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# Year 8

# Term 1

# Knowledge Organiser

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# Year 8 Knowledge Organiser NUMBER SKILLS

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

- Add and subtract numbers using the column method.
- Multiply numbers using a suitable written method.
- Divide numbers using the bus stop method.
- Calculate with directed numbers.
- Round values to a suitable degree of accuracy.

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## Key Words

**Add:** Finding the total of 2 or more number.
**Subtract:** Finding the difference between 2 numbers.
**Multiply:** Increasing a value by a given times table.
**Divide**: Share a given number using a specific times table.
**Directed numbers:** Positive and negative numbers.
**Round:** Changing the given number to a value that it is close to.

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## Column addition and subtraction

| | | | | | |
|---|---|---|---|---|---|
| | 4 | 5 | 8 | 6 | 4 |
| + | 2 | 3 | 4 | 9 | 7 |
| | 6 | 9 | 3 | 6 | 1 |
| | | 1 | 1 | 1 | |

**Addition**: Starting with the ones, add each column in turn. Regroup tens, hundreds etc as required.

| | | | | | |
|---|---|---|---|---|---|
| | 3 | 5 | ~~7~~ 6 | ~~14~~ 13 | ~~2~~ 1 |
| - | | 3 | 4 | 7 | 6 |
| | 3 | 2 | 2 | 6 | 6 |

You must remember to borrow if you can't subtract with the numbers you have.

**Subtraction**: Starting with the ones, subtract each column in turn. Exchange tens, hundreds etc as required.

| | | | |
|---|---|---|---|
| 1 | ~~3~~ | ~~2~~ | |
| | 1 | 5 | 4 |
| × | | 2 | 6 |
| | 9 | 2 | 4 |
| 3 | 0 | 8 | 0 |
| 4 | 0 | 0 | 4 |
| 1 | 1 | | |

**Multiplication:** Starting with the ones multiply separately each value in the top row. When moving to the tens, hundreds etc remember to add in the correct number of zeros to reflect its value. When you have finished multiplying add your totals together.

Remember to add in one zero when moving to the tens column to reflect its value.

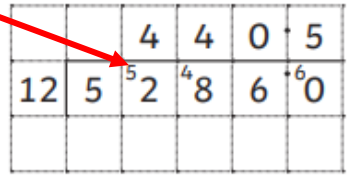
# Year 8 Knowledge Organiser NUMBER SKILLS

## Division

**Division**: Set up your question as shown. Starting from the left divide the number under the bus stop by the number on the outside. Any remainders must be carried to the next value along. Continue this process until you have got to the end of the number you are dividing.

You must carry any remainders here.

Start from the left.

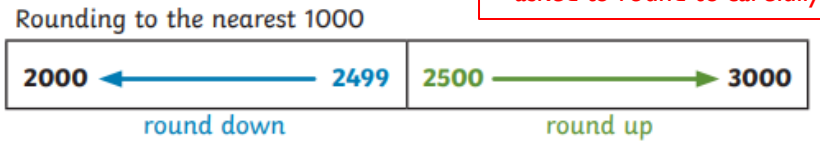



5 ÷ 12 = 0 r5
52 ÷ 12 = 4 r4
48 ÷ 12 = 4
6 ÷ 12 = 0 r6

## Rounding

To make a number simpler but keep its value close to what it was.
If the digit to the right of the rounding digit is less than 5, round down. If the digit to the right of the rounding digit is 5 or more, round up.
For example, 74 round to the nearest ten is 70, because 74 is closer to 70 than 80.

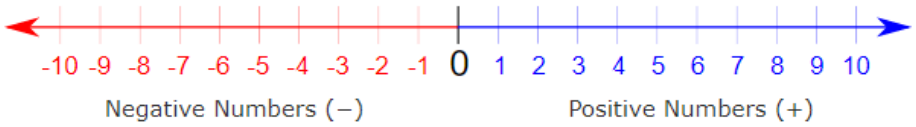
Always read what you are asked to round to carefully.




## Directed numbers

**Directed numbers:** This refers to both positive and negative numbers/integers.

- \- is used in front of an integer if it is negative
- \+ is sometimes used in front of an integer if it is positive but not always




To calculate with negative numbers we must follow the following rules:

| | Rule | Example |
|---|---|---|
| +(+)<br>−(−) | Two like signs become a **positive sign** | 3+(+2) = 3 + 2 = 5<br>6−(−3) = 6 + 3 = 9 |
| +(−)<br>−(+) | Two unlike signs become a **negative sign** | 7+(−2) = 7 − 2 = 5<br>8−(+2) = 8 − 2 = 6 |

There won't always be brackets in the question but it doesn't change the meaning.

