



YEAR 9

KNOWLEDGE ORGANISERS



BLOCK: DEVELOPING GEOMETRY

Angles in parallel lines and polygons

Area of trapezia and circles

Line symmetry and reflection

"MATHS OPENS DOORS"

YEAR 9 - DEVELOPING GEOMETRY...

Angles in parallel lines and polygons

What do I need to be able to do?

By the end of this unit you should be able to:

- Identify alternate angles
- Identify corresponding angles
- Identify co-interior angles
- Find the sum of interior angles in polygons
- Find the sum of exterior angles in polygons
- Find interior angles in regular polygons

Keywords

- Angle:** the amount of turn between two rays (lines) meeting at a common point. An angle is measured in degrees.
- Isosceles:** having one pair of equal sides — can apply to triangles or trapezia
- Parallel:** straight lines which are always the same distance apart and never touching
- Polygon:** a closed 2-d shape made up with three or more straight sides
- Regular (polygon):** a regular polygon has all sides equal and all angles equal
- Sum:** the result when two or more numbers are added together
- Transversal:** a straight line that cuts across two or more other lines

Basic angle rules and notation R

Acute Angles
 $0^\circ < \text{angle} < 90^\circ$

Right Angles
 90°

Obtuse
 $90^\circ < \text{angle} < 180^\circ$

Reflex
 $180^\circ < \text{angle} < 360^\circ$

Straight Line
 180°

The letter in the middle is the angle
 The arc represents the part of the angle

Angle Notation: three letters ABC
 This is the angle at B = 113°

Line Notation: two letters EC
 The line that joins E to C

Vertically opposite angles
 Equal
Angles around a point
 360°

Parallel lines

Still remember to look for angles on straight lines, around a point and vertically opposite!

Lines OF and BE are transversals (lines that bisect the parallel lines)

Corresponding angles often identified by their "F shape" in position

Alternate angles often identified by their "Z shape" in position

This notation identifies parallel lines

Alternate/ Corresponding angles

Because alternate angles are equal the highlighted angles are the same size

Because corresponding angles are equal the highlighted angles are the same size

Co-interior angles

Because co-interior angles have a sum of 180° the highlighted angle is 110°

Os angles on a line add up to 180° co-interior angles can also be calculated from applying alternate/ corresponding rules first

Triangles & Quadrilaterals R

Side, Angle, Angle

Side, Angle, Side

Side, Side, Side

Link to steps R

Properties of Quadrilaterals

Square
 All sides equal size
 All angles 90°
 Opposite sides are parallel

Rectangle
 All angles 90°
 Opposite sides are parallel

Rhombus
 All sides equal size
 Opposite angles are equal

Parallelogram
 Opposite sides are parallel
 Opposite angles are equal
 Co-interior angles

Trapezium
 One pair of parallel lines

Kite
 No parallel lines
 Equal lengths on top sides
 Equal lengths on bottom sides
 One pair of equal angles

Sum of exterior angles

Exterior angles all add up to 360°

Using exterior angles

Interior angle + Exterior angle = straight line = 180°
 Exterior angle = $180 - 165 = 15^\circ$

Number of sides = $360^\circ \div \text{exterior angle}$
 Number of sides = $360 \div 15 = 24$ sides

Sum of interior angles

Interior Angles
 The angles enclosed by the polygon

$(\text{number of sides} - 2) \times 180$

Sum of the interior angles = $(5 - 2) \times 180$

This shape can be made from three triangles
 Each triangle has 180°

Sum of the interior angles = $3 \times 180 = 540^\circ$

Remember this is all of the interior angles added together

Missing angles in regular polygons

Exterior angle = $360 \div 8 = 45^\circ$

Interior angle = $\frac{(8-2) \times 180}{8} = \frac{6 \times 180}{8} = 135^\circ$

Exterior angles in regular polygons = $360^\circ \div \text{number of sides}$

Interior angles in regular polygons = $\frac{(\text{number of sides} - 2) \times 180}{\text{number of sides}}$

YEAR 9 - DEVELOPING GEOMETRY...

Area of trapezia and Circles

What do I need to be able to do?

By the end of this unit you should be able to:

- Recall area of basic 2D shapes
- Find the area of a trapezium
- Find the area of a circle
- Find the area of compound shapes
- Find the perimeter of compound shapes

Keywords

Area: the amount of space inside the boundary of a 2-d shape.

