Angles, Polygons & Constructions

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Geometry questions reward careful seeing. The numbers in a diagram are not random; each angle, parallel line, triangle, or polygon property is a clue that tells you which rule to apply next.

In the CSEC exam, Geometry and Trigonometry carry a large share of Paper 02 marks, so explanations matter as much as calculation. When you find an angle, write the reason beside it, such as "angles on a straight line", "alternate angles", or "sum of angles in a triangle". That written reason is often where method marks are earned.

Definitions

Point: A location with no size or dimension (marked with a dot or letter)

Line: Infinite straight path extending in both directions (no endpoints)

Ray: Part of a line with one endpoint, extending infinitely in one direction

Line segment: Part of a line with two endpoints (finite length)

Angle: Two rays sharing an endpoint (vertex)

Plane: A flat 2D surface extending infinitely in all directions

Types of Angles

Angle names help you quickly judge whether an answer is reasonable. For example, if a diagram clearly shows a small angle, an answer like 145° should make you pause and check your working.

- **Acute angle:** Less than 90°
- **Right angle:** Exactly 90°
- **Obtuse angle:** Between 90° and 180°
- **Reflex angle:** Between 180° and 360°
- **Straight angle:** Exactly 180°

Angle Relationships

Most angle calculations come from a small set of relationships. In written answers, the relationship is your reason. Do not only write the number; write the property that made the number true.

Complementary angles: Sum to 90°

- Example: 30° + 60° = 90°

Supplementary angles: Sum to 180°

- Example: 120° + 60° = 180°

Vertically opposite angles: Equal when two lines intersect

- If two lines cross, angles across from each other are equal

Lines

Parallel-line questions are common because one transversal creates several equal or supplementary angles. Once you identify a pair of parallel lines, scan for corresponding, alternate, and co-interior positions before doing arithmetic.

Parallel lines: Never intersect, always same distance apart

- Notation: $l1 \parallel l2$

Perpendicular lines: Meet at 90° angle

- Notation: $l1 \perp l2$

Transversal: Line crossing two other lines

When a transversal crosses parallel lines:

- **Alternate angles:** Equal (on opposite sides of transversal, between parallel lines)
- **Corresponding angles:** Equal (same position relative to transversal at each intersection)
- **Co-interior angles:** Supplementary (same side of transversal, between parallel lines; sum to 180°)

Constructions Using Geometric Instruments

Constructions test accuracy and method, not freehand drawing. The compass marks and construction lines show how the figure was made, so leave them visible unless the question tells you otherwise.

Construction means drawing geometric figures accurately using only a compass, straightedge, and protractor.

Geometric Constructions Video

Key Construction Tasks

- 1. **Perpendicular from point to line**
- 2. **Parallel line through external point**
- 3. **Bisect a line segment** (find midpoint)
- 4. **Bisect an angle**
- 5. **Common angles:** 30°, 45°, 60°, 90°, 120°
- 6. **Triangles:** Using different given information
- 7. **Regular polygons:** Pentagon, hexagon, octagon

Polygons and Their Properties

Triangles

Triangle questions often combine side information with angle information. If two sides are equal, look for equal opposite angles. If one angle is missing, use the 180° angle sum before trying anything more complicated.

Types by Sides

- **Equilateral:** All sides equal, all angles 60°
- **Isosceles:** Two sides equal, two angles equal
- **Scalene:** All sides different, all angles different

Types by Angles

- **Acute:** All angles < 90°
- **Right:** One angle = 90°
- **Obtuse:** One angle > 90°

Angle Sum

Sum of angles in any triangle = 180°

Properties

- **Equilateral triangle:** All sides equal, all angles 60°
- **Isosceles triangle:** Angles opposite equal sides are equal
- **Right triangle:** Hypotenuse is longest side

Quadrilaterals

Quadrilaterals are easiest to identify by their guaranteed properties. A square has all rectangle properties and all rhombus properties, but a general parallelogram does not necessarily have right angles. Be precise about what is always true.

Type	Properties	Angles
Square	All sides equal, all angles 90°, diagonals equal and perpendicular	90° each
Rectangle	Opposite sides equal, all angles 90°, diagonals equal	90° each
Rhombus	All sides equal, opposite angles equal, diagonals perpendicular	Opposite angles equal
Parallelogram	Opposite sides equal and parallel, opposite angles equal	Opposite angles equal
Trapezium	One pair of parallel sides	Varies
Kite	Two pairs of adjacent equal sides, diagonals perpendicular	Varies

Sum of angles in any quadrilateral = 360°

Regular Polygons

Regular polygons are predictable because every side and every angle is equal. The formula comes from splitting the polygon into triangles from one vertex: an n-sided polygon contains $n-2$ triangles.

A **regular polygon** has all sides equal and all angles equal.

Interior angle of regular polygon with n sides:

$$\text{Interior angle} = \frac{(n-2) \times 180^\circ}{n}$$

Examples:

- Triangle ($n = 3$): $\frac{1 \times 180^\circ}{3} = 60^\circ$
- Square ($n = 4$): $\frac{2 \times 180^\circ}{4} = 90^\circ$
- Pentagon ($n = 5$): $\frac{3 \times 180^\circ}{5} = 108^\circ$
- Hexagon ($n = 6$): $\frac{4 \times 180^\circ}{6} = 120^\circ$

Symmetry

Line Symmetry (Reflection Symmetry)

Line symmetry asks whether one half can mirror the other exactly. Imagine folding along the proposed line; if every point lands on a matching point, it is a line of symmetry.

A figure has **line symmetry** if it can be folded along a line so both halves match exactly.

- **Square:** 4 lines of symmetry
- **Rectangle:** 2 lines of symmetry
- **Equilateral triangle:** 3 lines of symmetry
- **Isosceles triangle:** 1 line of symmetry
- **Circle:** Infinite lines of symmetry

Rotational Symmetry

Rotational symmetry asks how many times the shape matches itself during one full turn. The full 360° turn counts only through the number of matching positions, not as a separate extra position.

A figure has **rotational symmetry** if it looks the same after rotating less than 360°.

Order of rotational symmetry: Number of times it matches when rotated 360°

- **Square:** Order 4 (matches every 90°)
- **Rectangle:** Order 2 (matches every 180°)
- **Equilateral triangle:** Order 3 (matches every 120°)
- **Circle:** Order infinity