UNIT 31 *Angles and Symmetry* Introduction to SIM

Learning objectives

This is the first of two units on *angle geometry*. Angle geometry underpins all the work on trigonometry in the set of units that follows. After completing this unit of STUDENT INSTRUCTIONAL MATERIAL (SIM) you should

- be able to measure and construct accurately, using a protractor, angles up to $360°$
- be able to identify the rotational symmetry and line symmetry of 2 dimensional shapes
- know and understand the angle facts for points, lines, triangles and quadrilaterals
- know and understand the angle facts for parallel and intersecting lines
- be able to determine the size of the interior and exterior angles for a regular polygon.

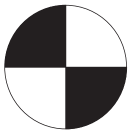
Key points and principles

- We use decimals to measure angles if accuracy is needed, e.g. $30.12°$, which means $30°$ and 0.12 of a degree, **not** $30°$ and $12'$ (minutes). If you use degrees/minutes, then be sure to use the correct notation, e.g. $45° \; 57'$.
- Proofs are important for many of the results in this unit.
- Students should be familiar with the names of common 2-dimensional and 3-dimensional shapes.
- Angles at a point sum to $360°$.
- Adjacent angles on a straight line sum to $180°$.
- A right angle is *exactly* $90°$.
- Angles in a triangle sum to $180°$.
- Angles in a quadrilateral sum to $360°$.
- Alternate angles are equal.
- Supplementary angles sum to $180°$.
- Corresponding angles are equal.
- Each angle at the centre of a regular n-sided polygon is $\frac{360°}{n}$.

UNIT 31 *Angles and Symmetry* Introduction to SIM

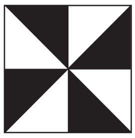
Facts to remember

- An object has *rotational symmetry* if it can be rotated about a point so that it fits on top of itself without completing a full turn. The shapes below have rotational symmetry.



In a complete turn this shape fits on top of itself two times.

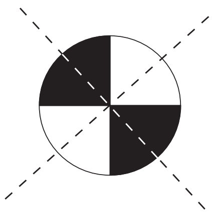
It has rotational symmetry of order 2.



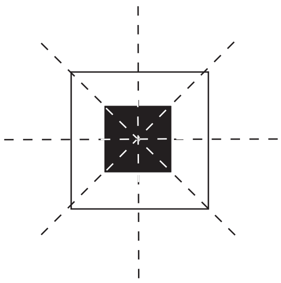
In a complete turn this shape fits on top of itself four times.

It has rotational symmetry of order 4.

- Shapes have *line symmetry* if a mirror could be placed so that one side is an exact reflection of the other. These imaginary 'mirror lines' are shown by dotted lines in the diagrams below.



This shape has 2 lines of symmetry.

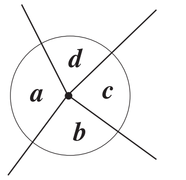


This shape has 4 lines of symmetry.

- *Angles at a point*

  The angles at a point will always add up to 360°.

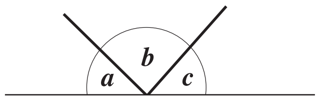
  It does not matter how many angles are formed at the point – their total will always be 360°.



$a + b + c + d = 360^\circ$

- *Angles on a line*

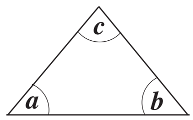
  Adjacent angles that form a straight line add up to 180°.



$a + b + c = 180^\circ$

- *Angles in a triangle*

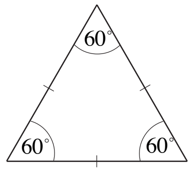
  The angles in any triangle add up to 180°.



$a + b + c = 180^\circ$

- *Angles in an equilateral triangle*

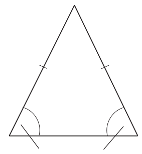
  In an equilateral triangle all the angles are 60° and all the sides are the same length.



UNIT 31 *Angles and Symmetry* Introduction to SIM

- *Angles in an isosceles triangle*

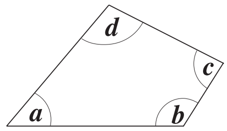
  In an isosceles triangle two sides are the same length and the two base angles are the same size.



equal angles

- *Angles in a quadrilateral*

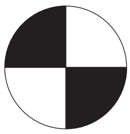
  The angles in any quadrilateral add up to 360°.



$a + b + c + d = 360°$

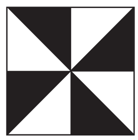
Glossary of Terms

- An object has *rotational symmetry* if it can be rotated about a point so that it fits on top of itself without completing a full turn. The shapes below have rotational symmetry.



In a complete turn this shape fits on top of itself two times.

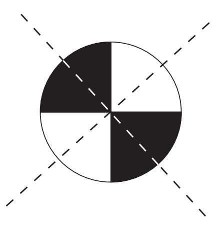
It has rotational symmetry of order 2.



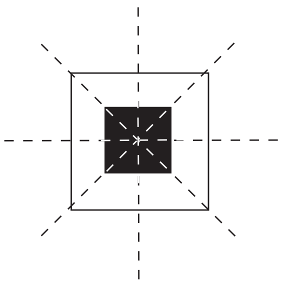
In a complete turn this shape fits on top of itself four times.

It has rotational symmetry of order 4.

- Shapes have *line symmetry* if a mirror could be placed so that one side is an exact reflection of the other. These imaginary 'mirror lines' are shown by dotted lines in the diagrams below.



This shape has 2 lines of symmetry.



This shape has 4 lines of symmetry.

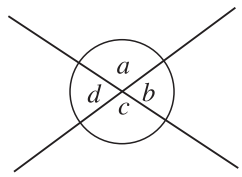
UNIT 31 *Angles and Symmetry* Introduction to SIM

- *Opposite angles*

  When any two lines intersect, two pairs of equal opposite angles are formed.

  The two angles marked a and c are a pair of *opposite* equal angles; $a = c$.

  The angles marked b and d are also a pair of opposite equal angles; $b = d$.



- *Corresponding angles*

  When a line intersects a pair of parallel lines, $a = b$.

  The angles a and b are called *corresponding* angles.

- *Alternate angles*

  The angles c and d are equal.