Interior Angles of Polygons

Applications and design

Name _____ **Date** _____ **Score** _____ / 10

QUICK REVIEW

A convex polygon with n sides has interior-angle sum $S = (n-2)180^\circ$. If regular, each interior angle is $I = S/n = 180^\circ - 360^\circ/n$. One exterior angle at each vertex, taken consistently around a convex polygon, sums to 360°; a regular polygon has exterior angle $E = 360^\circ/n$. Interior and adjacent exterior angles sum to 180°. Check that a recovered side count is an integer at least 3.

Worked example

Find one interior angle of a regular nonagon (9 sides).

1. A convex 9-gon can be partitioned from one vertex into $9-2=7$ triangles without overlap.
2. The interior-angle sum is $(9-2)180^\circ = 7(180^\circ) = 1260^\circ$.
3. Because the polygon is regular, divide equally: $1260/9 = 140^\circ$ per interior angle. The sum and one-angle measure are different quantities.
Answer: 140°

Practice Problems

Show your thinking.

1. A designer wants a regular sign with exterior angle 40°. How many sides should it have?

2. A regular octagonal table needs trim at each corner. Find the interior corner angle.

3. A robot traces a regular polygon, turning 30° at each corner. How many corners complete one trip?

4. Design a regular polygon tile with interior angle 120°. Find its side count and how many such angles fill one point.

5. A pentagonal room has four interior corners $90^\circ, 90^\circ, 115^\circ, 125^\circ$. Find the fifth corner.

6. A regular decorative border has 18 sides. Find the exterior turn at each corner and the interior angle.

7. A designer proposes three regular pentagon corners, each 108°, meeting at a point. Find the angular gap.

8. A convex courtyard has interior-angle sum 1440°. How many corners need paving markers?

9. Design a regular polygon with each interior angle at least 150°. What is the smallest possible side count?

10. A regular hexagonal sign has interior angle 120°. Replacing it with a regular decagon changes each corner by how much?

Answer Key

1. 9 sides
2. 135°
3. 12 corners
4. 6 sides; 3 angles.
5. 120°
6. 20° exterior; 160° interior.
7. 36°
8. 10 markers
9. 12 sides
10. 24° larger

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Equal exterior angles around the sign total 360°.
2. The count is $n = 360/40 = 9$ sides.
3. The resulting interior angle is $180 - 40 = 140^\circ$, and $9(40) = 360$ checks the turn around the sign.

Problem 2

1. The octagon interior sum is $(8 - 2)180 = 1080$ degrees.
2. Each of its eight equal corners measures $1080/8 = 135$ degrees.
3. The adjacent exterior turn is $180 - 135 = 45^\circ$, and $8(45) = 360$ checks the corner geometry.

Problem 3

1. The exterior turns sum to 360° for one complete trip.
2. The corner count is $360/30 = 12$.
3. Each interior angle is $180 - 30 = 150^\circ$. Twelve exterior turns give $12(30) = 360$, returning the robot to its original direction.

Problem 4

1. The exterior is $180 - 120 = 60^\circ$, so the side count is $360/60 = 6$.
2. The number of 120° corners filling one full point is $360/120 = 3$.
3. Three regular hexagon corners meet with total $3(120) = 360^\circ$, so these corner angles leave no gap at that meeting.

Problem 5

1. The pentagon sum is $(5 - 2)180 = 540$ degrees.
2. The four known corners total $90 + 90 + 115 + 125 = 420$, leaving $540 - 420 = 120$ degrees.
3. The full sum $420 + 120 = 540$ checks the room plan; no assumption of equal corners is needed.

Problem 6

1. The exterior turn is $360/18 = 20$ degrees.
2. The interior angle is $180 - 20 = 160$ degrees.
3. The checks $18(20) = 360$ and $18(160) = 2880 = (18 - 2)180$ verify both measures used in the border design.

Problem 7

1. The three corners together cover $3(108) = 324$ degrees.
2. The remaining gap is $360 - 324 = 36$ degrees.
3. These three corners alone do not fill the point. The 36° gap must be filled by another shape or left open in the design.

Problem 8

1. The side count satisfies $(n - 2)180 = 1440$.
2. Divide by 180: $n - 2 = 8$, hence $n = 10$.
3. A polygon has one vertex per side, so 10 corners require 10 markers. The quotient 8 counted partition triangles, not markers.

Problem 9

1. The formula $I = 180 - 360/n$ gives $180 - 360/n \geq 150$.
2. Thus $360/n \leq 30$, requiring $n \geq 12$ for positive n.
3. Twelve sides give 150° exactly; eleven give $180 - 360/11 \approx 147.3^\circ$, below the limit. The minimum integer count is 12.

Problem 10

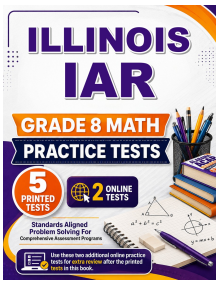
1. The decagon interior sum is $(10 - 2)180 = 1440$ degrees, so each corner is $1440/10 = 144^\circ$.
2. The increase over the hexagon corner is $144 - 120 = 24$ degrees.
3. The corners become 24° wider. More sides increase a regular polygon's interior angle while decreasing its exterior turn.

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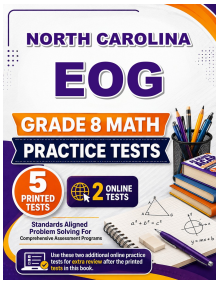
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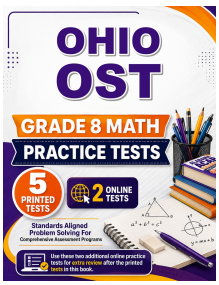
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