

YEAR 8 - DEVELOPING GEOMETRY...

Angles in parallel lines and polygons

@whisto_maths

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

Parallel Straight lines that never meet

Angle: The figure formed by two straight lines meeting (measured in degrees)

Transversal: A line that cuts across two or more other (normally parallel) lines

Isoceles: Two equal size lines and equal size angles (in a triangle or trapezium)

Polygon: A 2D shape made with straight lines

Sum: Addition (total of all the interior angles added together)

Regular polygon: All the sides have equal length, all the interior angles have equal size.

Basic angle rules and notation

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

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 = 115°
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 DF and BE are transversals (lines that cross 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°

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

Triangles & Quadrilaterals

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

Exterior Angles are the angle formed from the straight-line extension at the side of the shape

Sum of interior angles

Interior Angles
The angles enclosed by the polygon

(number of sides - 2) x 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 8 - DEVELOPING GEOMETRY...

Area of trapezia and Circles

@whisto_maths

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

Congruent: The same

Area: Space inside a 2D object

Perimeter: Length around the outside of a 2D object

Pi (π): The ratio of a circle's circumference to its diameter

Perpendicular: At an angle of 90° to a given surface

Formula: A mathematical relationship/ rule given in symbols. E.g. $b \times h$ = area of rectangle/ square

Infinity (∞): A number without a given ending (too great to count to the end of the number) — never ends

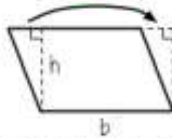
Sector: A part of the circle enclosed by two radii and an arc.

Area — rectangles, triangles, parallelograms

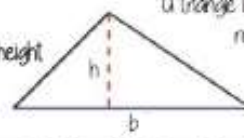
Rectangle
Base x Height



Parallelogram/ Rhombus
Base x Perpendicular height



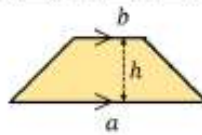
Triangle
 $\frac{1}{2}$ x Base x Perpendicular height



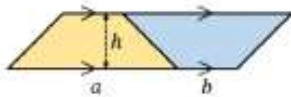
A triangle is half the size of the rectangle it would fit in

Area of a trapezium

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



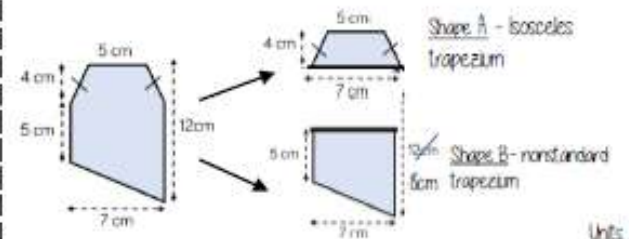
Why?



- 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.



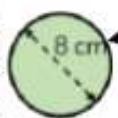
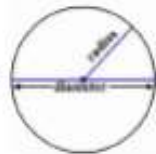
$$\text{Shape A} + \text{Shape B} = \text{total area}$$

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

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



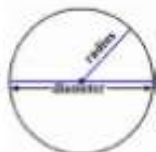
$$\begin{aligned} \text{Circle Area} &= 16\pi \text{ cm}^2 \\ \text{Quarter} &= 4\pi \text{ cm}^2 \end{aligned}$$

Area of a circle (Calculator)



SHIFT $\times 10^0$

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



How to get π symbol on the calculator

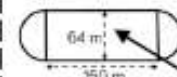
It is important to round your answer suitably — to significant figures or decimal places. This will give you a decimal solution that will go on forever!

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.

YEAR 8 - DEVELOPING GEOMETRY...

Line symmetry and reflection

@whisto_maths

What do I need to be able to do?