Positive integers won't always have + in front of them.

# Year 8 Knowledge Organiser NUMBER PROPERTIES

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

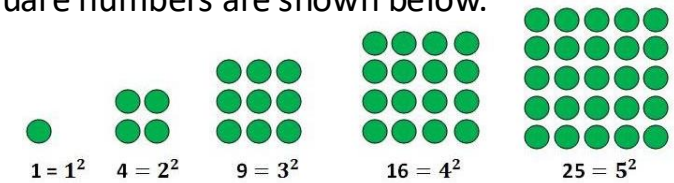
- Recognise and calculate square numbers and roots.
- Recognise and calculate cube numbers and roots.
- Use BIDMAS to complete calculations.
- Identify factors and multiples.
- Identify a prime number and complete a prime factor tree.

## Key Words

**Square:** A square number is the result of multiplying a number by itself.
**Cube:** A cube number is the result of multiplying a number by itself twice.
**Root:** A root is the reverse of a power.
**Prime number:** A prime is a number that has only two factors which are 1 and itself.
**Multiple:** A number in the given numbers times table.
**Factor:** A number that fits into another number exactly.
**Operation:** In maths these are the functions × ÷ + -.
**Indices:** These are the squares, cubes and powers.

## Squares, cubes and roots

**Square numbers**: This is when we multiply a number by itself, the first 5 square numbers are shown below.



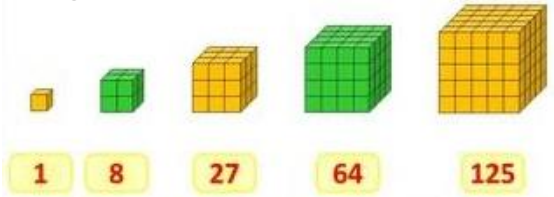

**Square roots**: This is the number that we started with to get the square numbers.

Remember the answer is 7 not 7x7.

$\sqrt{49}$ = 7 because 7x7 is 49

$\sqrt{100}$ = 10 because 10x10 is 10

**Cube numbers**: This is when we multiply a number by itself and then by itself again, the first 5 cube numbers are shown below.




## Index form

**Index number**: An index number is a number which is raised to a power. The power, also known as the index, tells you how many times you have to multiply the number by itself.

$2^5$ is the index notation.

$2^5 = 2 \times 2 \times 2 \times 2 \times 2 = 32$

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# Year 8 Knowledge Organiser NUMBER PROPERTIES

## Multiples and factors

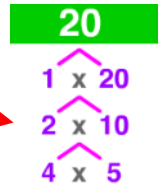
**Multiples**: The result of multiplying a number by and integer. It is the times table of a number.

Multiples of 4: 4, 8, 12, 16,20 …
Multiples of 5: 5, 10, 15, 20, 25….

Multiples are the list of times tables.

**Factors:** A number that divides exactly into another number without a remainder. It is often helpful to write them in pairs.

Write them in pairs first so you don't miss any!




Factors of 20 = 1, 2, 4, 5, 10, 20

## Prime numbers

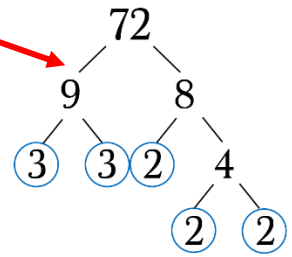
**Prime**: This is a number that has exactly 2 factors; 1 and itself.

2 is the only even prime. The first 10 prime numbers are:
2, 3, 5, 7, 11, 13, 17, 19, 23, 29

These are not the only prime numbers.

**Prime factorisation**: This is when we split a number into its prime factors using a factor tree. We circle the prime factors.

We need to find pairs of numbers that multiply to give the number above.




If a number is repeated we write it as a power.

$72 = 2^3 \times 3^2$

## BIDMAS – order of operations

**B** Brackets
**I** Indices
**D** Division
**M** Multiplication
**A** Addition
**S** Subtraction

If a calculation contains the circled calculations then you need to work from left to right.

This question can be split into two separate calculations which are then combined to get the answer.

$5 \times 4 - 8 \div 2$

$20 \quad - \quad 4 \quad = \mathbf{16}$

We need to deal with the powers inside the brackets first by calculating $2^2$.

