

## What do I need to be able to do?

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

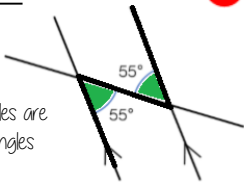
- Identify angles in parallel lines
- Solve angle problems
- Make conjectures with angles
- Make conjectures with shapes

## Keywords

- Parallel:** two straight lines that never meet with the same gradient  
**Perpendicular:** two straight lines that meet at  $90^\circ$   
**Transversal:** a line that crosses at least two other lines  
**Sum:** the result of adding two or more numbers  
**Conjecture:** a statement that might be true but is not proven  
**Equation:** a statement that says two things are equal  
**Polygon:** a 2D shape made from straight edges  
**Counterexample:** an example that disproves a statement

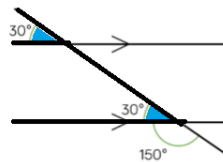
## Alternate angles

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



## Corresponding angles

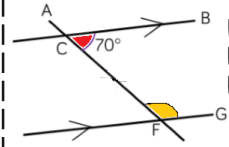
Because corresponding angles are equal the highlighted angles are the same size



## Co-interior angles

Because co-interior angles have a sum of  $180^\circ$  the highlighted angle is  $110^\circ$

As angles on a line add up to  $180^\circ$  co-interior angles can also be calculated from applying alternate/ corresponding rules first

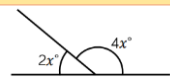


## Solving angle problems

### Angles on a straight line



Link angle facts to algebra



$$2x + 4x = 180^\circ$$

State the reason

The sum of angles on a straight line is  $180^\circ$

Solve

$$2x + 4x = 180^\circ$$

$$6x = 180^\circ$$

$$x = 30^\circ$$

**Vertically opposite angles**  
Equal

**Angles around a point**  
 $360^\circ$

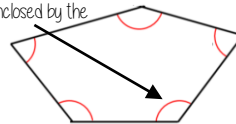


**Triangles**  
Sum of angles is  $180^\circ$

Isosceles have the same base angles

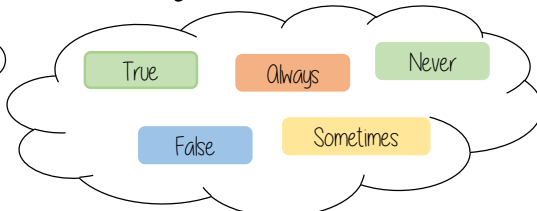
### Interior Angles

The angles enclosed by the polygon



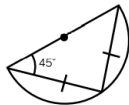
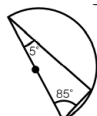
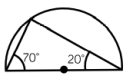
$$(\text{number of sides} - 2) \times 180$$

## Making conjectures with angles



### Proving a conjecture

A pattern is noticed for many cases



Apply the angle rules

The sum of angles in a triangle is  $180^\circ$

Test the theory

$$180 - 70 - 20 = 90$$

$$180 - 85 - 5 = 90$$

$$180 - 45 - 45 = 90$$

Make conjecture

The angle that meets the circumference in a semi circle is  $90^\circ$

### Disproving a conjecture

Only one counterexample is needed to disprove a conjecture

## Making conjectures with shapes

Keywords and facts to recall with shape

**Area:** the amount of space inside a shape  
**Perimeter:** the length around a shape  
**Regular Polygons:** All sides and angles are equal

### Quadrilateral Facts

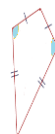
**Square**  
All sides equal size  
All angles  $90^\circ$   
Opposite sides are parallel

**Rectangle**  
All angles  $90^\circ$   
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



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

## What do I need to be able to do?

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

- Find single event probability
- Find relative frequency
- Find expected outcomes
- Find independent events
- Use diagrams to work out probabilities

## Keywords

**Probability:** the chance that something will happen

**Relative Frequency:** how often something happens divided by the outcomes

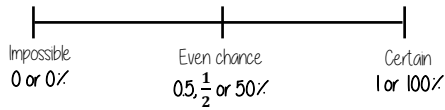
**Independent:** an event that is not effected by any other events.

**Chance:** the likelihood of a particular outcome.

**Event:** the outcome of a probability – a set of possible outcomes.

**Biased:** a built in error that makes all values wrong by a certain amount.

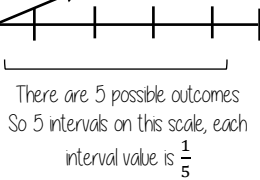
## The probability scale



The more likely an event the further up the probability it will be in comparison to another event (It will have a probability closer to 1)



There are 2 pink and 2 yellow balls, so they have the same probability



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## Single event probability

Probability is always a value between 0 and 1



The probability of getting a blue ball is  $\frac{1}{5}$   
∴ The probability of NOT getting a blue ball is  $\frac{4}{5}$

The sum of the probabilities is 1

The table shows the probability of selecting a type of chocolate

Dark	Milk	White
0.15	0.35	

$$P(\text{white chocolate}) = 1 - 0.15 - 0.35 = 0.5$$



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## Relative Frequency

$$\frac{\text{Frequency of event}}{\text{Total number of outcomes}}$$

Remember to calculate or identify the overall number of outcomes!

