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| **UNIT 6: Angles, polygons and parallel lines** |

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**SPECIFICATION REFERENCES**

A8 work with coordinates in all four quadrants

G1 use conventional terms and notation: points, lines, vertices, edges, planes, parallel lines, perpendicular lines, right angles, polygons, regular polygons and polygons with reflection and/or rotation symmetries; use the standard conventions for labelling and referring to the sides and angles of triangles; draw diagrams from written description

G3 apply the properties of angles at a point, angles at a point on a straight line, vertically opposite angles; understand and use alternate and corresponding angles on parallel lines; derive and use the sum of angles in a triangle (e.g. to deduce and use the angle sum in any polygon, and to derive properties of regular polygons)

G4 derive and apply the properties and definitions of special types of quadrilaterals, including square, rectangle, parallelogram, trapezium, kite and rhombus; and triangles and other plane figures using appropriate language

G7 identify and describe congruent and similar shapes

G6 apply angle facts, triangle congruence, similarity and properties of quadrilaterals to conjecture and derive results about angles and sides, including … the fact that the base angles of an isosceles triangle are equal, and use known results to obtain simple proofs

G11 solve geometrical problems on coordinate axes

G15 measure line segments and angles in geometric figures

**PRIOR KNOWLEDGE**

Students should be able to use a ruler and protractor.

Students should have an understanding of angles as a measure of turning.

Students should be able to name angles and distinguish between acute, obtuse, reflex and right angles.

Students should recognise reflection symmetry, be able to identify and draw lines of symmetry, and complete diagrams with given number of lines of symmetry.

Students should recognise rotation symmetry and be able to identify orders of rotational symmetry, and complete diagrams with given order of rotational symmetry.

**KEYWORDS**

Quadrilateral, angle, polygon, interior, exterior, proof, tessellation, rotational symmetry, parallel, corresponding, alternate, co-interior, vertices, edge, face, sides, triangle, perpendicular, isosceles, scalene, clockwise, anticlockwise, hexagons, heptagons, octagons, decagons, obtuse, acute, reflex, quadrilateral, triangle, regular, irregular, two-dimensional, three-dimensional, measure, line, angle, order, intersecting

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| **6a. Properties of shapes, parallel lines and angle facts**(G1, G3, G4, G6, G11, G15, A8) | **Teaching time**6-8 hours |

**OBJECTIVES**

By the end of the sub-unit, students should be able to:

* Estimate sizes of angles;
* Measure angles using a protractor;
* Use geometric language appropriately;
* Use letters to identify points, lines and angles;
* Use two-letter notation for a line and three-letter notation for an angle;
* Describe angles as turns and in degrees and understand clockwise and anticlockwise;
* Know that there are 360° in a full turn, 180° in a half turn and 90° in a quarter turn;
* Identify a line perpendicular to a given line on a diagram and use their properties;
* Identify parallel lines on a diagram and use their properties;
* Find missing angles using properties of corresponding and alternate angles;
* Understand and use the angle properties of parallel lines.
* Recall the properties and definitions of special types of quadrilaterals, including symmetry properties;
* List the properties of each special type of quadrilateral, or identify (name) a given shape;
* Draw sketches of shapes;
* Classify quadrilaterals by their geometric properties and name all quadrilaterals that have a specific property;
* Identify quadrilaterals from everyday usage;
* Given some information about a shape on coordinate axes, complete the shape; Understand and use the angle properties of quadrilaterals;
* Use the fact that angle sum of a quadrilateral is 360°;
* Recall and use properties of angles at a point, angles at a point on a straight line, right angles, and vertically opposite angles;
* Distinguish between scalene, equilateral, isosceles and right-angled triangles;
* Derive and use the sum of angles in a triangle;
* Find a missing angle in a triangle, using the angle sum of a triangle is 180°;
* Understand and use the angle properties of triangles, use the symmetry property of isosceles triangle to show that base angles are equal;
* Use the side/angle properties of isosceles and equilateral triangles;
* Understand and use the angle properties of intersecting lines;
* Understand a proof that the exterior angle of a triangle is equal to the sum of the interior angles at the other two vertices; Use geometrical language appropriately, give reasons for angle calculations and show step-by-step deduction when solving problems.

**POSSIBLE SUCCESS CRITERIA**

Name all quadrilaterals that have a specific property.

Use geometric reasoning to answer problems giving detailed reasons.

Find the size of missing angles at a point or at a point on a straight line.

Convince me that a parallelogram is a rhombus.

**OPPORTUNITIES FOR REASONING/PROBLEM SOLVING**

Multi-step “angle chasing” style problems that involve justifying how students have found a specific angle.

Geometrical problems involving algebra whereby equations can be formed and solved allow students the opportunity to make and use connections with different parts of mathematics.

What is the same, and what is different between families of polygons?

**COMMON MISCONCEPTIONS**

Pupils may believe, incorrectly, that perpendicular lines have to be horizontal/vertical or all triangles have rotational symmetry of order 3.

Some students will think that all trapezia are isosceles, or a square is only square if ‘horizontal’, or a ‘non-horizontal’ square is called a diamond.

Some students may think that the equal angles in an isosceles triangle are the ‘base angles’.

Incorrectly identifying the ‘base angles’ (i.e. the equal angles) of an isosceles triangle when not drawn horizontally.

**NOTES**

Emphasise that diagrams in examinations are seldom drawn accurately.

Make sure drawings are neat, labelled and accurate.

Give students lots of practice.

Angles should be accurate to within 2°.

Investigate Rangoli patterns.

Use tracing paper to assist with symmetry questions.

Ask students to find their own examples of symmetry in real life.

Emphasise that diagrams in examinations are seldom drawn accurately.

Make sure drawings are neat, labelled and accurate.

Students should have plenty of practice drawing examples to illustrate the properties and encourage them to check their drawings.

Emphasise the need to give geometric reasons when required.