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

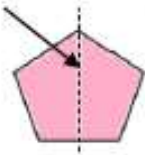
- Recognise line symmetry
- Reflect in a horizontal line
- Reflect in a vertical line
- Reflect in a diagonal line

Keywords

Mirror line: a line that passes through the center of a shape with a mirror image on either side of the line
Line of symmetry: same definition as the mirror line
Reflect: mapping of one object from one position to another of equal distance from a given line
Vertex: a point where two or more line segments meet
Perpendicular lines: that cross at 90°
Horizontal: a straight line from left to right (parallel to the x axis)
Vertical: a straight line from top to bottom (parallel to the y axis)

Lines of symmetry

Mirror line (line of reflection)



Shapes can have more than one line of symmetry...
 This regular polygon (a regular pentagon has 5 lines of symmetry)



Rhombus
Two lines of symmetry

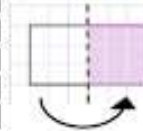
Parallelogram

No lines of symmetry

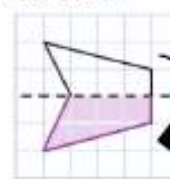


A circle has an infinite amount of lines of symmetry

Reflect horizontally/vertically (1)



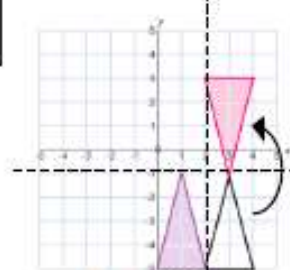
Reflection in a vertical line



Reflection in a horizontal line

Note: a reflection doubles the area of the original shape

Reflection on an axis grid

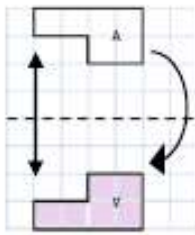


Reflection in the line $x=2$

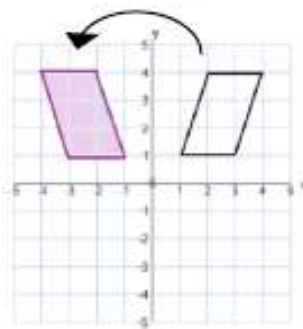
Reflection in the line $y=-2$

Reflect horizontally/vertically (2)

All points need to be the same distance away from the line of reflection



Reflection in the line y axis — this is also a reflection in the line $x=0$



Lines parallel to the x and y axes

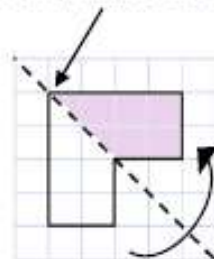
REMEMBER

Lines parallel to the x -axis are $y = \dots$

Lines parallel to the y -axis are $x = \dots$

Reflect Diagonally (1)

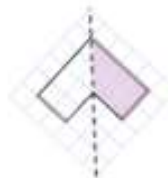
Points on the mirror line don't change position



Fold along the line of symmetry to check the direction of the reflection

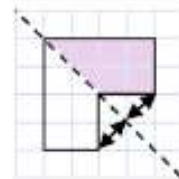
Turn your image

If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)



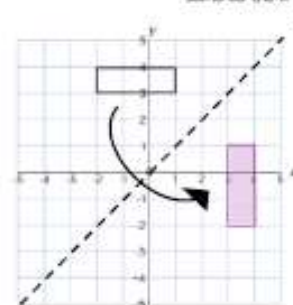
Drawing perpendicular lines

Perpendicular lines to and from the mirror line can help you to plot diagonal reflections

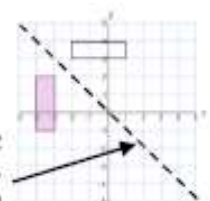


Reflect Diagonally (2)

This is the line $y = x$ (every y coordinate is the same as the x coordinate along this line)



This is the line $y = -x$
 The x and y coordinate have the same value but opposite sign



Turn your image

If you turn your image it becomes a vertical/ horizontal reflection (also good to check your answer this way)



YEAR 8 - REASONING WITH DATA...

The data handling cycle

@whisto_maths

What do I need to be able to do?