$(2^2 + 6)^2 \times 4 - 8$

$(4 + 6)^2 \times 4 - 8$

$(10)^2 \times 4 - 8$

Once the bracket has been fully calculated we then look at the operations on the outside of the bracket.

$100 \times 4 - 8$

$400 - 8 = \mathbf{392}$

# Year 8 Knowledge Organiser PERIMETER & AREA

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

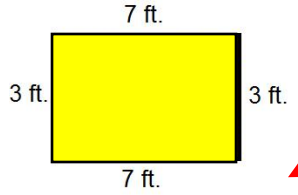
- Calculate the perimeter of a shape.
- Calculate the area of a square, rectangle, triangle, parallelogram and trapezium.
- Calculate the surface area of a cube.
- Calculate the surface area of a cuboid.
- Calculate the area of a triangular prism.

## Key Words

**Perimeter:** The total distance around the outside of a shape.
**Area:** The space inside a 2D shape.
**Length:** How long a shape is.
**Width:** How wide a shape is.
**Height:** How high a shape is.
**Base:** The bottom of a shape.
**Face:** The flat part of a 3D solid.
**Edge:** Where 2 faces meet.
**Parallel**: Two lines that never meet.

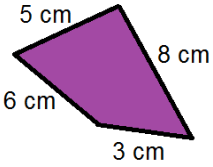
## Perimeter

**Perimeter:** This is the total distance around the outside of the shape.




7 + 3 + 7 + 3 = 20
The perimeter is 20 feet.

We must remember to include all of the sides.




5 + 8 + 3 + 6 = 22
The perimeter is 22 cm.

## Area – Rectangles and parallelograms

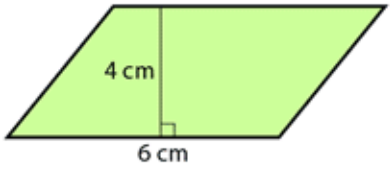
**Area:** This is the space that a 2D shape takes up.

**Squares and rectangles:**
The formula is the same for both shapes: **A = Length x Width**


A = 3 x 3
= 9cm²


A = 10 x 4
= 40cm²

**Parallelograms:**
The formula is similar to a rectangle but instead of width we use the height. **A = Length x Height**




A = 6 x 4
= 24cm²

Sometimes the length is referred to as the base.

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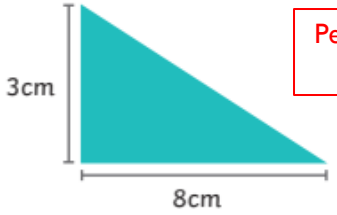
# Year 8 Knowledge Organiser PERIMETER & AREA

## Area - Triangles

To find the area of a triangle we use the following formula:

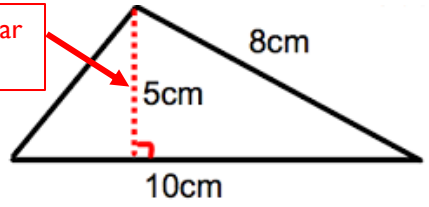
$$\textbf{Area} = \frac{\text{Base x perpendicular height}}{2}$$

The formula is very similar to a rectangle but we must divide by 2 because a triangle is half the size of a rectangle.




Area = $\frac{8 \times 3}{2}$

= 12cm²




Area = $\frac{10 \times 5}{2}$

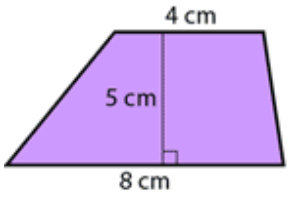
= 25cm²

## Area - Trapeziums

To find the area of a trapezium we use the following formula:

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

Where a and b are the parallel sides and h is the height.




Area= 4 + 8 = 12 — Add the parallel sides.

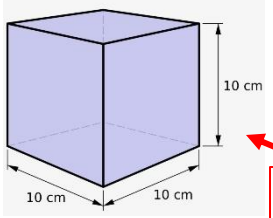
12 ÷ 2 = 6 — Divide the total by 2.

6 x 5 = 30cm² — Multiply by the height.

## Surface area

**Surface area**: This is the area of all of the faces of a 3D solid added together.

**Cubes**: Find the area of one of the faces and then multiply by 6. This is because all of the faces of a cube are the same size.

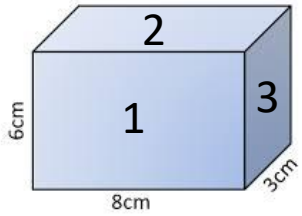



Area of 1 face = 10 x 10 = 100cm²

Total surface area = 100 x 6 = 600cm²

There are 6 faces with the same area.