Colour	Frequency	Relative Frequency
Green	6	0.3
Yellow	12	0.6
Blue	2	0.1
	20	

Relative frequency can be used to find expected outcomes

e.g. Use the relative probability to find the expected outcome for green if there are 100 selections

$$\text{Relative frequency} \times \text{Number of times} \\ 0.3 \times 100 = 30$$

## Expected outcomes

Expected outcomes are estimations. It is a long term average rather than a prediction.

Dark	Milk	White
0.15	0.35	0.5

The sum of the probabilities is 1

An experiment is carried out 400 times  
Show that dark chocolate is expected to be selected 60 times

$$0.15 \times 400 = 60$$

## Independent events



The rolling of one dice has no impact on the rolling of the other. The individual probabilities should be calculated separately.

Probability of event 1  $\times$  Probability of event 2



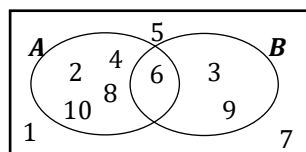
$$P(5) = \frac{1}{6} \quad P(R) = \frac{1}{4}$$

Find the probability of getting a 5 and a red

$$P(5 \text{ and } R) = \frac{1}{6} \times \frac{1}{4} = \frac{1}{24}$$

## Using diagrams

Recap Venn diagrams, Sample space diagrams and Two-way tables



	Car	Bus	Wak	Total
Boys	15	24	14	53
Girls	6	20	21	47
Total	21	44	35	100

The possible outcomes from tossing a coin

The possible outcomes from rolling a dice

	1	2	3	4	5	6
H	1H	2H	3H	4H	5H	6H
T	1T	2T	3T	4T	5T	6T

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## What do I need to be able to do?

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

- Solve speed, distance, time questions
- Use distance time graphs
- Solve density, mass, volume problems
- Solve flow problems
- Use flow graphs
- Interpret rates of change and their units

## Keywords

**Convert:** change

**Mass:** a measure of how much matter is in an object. Commonly measured by weight

**Origin:** the coordinate (0, 0)

**Volume:** the amount of 3D space a shape takes up

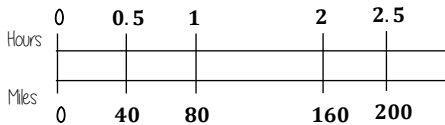
**Substitute:** putting numbers where letters are – replacing numbers into a formula

## Speed, Distance, Time

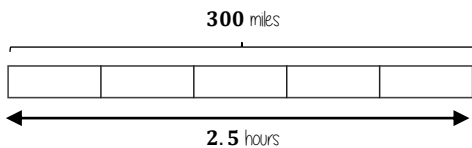
'per' for every  
e.g. 80 miles per hour (mph)  
Travel 80 miles every hour

$$\text{speed} = \frac{\text{distance}}{\text{time}}$$

You can use a double number line to help you calculate distance



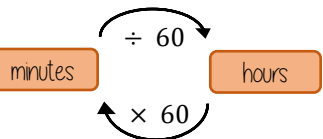
e.g. A boat travels at a constant speed for 2.5 hours  
It travels 300 miles.



