# Interior Angles of Polygons

Investigate mistakes and missing measures

**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 $360^\circ$; a regular polygon has exterior angle $E = 360^\circ/n$. Interior and adjacent exterior angles sum to $180^\circ$. 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:** $140^\circ$

## Practice Problems

Show your thinking.

**1.** A polygon has interior-angle sum $1260^\circ$. Recover its side count.

**2.** A regular polygon has interior angle $150^\circ$. Recover its number of sides.

**3.** A regular polygon has exterior angle $24^\circ$. Find its side count and interior-angle sum.

**4.** A student uses $8(180) = 1440$ as the interior sum of an octagon. Correct it.

**5.** Could a regular polygon have exterior angle exactly $50^\circ$? Explain.

**6.** A student divides a hexagon sum $720^\circ$ by $6$ and claims every hexagon angle is $120^\circ$. What condition is missing?

**7.** A convex hexagon has five angles $100^\circ, 110^\circ, 120^\circ, 130^\circ, 140^\circ$. Recover the sixth.

**8.** A polygon sum is $900^\circ$. A student calls it a pentagon because $900/180 = 5$. Correct the side count.

**9.** A regular polygon interior angle is $144^\circ$. A student predicts $8$ sides. Correct the count.

**10.** Can a convex polygon have interior-angle sum $1000^\circ$? Use the side-count formula.

# Answer Key

1. $9$ sides
2. $12$ sides
3. $15$ sides; $2340°$.
4. $1080°$
5. No; $360/50 = 7.2$ is not an integer.
6. Equal angles, as in a regular hexagon.
7. $120°$
8. $7$ sides
9. $10$ sides
10. No.

## Step-by-Step Solutions

Follow each calculation, then check your own work.

### Problem 1

1. The sum equation is $(n-2)180 = 1260$.
2. Divide by $180$: $n - 2 = 7$, so $n = 9$.
3. The check $(9-2)180 = 1260$ verifies a whole side count at least $3$. The number $7$ counts triangles, not sides.

### Problem 2

1. The exterior angle is $180 - 150 = 30$ degrees.
2. Because equal exterior angles total $360°$, $n = 360/30 = 12$.
3. The interior check $(12-2)180/12 = 150°$ agrees. The reciprocal relation uses exterior angle, not the interior directly.

### Problem 3

1. The count is $n = 360/24 = 15$ sides.
2. The interior-angle sum is $(15-2)180 = 13(180) = 2340$ degrees.
3. Each interior is $180 - 24 = 156°$, and $15(156) = 2340$ checks the recovered sum.

### Problem 4

1. The formula counts $n - 2$ triangles, so an octagon gives $8 - 2 = 6$ triangles.
2. The sum is $6(180) = 1080$ degrees, not $8(180) = 1440$.
3. The student overcounted by $2(180) = 360°$. An octagon has eight angles, but its triangle partition has six triangles.

### Problem 5

1. The equal-exterior relation would require $n(50) = 360$.
2. Then $n = 360/50 = 7.2$, which cannot count sides of a polygon.
3. Thus no regular polygon has exact exterior angle $50°$. Rounding to seven sides would change the required angle to $360/7$.

### Problem 6

1. The sum $(6-2)180 = 720°$ is correct for any convex hexagon.
2. The calculation $720/6 = 120°$ gives an average, not necessarily each individual angle.
3. To conclude that every angle is $120°$, equality of all six angles is needed; regularity guarantees it. A sum alone does not guarantee equal parts.

### Problem 7

1. The total is $(6-2)180 = 720$ degrees.
2. The five known measures sum to $100 + 110 + 120 + 130 + 140 = 600$, leaving $720 - 600 = 120$ degrees.
3. The check $600 + 120 = 720$ verifies the result, and all angles are below $180°$, consistent with convexity.

### Problem 8

1. The quotient $900/180 = 5$ equals $n - 2$, the triangle count.
2. Add $2$: $n = 5 + 2 = 7$ sides.
3. The check $(7-2)180 = 900$ confirms a heptagon. A pentagon would have sum $(5-2)180 = 540°$.

### Problem 9

1. The adjacent exterior angle is $180 - 144 = 36$ degrees.
2. The equal exterior-angle count is $360/36 = 10$ sides.
3. The check $(10-2)180/10 = 144°$ works. An octagon instead has interior angle $135°$, so eight sides is incorrect.

### Problem 10

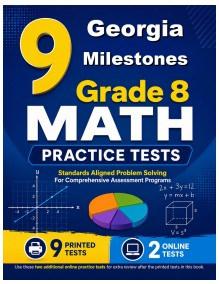
1. The sum equation would give $n - 2 = 1000/180 = 50/9$.
2. Then $n = 50/9 + 2 = 68/9$, which is not an integer.
3. The value $68/9$ cannot count sides, so the exact sum $1000°$ is impossible. Rounding the side count would change the angle sum.

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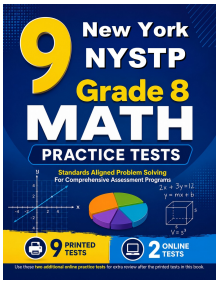

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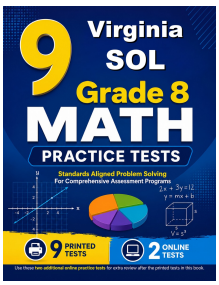

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