

Angles in Polygons

Solutions

For AQA GCSE Mathematics (8300) • 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 (1 mark)

Circle the sum of the interior angles of a hexagon.

Options: 360° , 540° , 720° , 1080°

A hexagon has 6 sides.

Draw lines from one corner to split it into triangles: you get $6 - 2 = 4$ triangles.

The angles in each triangle add up to 180° .

$$4 \times 180 = 720^\circ$$

Answer: 720°

2 (1 mark)

Work out the size of each exterior angle of a regular hexagon.

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

A regular hexagon has 6 equal exterior angles.

$$360 \div 6 = 60^\circ$$

Answer: 60°

3 (1 mark)

Callum splits a hexagon into triangles by drawing all the diagonals from one vertex.

He says,

‘This makes 6 triangles, so the angles in a hexagon add up to $6 \times 180^\circ = 1080^\circ$ ’

Is he correct? Tick a box.

Give a reason for your answer.

From one vertex, you can only draw diagonals to the vertices that are not next to it.

A hexagon has $6 - 3 = 3$ such diagonals, which split it into $6 - 2 = 4$ triangles, not 6.

So the angles add up to $4 \times 180 = 720^\circ$, not 1080° .

Answer: No, there are 4 triangles, so the sum is 720°

Tip: The number of triangles is always 2 less than the number of sides, so the angle sum is $(n - 2) \times 180^\circ$.

4 (2 marks)

The exterior angles of a regular polygon are all 24°

Work out the total of all the interior angles of this polygon.

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

Number of sides = $360 \div 24 = 15$

Sum of the interior angles = $(15 - 2) \times 180$

= $13 \times 180 = 2340^\circ$

Answer: 2340°

Tip: Find the number of sides first. Then use $(n - 2) \times 180$, not $n \times 180$.

Marks: 1 mark for 15 sides. 1 mark for 2340.

5 (2 marks)

Each exterior angle of a regular polygon is 40°

Priti says,

‘So each interior angle is $360^\circ - 40^\circ = 320^\circ$ ’

(a) Is Priti correct? Tick a box.

Give a reason for your answer.

An interior angle and an exterior angle lie on a straight line, so they add up to 180° , not 360° .

Each interior angle is $180 - 40 = 140^\circ$.

Answer: No, interior angle = $180 - 40 = 140^\circ$

Tip: Interior angle + exterior angle = 180° . It is the **sum of all the exterior angles** that is 360° .

(b) Work out the number of sides of the polygon.

The exterior angles add up to 360° .

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

Answer: 9

6 (2 marks)

Work out the size of an interior angle of a regular pentagon.

A pentagon splits into $5 - 2 = 3$ triangles.

Sum of the interior angles: $3 \times 180 = 540^\circ$

A regular pentagon has 5 equal angles.

$540 \div 5 = 108^\circ$

(Another way: exterior angle = $360 \div 5 = 72^\circ$, so interior angle = $180 - 72 = 108^\circ$.)

Answer: 108°

Marks: 1 mark for $540 \div 5$ or $180 - 72$. 1 mark for 108.

7 (2 marks)

The angles of a pentagon are

100° 120° 95° 110° x

Work out the size of angle x .

The angles in a pentagon add up to $3 \times 180 = 540^\circ$.

Add the four angles you know: $100 + 120 + 95 + 110 = 425$

$$x = 540 - 425 = 115^\circ$$

Answer: 115°

Tip: This pentagon is not regular, so its angles are not all equal. Subtract the known angles from 540.

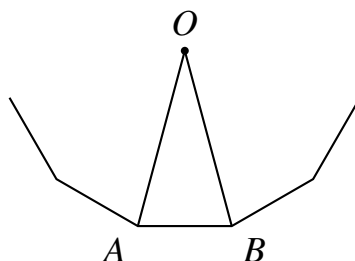
Marks: 1 mark for using 540. 1 mark for 115.

8 (2 marks)

Part of a regular polygon with 12 sides is shown.

O is the centre of the polygon.

A and B are vertices of the polygon.



