

Angles in Polygons

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)

Work out the sum of the interior angles of an octagon.

An octagon has 8 sides.

From one corner, it can be split into $8 - 2 = 6$ triangles.

The angles in each triangle add up to 180° .

$$6 \times 180 = 1080^\circ$$

Answer: 1080°

Tip: The number of triangles is always 2 less than the number of sides, so use $(n - 2) \times 180$. Using 8×180 is a common mistake.

Marks: 1 mark for 6×180 . 1 mark for 1080.

2 (2 marks)

Work out the size of each interior angle of a regular decagon.
(A decagon has 10 sides.)

The exterior angles of a polygon add up to 360° .

$$\text{Exterior angle: } 360 \div 10 = 36^\circ$$

$$\text{Interior angle} + \text{exterior angle} = 180^\circ$$

Interior angle: $180 - 36 = 144^\circ$

Answer: 144°

Tip: 36° is the exterior angle. Remember to subtract it from 180 to get the interior angle.

Marks: 1 mark for $360 \div 10$ or $8 \times 180 \div 10$. 1 mark for 144.

3 (2 marks)

Riya says,

‘A regular polygon can have exterior angles of 50° ’

Is Riya correct?

You must show how you get your answer.

The exterior angles of a polygon add up to 360° .

Number of sides = $360 \div 50 = 7.2$

A polygon must have a whole number of sides.

So Riya is not correct.

Answer: No, $360 \div 50 = 7.2$, which is not a whole number

Tip: The exterior angle of a regular polygon must divide exactly into 360.

Marks: 1 mark for $360 \div 50$ (or for showing that 7 sides gives more than 50° and 8 sides gives less). 1 mark for “No” with 7.2.

4 (2 marks)

The diagram shows part of a regular polygon.



Diagram **NOT** accurately drawn

Work out the number of sides of the polygon.

The marked angle is an interior angle.

Exterior angle: $180 - 140 = 40^\circ$

The exterior angles add up to 360° .

Number of sides = $360 \div 40 = 9$

Answer: 9

Tip: Change the interior angle into an exterior angle first. $360 \div 140$ is not the number of sides.

Marks: 1 mark for $180 - 140$ and then $360 \div 40$. 1 mark for 9.

5 (2 marks)

Show that the sum of the interior angles of a hexagon is 720°

Draw lines from one corner of the hexagon to the other corners.

This splits the hexagon into 4 triangles.

The angles in each triangle add up to 180° .

$4 \times 180 = 720^\circ$

Answer: $4 \times 180 = 720$

Marks: 1 mark for splitting into 4 triangles. 1 mark for $4 \times 180 = 720$.

6 (3 marks)

Q is a regular polygon.

Each exterior angle of Q is half the size of each exterior angle of a regular hexagon.

Work out the sum of the interior angles of Q .

Exterior angle of a regular hexagon: $360 \div 6 = 60^\circ$

Exterior angle of Q : $60 \div 2 = 30^\circ$

Number of sides of Q : $360 \div 30 = 12$

Sum of the interior angles of Q : $(12 - 2) \times 180 = 1800^\circ$

Answer: 1800°

Tip: Halve the **exterior** angle, not the interior angle or the number of sides. Halving the exterior angle doubles the number of sides.

Marks: 1 mark for 30° . 1 mark for 12 sides. 1 mark for 1800.

7 (3 marks)

The diagram shows a regular pentagon $ABCDE$ and an equilateral triangle ABP .

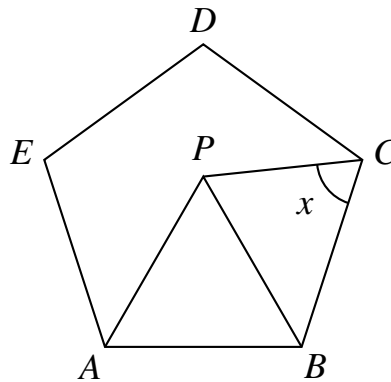


Diagram **NOT** accurately drawn

Find the size of the angle marked x .

You must show all your working.

Interior angle of a regular pentagon: $540 \div 5 = 108^\circ$, so angle $ABC = 108^\circ$

Triangle ABP is equilateral, so angle $ABP = 60^\circ$

Angle $PBC = 108 - 60 = 48^\circ$

$BP = AB$ (equilateral triangle) and $AB = BC$ (regular pentagon), so $BP = BC$.

So triangle PBC is isosceles.

$$x = (180 - 48) \div 2 = 66^\circ$$

Answer: 66°

Tip: Look for equal lengths: every side of the pentagon and every side of the equilateral triangle is the same length.

Marks: 1 mark for 108 or 48. 1 mark for seeing that triangle PBC is isosceles. 1 mark for 66.

8 (3 marks)

The angles of a hexagon are

$$x \quad x + 10 \quad 2x \quad 2x - 20 \quad 130 \quad 150$$

All the angles are in degrees.

Work out the value of x .

The angles in a hexagon add up to $4 \times 180 = 720^\circ$.

$$x + (x + 10) + 2x + (2x - 20) + 130 + 150 = 720$$

Collect the x terms: $x + x + 2x + 2x = 6x$

Collect the numbers: $10 - 20 + 130 + 150 = 270$

$$6x + 270 = 720$$

$$6x = 450$$

$$x = 75$$

Answer: $x = 75$

Tip: Use 720° for a hexagon, not 360° .

Marks: 1 mark for making the angles equal 720. 1 mark for $6x = 450$. 1 mark for $x = 75$.

9 (3 marks)

The diagram shows a regular pentagon (shaded).

Each side of the pentagon has been extended to make a star.

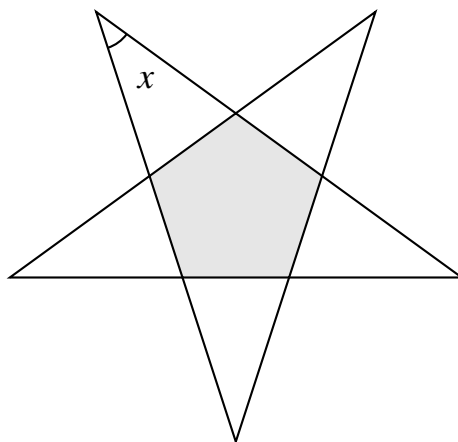


Diagram **NOT** accurately drawn

Work out the size of the angle marked x .

You must show all your working.

Each point of the star is a triangle standing on one side of the pentagon.

The two base angles of this triangle are exterior angles of the pentagon.

Exterior angle of a regular pentagon: $360 \div 5 = 72^\circ$

Angles in a triangle add up to 180° .

$$x = 180 - 72 - 72 = 36^\circ$$

Answer: 36°

Tip: The base angles of each point are **exterior** angles (72°), because each side has been extended in a straight line. Using 108° gives an impossible triangle.

Marks: 1 mark for 72° (or interior angle 108° and $180 - 108$). 1 mark for $180 - 72 - 72$. 1 mark for 36.