Bar models can help to calculate mph

Each part is half an hour  
Each part is 60 miles

## Speed, Distance, Time



Before calculations – make sure you are working in the same units as the speed

Learn or learn how to rearrange the formula for speed, distance and time

$$\text{time} = \frac{\text{distance}}{\text{speed}}$$

$$\text{distance} = \text{speed} \times \text{time}$$

Substitute in the variables given

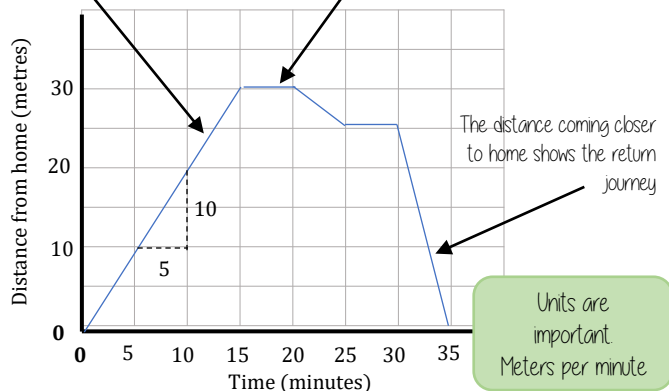
## Distance – Time graphs

The steeper a gradient the faster the speed

$$\frac{10}{5} = 2 \text{ metres per min}$$

Gradient = speed

Horizontal lines represent staying still

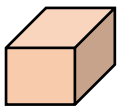


## Density, Mass, Volume

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

$$\text{volume} = \frac{\text{mass}}{\text{density}}$$

$$\text{mass} = \text{volume} \times \text{density}$$



$$\text{volume of prism} = \text{Area of cross section} \times \text{Depth}$$



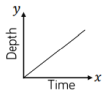
## Flow problems & graphs



This will fill at a constant rate, then as the space decreases it will speed up and the neck of the bottle fill at a faster constant speed



The cylinder will fill at a constant speed



Units are important  
Ensure any volume calculations are the same unit as the rate of flow

## Rates of change & units

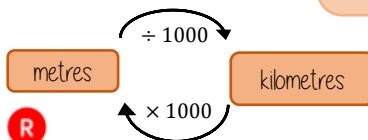
Common rates of change relationships

Revisit your conversions between units of length and capacity

Speed: miles per hour

Exchange rates: euros per pounds

Density: mass per volume



# Algebraic Representation

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## What do I need to be able to do?

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

- Draw quadratic graphs
- Interpret quadratic graphs
- Interpret other graphs including reciprocals
- Represent inequalities

## Keywords

**Quadratic:** a curved graph with the highest power being 2. Square power.

**Inequality:** makes a non equal comparison between two numbers

**Reciprocal:** a reciprocal is 1 divided by the number

**Cubic:** a curved graph with the highest power being 3. Cubic power.

**Origin:** the coordinate (0, 0)

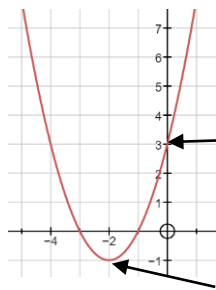
**Parabola:** a 'u' shaped curve that has mirror symmetry

## Quadratic Graphs

$$y = x^2 + 4x + 3$$

If  $x^2$  is the highest power in your equation then you have a quadratic graph

It will have a parabola shape



Substitute the  $x$  values into the equation of your line to find the  $y$  coordinates

$x$	-4	-3	-2	-1	0	1
$y$	3	0	-1	0	3	8

Coordinate pairs for plotting (-3, 0)

Plot all of the coordinate pairs and join the points with a curve (freehand)

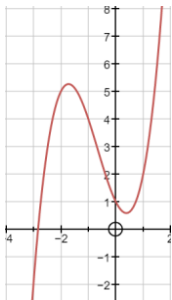
Quadratic graphs are always symmetrical with the turning point in the middle

## Interpret other graphs

### Cubic Graphs

$$y = x^3 + 2x^2 - 2x + 1$$

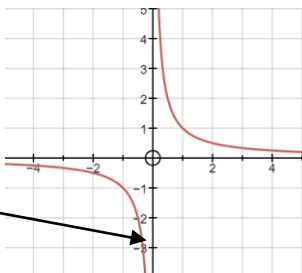
If  $x^3$  is the highest power in your equation then you have a cubic graph



Reciprocal graphs never touch the  $y$  axis  
This is because  $x$  cannot be 0  
This is an asymptote

### Reciprocal Graphs

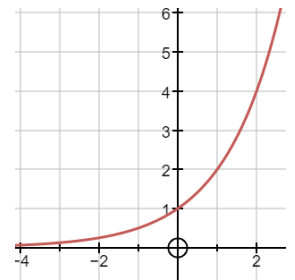
$$y = \frac{1}{x}$$



### Exponential Graphs

$$y = 2^x$$

Exponential graphs have a power of  $x$

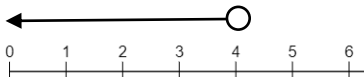


## Represent Inequalities

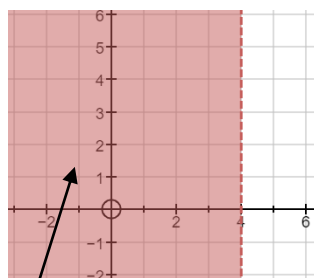
Multiple methods of representing inequalities

$$x < 4$$

All values are less than 4



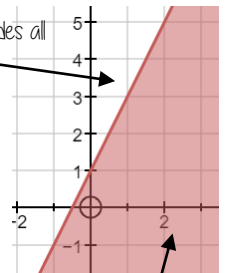
The shaded area indicates all possible values of  $x$



The dotted line shows that the inequality does not include these points

The solid line shows that the inequality includes all the points on this line

$$y \geq 2x + 1$$



The shaded area indicates all possible solutions to this inequality