]
- C7** Explain why the diagonal through a cube of side s is $s\sqrt{3}$ [3 marks]
- C8** m and n are positive whole numbers with $m > n$
- (a) Show that $(m^2 - n^2)^2 + (2mn)^2 = (m^2 + n^2)^2$
- (b) Use $m = 5$, $n = 2$ to find a right-angled triangle with whole-number sides. [5 marks]



D**Problem solving**

You decide the method. Read the whole question first, and show every step.

FOUNDATION

Everyone starts here

- D1** A ladder 5 m long leans against a vertical wall.
Its foot is 1.4 m from the wall.
How high up the wall does the ladder reach?

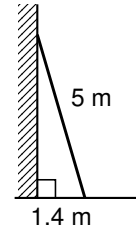


Diagram NOT accurately drawn

[3 marks]

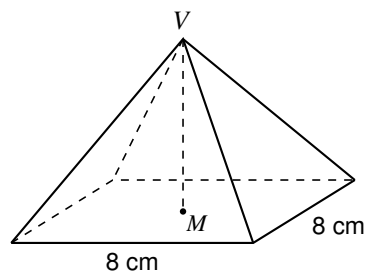
- D2** Amir walks 3 km east and then 4 km north. Bea walks straight from the same start to the same finish.
How much shorter is Bea's route? [4 marks]
- D3** A path goes diagonally across a rectangular field 60 m by 80 m. Edging for the path costs £4.50 per metre.
Work out the cost. [3 marks]
- D4** A square has a diagonal of 10 cm. Work out its area. [3 marks]



HIGHER*Higher tier only*

- D5** $VABCD$ is a pyramid with a square base of side 8 cm. V is vertically above M , the centre of the base, and $VM = 3$ cm.

- (a) Work out the height of a triangular face, from V to the middle of a base edge.
- (b) Work out the length of a sloping edge, to 1 decimal place.

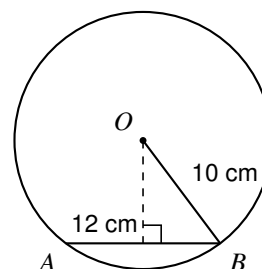
*Diagram NOT accurately drawn***[4 marks]**

- D6** A rhombus has diagonals of 10 cm and 24 cm. Work out its perimeter.

[4 marks]

- D7** O is the centre of a circle of radius 10 cm. AB is a chord of length 12 cm.

- (a) Work out the distance from O to AB
- (b) Work out the area of triangle OAB

*Diagram NOT accurately drawn***[4 marks]**

- D8** A closed box is 5 cm long, 4 cm wide and 3 cm high. An ant walks over the outside of the box from one corner to the opposite corner.

- (a) By unfolding the box, find the shortest distance the ant can walk, to 2 decimal places.
- (b) How much longer is this than the straight line through the box?

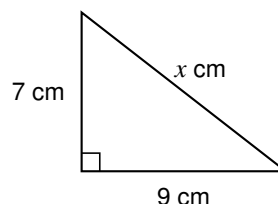
[5 marks]

E**Exam practice**

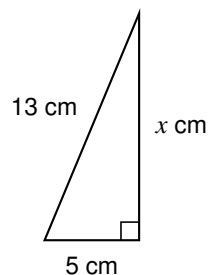
Exam-style questions. Write your answers in the spaces. Aim for about one minute per mark.

FOUNDATION*Foundation and Higher crossover***E1** Work out the value of x , to 1 decimal place.

.....

*Diagram NOT accurately drawn***(Total for Question E1 is 2 marks)****E2** Work out the value of x .

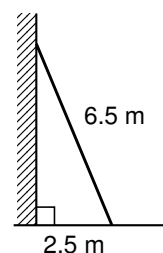
.....

*Diagram NOT accurately drawn***(Total for Question E2 is 3 marks)****E3** A ladder 6.5 m long leans against a wall. Its foot is 2.5 m from the wall.**(a)** How high up the wall does it reach?

.....

(2)**(b)** The foot is moved 1.5 m further from the wall. How far down the wall does the top slide, to 2 decimal places?

.....

(1)*Diagram NOT accurately drawn***(Total for Question E3 is 3 marks)**

- E4** Work out the distance between the points (1, 2) and (7, 10)

.....

(Total for Question E4 is 3 marks)

- E5** (a) Show that a triangle with sides 20 cm, 21 cm and 29 cm is right-angled.

(2)

- (b) Is a triangle with sides 9 cm, 12 cm and 16 cm right-angled? Show your working.

(2)

(Total for Question E5 is 4 marks)

HIGHER

Higher tier only

- E6** Work out the area of the isosceles triangle.

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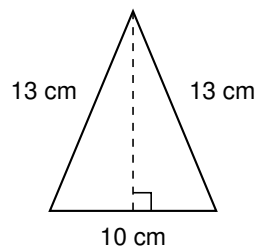


Diagram NOT accurately drawn

(Total for Question E6 is 3 marks)

- E7** Work out the length of the diagonal AG of the cuboid.

.....

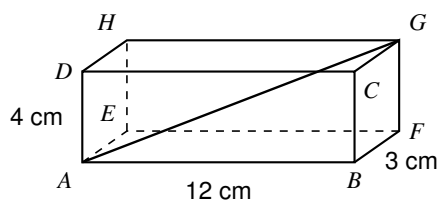


Diagram NOT accurately drawn

(Total for Question E7 is 3 marks)



E8 A rectangle is 4 cm by 6 cm.

(a) Show that the length of its diagonal is $2\sqrt{13}$ cm.

(2)

(b) The diagonal cuts the rectangle into two triangles. Write down the perimeter of one triangle, in surd form.

.....

(2)

(Total for Question E8 is 4 marks)

E9 The sides of a right-angled triangle are x cm, $(x+7)$ cm and $(x+8)$ cm.

(a) Show that $x^2 - 2x - 15 = 0$

(2)

(b) Work out the area of the triangle.

.....

(3)

(Total for Question E9 is 5 marks)

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