Interior and exterior angles worksheet

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Practice questions

Level 1: Foundation

A1. Work out the sum of the interior angles of: (a) a pentagon (b) a heptagon (c) a nonagon (d) a 12-sided polygon

A2. Work out the size of each exterior angle of: (a) a square (b) a regular hexagon (c) a regular octagon (d) a regular 20-sided polygon

A3. Work out the size of each interior angle of: (a) a regular pentagon (b) a regular hexagon (c) a regular nonagon (d) a regular 12-sided polygon

A4. An interior angle of a polygon is 125°. Work out the exterior angle at the same vertex.

A5. A quadrilateral has angles 85°, 100°, 75° and x. Find x.

A6. A pentagon has angles 100°, 115°, 90°, 120° and x. Find x.

A7. Three of the exterior angles of a quadrilateral are 80°, 95° and 100°. Find the fourth exterior angle.

Level 2: Foundation and Higher

B1. Each exterior angle of a regular polygon is 40°. How many sides does it have? What is the polygon called?

B2. Each exterior angle of a regular polygon is 30°. How many sides does it have?

B3. Each interior angle of a regular polygon is 162°. How many sides does it have?

B4. Each interior angle of a regular polygon is 108°. Name the polygon.

B5. Four of the interior angles of a hexagon are 110°, 130°, 125° and 115°. The other two angles are equal. Find the size of each of them.

B6. The interior angles of a polygon add up to 2340°. How many sides does it have?

B7. Explain whether a regular polygon can have: (a) an exterior angle of 50° (b) an interior angle of 165°

B8. Work out the interior angle of a regular heptagon. Give your answer to 1 decimal place.

Level 3: Higher

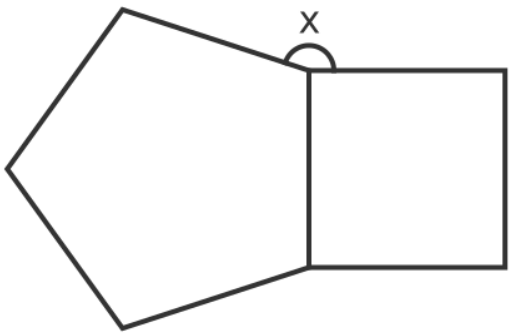
C1. A pentagon has interior angles x, $2x$, $3x$, $2x + 20°$ and $x + 70°$. (a) Find x. (b) Find the largest angle.

C2. The exterior angles of a pentagon are $x + 10°$, $2x$, $2x + 20°$, $3x$ and $x + 60°$. (a) Find x. (b) Find the interior angle at the vertex whose exterior angle is $2x + 20°$.

C3. Each interior angle of a regular polygon is 5 times its exterior angle. How many sides does the polygon have?

C4. Each interior angle of a regular polygon is 150° more than its exterior angle. How many sides does the polygon have?

C5. A regular pentagon and a square share a side. Find the angle at the shared vertex, outside both shapes.



C6. $ABCDEF$ is a regular hexagon. Find angle BAC. Give reasons.

C7. $ABCDEFGH$ is a regular octagon. Extend sides AB and DC so they meet at point P. Find angle BPC. Give reasons.

C8. Prove that the exterior angles of any polygon add up to 360°. Use the formula for the sum of the interior angles.

Level 4: Problem solving and reasoning

D1. Sam says: *"A regular polygon with an interior angle of* $135°$ *is a hexagon."* Is Sam correct? Explain your answer.

D2. Explain why regular pentagons can't **tessellate** (fit together around a point without gaps or overlaps).

D3. Two regular octagons and one other regular polygon meet at a point with no gaps. What is the other polygon?

D4. A regular hexagon, a square and a regular polygon X meet at a point with no gaps. How many sides does X have?

D5. Polygon A is regular and has 6 sides. Polygon B is regular, and its exterior angle is half the exterior angle of polygon A. How many sides does polygon B have?

D6. Priya says: *"If I double the number of sides of a polygon, the sum of its interior angles doubles."* Test her claim with an example. Is she right?

Answers

Level 1: Foundation

A1.

- (a) $3 \times 180° = 540°$
- (b) $5 \times 180° = 900°$
- (c) $7 \times 180° = 1260°$
- (d) $10 \times 180° = 1800°$

A2.

- (a) $360° \div 4 = 90°$
- (b) $360° \div 6 = 60°$
- (c) $360° \div 8 = 45°$
- (d) $360° \div 20 = 18°$

A3.

- (a) $180° - 72° = 108°$
- (b) $180° - 60° = 120°$
- (c) $180° - 40° = 140°$
- (d) $180° - 30° = 150°$

A4.