**Cuboids:** They have 3 pairs of faces. We need to find the area of each of the faces we can see, add them together and then double.




Face 1 = 8 x 6 = 48cm²

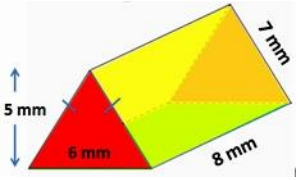
Face 2 = 8 x 3 = 24cm²

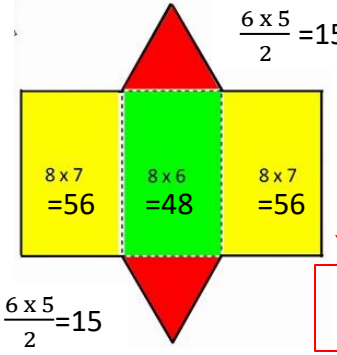
Face 3 = 3 x 6 = 18cm²

Total = 90cm²

Surface area = 2 x 90 = 180cm²

**Triangular prism:** They have a pair of triangular sides and 3 rectangular sides




Surface area

= 15 + 15 + 56 + 56 + 48

=190mm²

Find the area of each face and then add together.

# Year 8 Knowledge Organiser VOLUME

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

- Identify the number of faces, edges and vertices of a 3D solid.
- Explain what volume means.
- Calculate the volume of a cube or cuboid.
- Calculate the volume of a triangular prism.
- Calculate the volume of a cylinder.

## Key Words

**Volume:** The amount of space that an object occupies.
**Capacity:** The amount of space that a liquid occupies.
**Cuboid:** 3D shape with 6 square/rectangular faces.
**Prism:** A prism is a solid object with identical ends, flat faces
and the same cross section all along its length.
**Cross section**: A cross section is the shape made by cutting straight across an object.
**Vertices:** Angular points of shapes.
**Face:** A surface of a 3D shape.
**Edge:** A line which connects two faces on a 3D shape.

## 3D solids

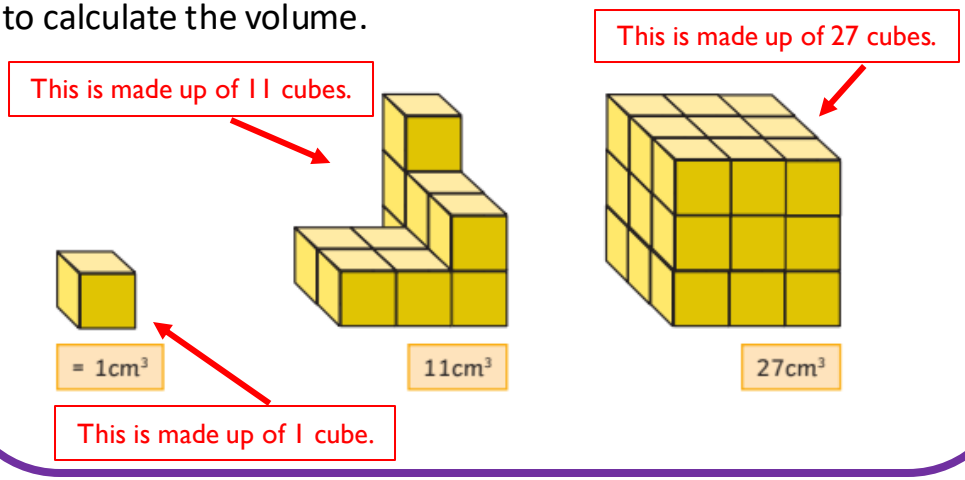
**3D solids**: They have 3 dimensions – length, width and depth. Here are the main 3D solids that you need to be familiar with.

| | | |
|---|---|---|
| **Cube**  6 square faces, 12 edges, 8 vertices | **Tetrahedron**  4 triangular faces, 6 edges, 4 vertices | **Sphere**  1 curved surface, 0 edges, 0 vertices |
| **Cuboid**  6 faces, 12 edges, 8 vertices | **Octahedron**  8 faces, 12 edges, 6 vertices | **Triangular prism**  5 faces, 9 edges, 6 vertices |
| **Square-based pyramid**  5 faces, 8 edges, 5 vertices | **Cone**  1 circular face, 1 curved surface, 1 curved edge, 1 apex | **Cylinder**  2 circular faces, 1 curved surface, 2 curved edges, 0 vertices |

You especially need to know the names of these solids.