Not drawn accurately

Work out the size of angle OAB .

Joining O to every vertex splits the polygon into 12 equal triangles.

$$\text{Angle } AOB = 360 \div 12 = 30^\circ$$

$OA = OB$, so triangle OAB is isosceles.

$$\text{Angle } OAB = (180 - 30) \div 2 = 75^\circ$$

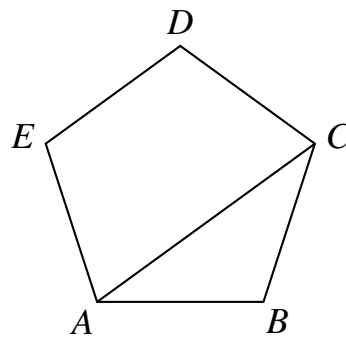
Answer: 75°

Tip: Triangle OAB is isosceles because O is the centre. The two base angles are equal.

Marks: 1 mark for angle $AOB = 30^\circ$. 1 mark for 75.

9 (3 marks)

$ABCDE$ is a regular pentagon.



Not drawn accurately

Work out the size of angle ACD .

Each interior angle of a regular pentagon is $540 \div 5 = 108^\circ$.

$AB = BC$, so triangle ABC is isosceles.

$$\text{Angle } BCA = (180 - 108) \div 2 = 36^\circ$$

$$\text{Angle } BCD = 108^\circ, \text{ so angle } ACD = 108 - 36 = 72^\circ$$

Answer: 72°

Tip: Look for the isosceles triangle. The sides of a regular polygon are all equal, so triangle ABC has two equal sides.

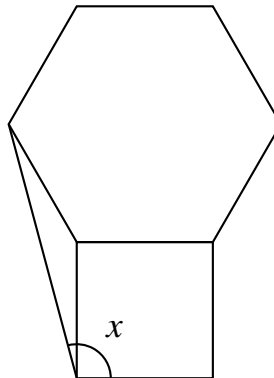
Marks: 1 mark for 108. 1 mark for angle $BCA = 36$. 1 mark for 72.

10 (3 marks)

The diagram shows a regular hexagon and a square.

They share a side.

A straight line joins a vertex of the hexagon to a vertex of the square.



Not drawn accurately

Work out the size of angle x .

Interior angle of a regular hexagon: $720 \div 6 = 120^\circ$

Angle in a square: 90°

Angles around a point add up to 360° , so the angle of the triangle at the shared vertex is $360 - 120 - 90 = 150^\circ$

The hexagon and the square have sides of the same length, so the triangle is isosceles.

Each of the other two angles in the triangle is $(180 - 150) \div 2 = 15^\circ$

Angle x is the 90° corner of the square plus this 15° angle.

$$x = 90 + 15 = 105^\circ$$

Answer: 105°

Tip: The hexagon and square share a side, so all their sides are the same length. That makes the triangle isosceles.

Marks: 1 mark for 150. 1 mark for 15. 1 mark for 105.

11 (3 marks)

A regular polygon has n sides.
The value of n increases.

(a) Tick **one** box for each statement.

	True	False
Each exterior angle gets smaller.	✓	
Each interior angle gets smaller.		✓
The sum of the interior angles gets bigger.	✓	
The sum of the exterior angles gets bigger.		✓

Exterior angle = $360 \div n$: dividing by a bigger number gives a smaller angle. True

Interior angle = $180 - \text{exterior angle}$, so it gets **bigger**. False

Sum of interior angles = $(n - 2) \times 180$, which gets bigger. True

The exterior angles always add up to 360° . False

Tip: The exterior angles of any polygon always add up to 360° , however many sides it has.

Marks: 2 marks for all four correct. 1 mark for two or three correct.

(b) Explain why a regular polygon cannot have an interior angle of 180°

The exterior angle would be $180 - 180 = 0^\circ$.

The exterior angles must add up to 360° , and you cannot make 360 from angles of 0° .

(An angle of 180° is a straight line, so there would be no corner.)

Answer: The exterior angle would be 0° , and $360 \div 0$ is impossible