Congruent: two shapes are congruent when they are identical, except that one may be a different way round to the other.

Formula: a rule or fact written in mathematical symbols

Infinity: an idea that something never ends

Perimeter: the distance around the boundary of a 2-d shape

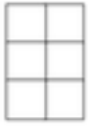
Perpendicular: at right angles (90°) to

PI (π): the ratio of a circle's circumference to its diameter. The numerical value of π is 3.14159265...

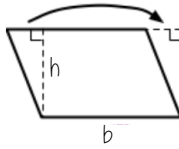
Sector: a "pie-slice" part of a circle, bounded by two radii and an arc.

Area - rectangles, triangles, parallelograms

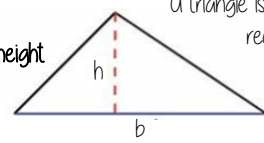
Rectangle
Base x Height



Parallelogram/ Rhombus
Base x Perpendicular height



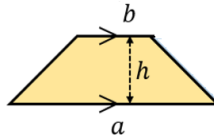
Triangle
 $\frac{1}{2} \times$ Base x Perpendicular height



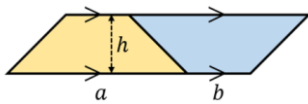
A triangle is half the size of the rectangle it would fit in

Area of a trapezium

Area of a trapezium
 $\frac{(a+b) \times h}{2}$



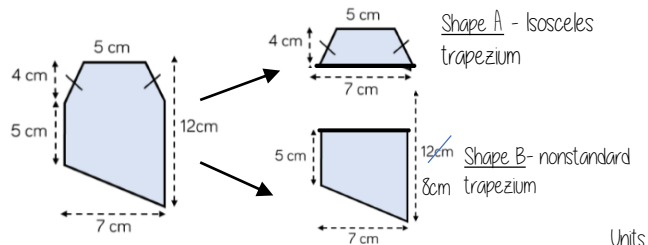
Why?



- Two congruent trapeziums make a parallelogram
- New length $(a+b) \times$ height
- Divide by 2 to find area of one

Compound shapes

To find the area compound shapes often need splitting into more manageable shapes first. Identify the shapes and missing sides etc. first.



Shape A + Shape B = total area

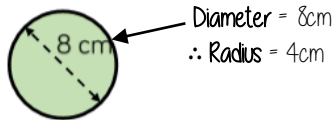
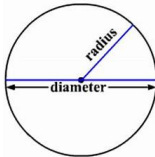
$$\frac{(5+7) \times 4}{2} + \frac{(5+8) \times 7}{2} = 24 + 45.5 = 69.5 \text{ cm}^2$$

Units

Area of a circle (Non-Calculator)

Read the question - leave in terms of π or if $\pi \approx 3$ (provides an estimate for answers)

Area of a circle
 $\pi \times \text{radius}^2$



Diameter = 8cm
 \therefore Radius = 4cm

$$\begin{aligned} \pi \times \text{radius}^2 \\ = \pi \times 4^2 \\ = \pi \times 16 \\ = 16\pi \text{ cm}^2 \end{aligned}$$

Find the area of one quarter of the circle



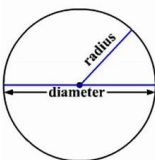
Circle Area = $16\pi \text{ cm}^2$
Quarter = $4\pi \text{ cm}^2$

Area of a circle (Calculator)



SHIFT $\times 10^x$

Area of a circle
 $\pi \times \text{radius}^2$



How to get π symbol on the calculator

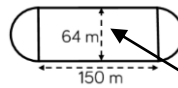
It is important to round your answer suitably - to significant figures or decimal places. This will give you a decimal solution that will go on forever!

Compound shapes including circles

Circumference
 $\pi \times \text{diameter}$

Compound shapes are not always area questions. For Perimeter you will need to use the circumference

Spotting diameters and radii



This dimension is also the diameter of the semi circles

$$\begin{aligned} \text{Arc lengths} &= \pi \times 64 \\ &= 64\pi \end{aligned}$$

Don't need to halve this because there are 2 ends which make the whole circle

Arc lengths + Straight lengths = total perimeter

$$\begin{aligned} &= 64\pi + 150 + 150 \\ &= (300 + 64\pi) \text{ m} \\ \text{OR} &= 501.1 \text{ m} \end{aligned}$$

Still remember to split up the compound shape into smaller more manageable individual shapes first