- $180° - 125° = 55°$

A5.

- $360° - (85° + 100° + 75°) = 360° - 260° = 100°$

A6.

- $540° - (100° + 115° + 90° + 120°) = 540° - 425° = 115°$

A7.

- $360° - (80° + 95° + 100°) = 360° - 275° = 85°$

Level 2: Foundation and Higher

B1.

- $360 \div 40 = 9$ sides, so it's a **nonagon**.

B2.

- $360 \div 30 = 12$ sides

B3.

- Exterior angle $= 180° - 162° = 18°$, so $n = 360 \div 18 = 20$ sides.

B4.

- Exterior angle $= 180° - 108° = 72°$, so $n = 360 \div 72 = 5$. It's a **regular pentagon**.

B5.

- Sum $= 720°$
- Known angles: $110 + 130 + 125 + 115 = 480°$
- The two equal angles total $720° - 480° = 240°$, so each one is $120°$.

B6.

- $(n - 2) \times 180 = 2340$, so $n - 2 = 13$ and $n = 15$ sides.

B7.

- (a) **No.** $360 \div 50 = 7.2$, which is not a whole number.
- (b) **Yes.** Exterior angle $= 15°$ and $360 \div 15 = 24$, so it has 24 sides.

B8.

- $180° - \dfrac{360°}{7} = 128.571...° \approx 128.6°$

Level 3: Higher

C1.

- (a) $x + 2x + 3x + (2x + 20) + (x + 70) = 540$
- $9x + 90 = 540$, so $9x = 450$ and $x = 50$
- (b) The angles are $50°, 100°, 150°, 120°, 120°$, so the largest is $150°$.
- Check: $50 + 100 + 150 + 120 + 120 = 540$

C2.

- (a) $(x + 10) + 2x + (2x + 20) + 3x + (x + 60) = 360$
- $9x + 90 = 360$, so $9x = 270$ and $x = 30$
- (b) Exterior angle $= 2(30) + 20 = 80°$, so the interior angle $= 180° - 80° = 100°$.

C3.

- Let the exterior angle be e. Then $e + 5e = 180$, so $6e = 180$ and $e = 30°$.
- $n = 360 \div 30 = 12$ sides

C4.

- $e + (e + 150) = 180$, so $2e = 30$ and $e = 15°$.
- $n = 360 \div 15 = 24$ sides

C5.

- $360° - 108° - 90° = 162°$ (angles around a point)

C6.

- Interior angle $ABC = 120°$ (interior angle of a regular hexagon).
- $AB = BC$ (the sides of a regular hexagon are equal), so triangle ABC is isosceles.
- $BAC = (180° - 120°) \div 2 = 30°$ (base angles of an isosceles triangle are equal; angles in a triangle add up to 180°).

C7.

- Each exterior angle of a regular octagon $= 360° \div 8 = 45°$.
- So angle $PBC = 45°$ and angle $PCB = 45°$ (angles on a straight line add up to 180°: $180° - 135° = 45°$).
- In triangle PBC: $BPC = 180° - 45° - 45° = 90°$ (angles in a triangle add up to 180°).

C8.

- At each vertex, interior + exterior $= 180°$ (angles on a straight line).
- There are n vertices, so all the interior and exterior angles together add up to $n \times 180°$.
- The interior angles add up to $(n - 2) \times 180° = n \times 180° - 360°$.
- So the exterior angles add up to $n \times 180° - (n \times 180° - 360°) = 360°$

Level 4: Problem solving and reasoning

D1.

- **No.**
- Exterior angle $= 180° - 135° = 45°$, so $n = 360 \div 45 = 8$.
- The polygon is an **octagon**. (A regular hexagon has interior angles of 120°.)

D2.

- Each interior angle of a regular pentagon is 108°.
- For shapes to fit around a point, their angles must add up to exactly 360°. $360 \div 108 = 3.33...$, which isn't a whole number, so regular pentagons always leave a gap or overlap.

D3.

- $360° - 135° - 135° = 90°$, so the other polygon is a **square**.

D4.

- $360° - 120° - 90° = 150°$
- Exterior angle $= 180° - 150° = 30°$, so $n = 360 \div 30 = 12$ sides.

D5.

- Exterior angle of $A = 360 \div 6 = 60°$
- Exterior angle of $B = 30°$, so $n = 360 \div 30 = 12$ sides.

D6.

- **No.**
- A square has 360°. Doubling the sides gives an octagon, which has 1080°, not 720°.
- This is because the formula is $(n - 2) \times 180°$, not $n \times 180°$.