By the end of this unit you should be able to

- Set up a statistical enquiry
- Design and criticise questionnaires
- Draw and interpret multiple bar charts
- Draw and interpret line graphs
- Represent and interpret grouped quantitative data
- Find and interpret the range
- Compare distributions

Keywords

Hypothesis: an idea or question you want to test

Sampling: the group of things you want to use to check your hypothesis

Primary Data: data you collect yourself

Secondary Data: data you source from elsewhere e.g. the internet/ newspapers/ local statistics

Discrete Data: numerical data that can only take set values

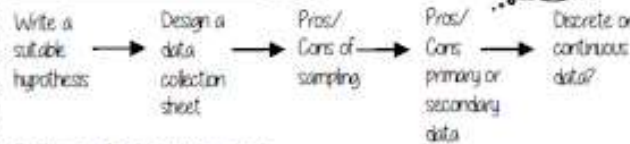
Continuous Data: numerical data that has an infinite number of values (often seen with height, distance, time)

Spread: the distance/ how spread out/ variation of data

Average: a measure of central tendency – or the typical value of all the data together

Proportion: numerical relationship that compares two things

Set up a statistical enquiry



Features of a data collection sheet

Grouped or ungrouped categories	Data Title	Tally	Frequency	Total number of that group observed

Design and criticise a questionnaire

The Question – be clear with the question – don't be too leading/ judgemental

e.g. How much pocket money do you get a week?

Responses – do you want closed or open responses? – do any options overlap? – have you an option for all responses?

Zero option → £0 £0.01 - £2 £2.01 - £4 more than £4 ← More option

NOTE: For responses about continuous data include inequalities $< x \leq$

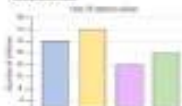
Pictograms, bar and line charts

Pictogram



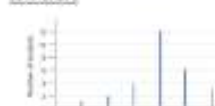
- Need to remember a key
- Visually able to identify mode

Bar Chart



- Gaps between the bars
- Clearly labelled axes
- Scale for the axes
- Title for the bar chart
- Discrete Data

Line Chart

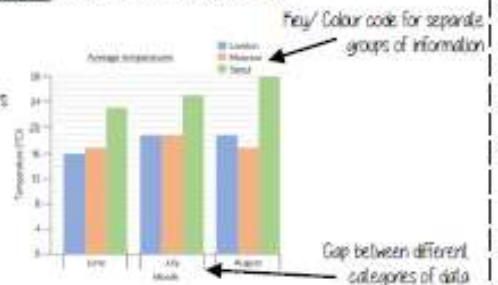


- Gaps between the lines
- Clearly labelled axes
- Scale for the axes
- Discrete Data

Multiple Bar chart

Compares multiple groups of data

- Clearly labelled axes
- Scale for axes
- Comparable data bars drawn next to each other



Draw and interpret Pie Charts

Remember a circle has 360°

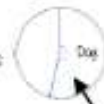
Species	Dog	Cat	Neither
Frequency	32	28	8

There were 60 people asked in this survey (Total frequency)

$\frac{32}{60}$ "32 out of 60 people had a dog"

This fraction of the 360 degrees represents dogs

$$\frac{32}{60} \times 360 = 192^\circ$$



Use a protractor to draw. This is 192°

Multiple method
As 60 goes into 360 – 6 times
Each frequency can be multiplied by 6 to find the degrees (proportion of 360)

Represents quantitative, discrete data

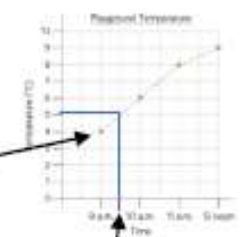
Draw and interpret line graphs

- Commonly used to show changing over time
- The points are the recorded information and the lines join the points

Line graphs do not need to start from 0

More than one piece of data can be plotted on the same graph to compare data

It is possible to make estimates from the line e.g. temperature at 9.30am is 5°C



Grouped quantitative data

Time Interval	Frequency
0 ≤ t < 5	4
5 ≤ t < 10	6
10 ≤ t < 15	5
15 ≤ t < 20	8
20 ≤ t < 25	10
25 ≤ t < 30	7

"More than or equal to 25 and less than 30 minutes"

This is a frequency diagram. There are no gaps between the bars.



The use of inequalities shows that this will be a frequency diagram

Grouping the data is useful if there is a large spread of data to begin with

Find and interpret the range

The range is a measure of spread

A smaller range means there is less variation in the results – it is more consistent data

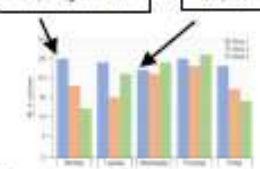
A range of 0 means all the data is the same value

Shop 1 has the smallest range – this indicates it has a more consistent flow of customers each week.

Difference between the biggest and smallest values

Shop 1 highest sale

Shop 1 lowest sale



Range of customers = 25 – 22 = 3 (Shop 1)

YEAR 8 - REASONING WITH DATA...

Measures of location

@whisto_maths

What do I need to be able to do?

By the end of this unit you should be able to

- Understand and use mean, median and mode
- Choose the most appropriate average
- Identify outliers
- Compare distributions using averages and range

Keywords

Spread: the distance/ how spread out/ variation of data

Average: a measure of central tendency – or the typical value of all the data together

Total: all the data added together

Frequency: the number of times the data values occur

Represent: something that shows the value of another

Outlier: a value that stands apart from the data set

Consistent: a set of data that is similar and doesn't change very much

Mean, Median, Mode

The Mean

A measure of average to find the central tendency... a typical value that represents the data

24, 8, 4, 11, 8

Find the sum of the data (add the values) 55

Divide the overall total by how many pieces of data you have $55 \div 5$

Mean = 11

The Median

The value in the center (in the middle) of the data

24, 8, 4, 11, 8

Put the data in order 4, 8, 8, 11, 24

Find the value in the middle 4, 8, 8, 11, 24

Median = 8

NOTE: If there is no single middle value find the mean of the two numbers left

The Mode (The modal value)

This is the number (OR the item) that occurs the most (it does not have to be numerical)

24, 8, 4, 11, 8

This can still be easier if the data is ordered first

4, 8, 8, 11, 24

Mode = 8

Choosing the appropriate average

The average should be a representative of the data set – so it should be compared to the set as a whole – to check if it is an appropriate average.

Here are the weekly wages of a small firm

£240	£240	£240	£240	£240
£260	£260	£300	£300	£700

Which average best represents the weekly wage?

The Mean = £307

The Median = £250

The Mode = £240

Put the data back into context

Mean/Median – too high (most of this company earn £240)

Mode is the best average that represents this wage

It is likely that the salaries above £240 are more senior staff members – their salary doesn't represent the average weekly wage of the majority of employees

Identify outliers

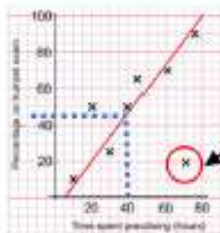
Outliers are values that stand well apart from the rest of the data

Outliers can have a big impact on range and mean. They have less impact on the median and the mode

Sometimes it is best to not use an outlier in calculations

Height in cm
152 150 142 158 151 155 149 156 160 151 144

Where an outlier is identified try to give it some context. This is likely to be a taller member of the group. Could it be an older student or a teacher?



Outliers can also be identified graphically e.g. on scatter graphs

Comparing distributions

Comparisons should include a statement of average and central tendency, as well as a statement about spread and consistency

Here are the number of runs scored last month by Lucy and James in cricket matches

Lucy: 45, 32, 37, 41, 48, 35
James: 60, 90, 41, 23, 14, 23

Lucy

Mean: 396 (ldp), Median: 38, Mode: no mode, Range: 16

James

Mean: 418 (ldp), Median: 32, Mode: 23, Range: 76

James has two extreme values that have a big impact on the range

James is less consistent than Lucy because his scores have a greater range. Lucy performed better on average because her scores have a similar mean and a higher median