## Volume – counting cubes

**Volume**: This is the amount of space that a 3D object occupies. Sometimes an object is made up of cubes, we can count them to calculate the volume.

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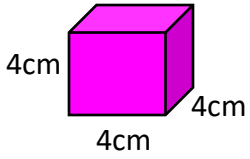
# Year 8 Knowledge Organiser VOLUME

## Cubes and cuboids

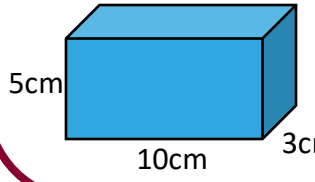
**Cubes and cuboids**: To calculate the volume of a cube and cuboid we use the following formula:

**Volume = Length x Width x Height**




Volume = 4 x 4 x 4 = 64cm³

The units are cubic for volume.



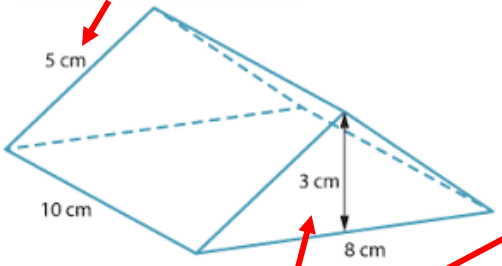

Volume = 10 x 3 x 5 = 150cm³

It doesn't matter which order you multiply in.

## Triangular prism

**Prisms**: To calculate the volume of a prism we calculate the area of the cross section (end face) and then multiply by the length.

We do not need this.




**Volume = Area of the cross section x Length**

Area of triangle $= \frac{3 \times 8}{2} = 12$

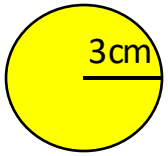
Volume = 12 x 10 = 120cm³

Area of the cross section.

Multiply the area of the cross section by 10 which is the length.

## Cylinders

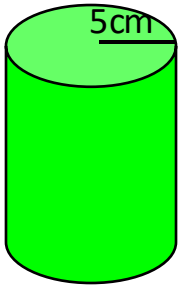
**Cylinders:** A cylinder is a prism so we use the same formula as for a triangular prism. The difference is that the cross section this time is a circle.




**Reminder:**

Area of a circle = $\pi r^2$ ( r is the radius)

Area = π x 3² = 9π = 28.3cm²




**Volume = Area of the cross section x Length**

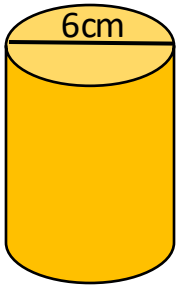
**= πr² x Length**

Sometimes we leave our answer in terms of π.

Volume = π x 5² x 8

= 200π

= 628.3cm³




We have the diameter so we must divide by 2 to get the radius.

Radius = 6 ÷ 2 = 3cm

Volume = π x 3² x 7

= 63π

= 197.9cm³

# Year 8 Knowledge Organiser DATA 1

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

- Understand how to represent the number 5 in a tally.
- Calculate the mode, median, range and mean of a list of data.
- Complete and read information from a pictogram.
- Draw and read a bar chart.

## Key Words

**Mean:** Add all of the numbers together and divide by how many there were.
**Range:** The biggest number subtract the smallest number.
**Mode:** The value there the most times.
**Median:** The middle number when they are in order.
**Frequency:** The number which tells us how many pieces of data there are.

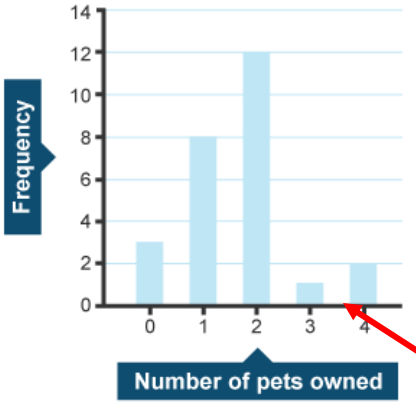
## Tally Charts

Tally marks are used to help count things. Each vertical line represents one unit. The fifth tally mark goes down across the first four to make it easier to count. The frequency column is completed after all the data has been collected.

You must represent 5 like this.

| Eye Colour | Tally | Frequency |
|---|---|---|
| brown | 𝍸 \| | 6 |
| blue | 𝍸 \|\|\| | 8 |
| green | \|\|\| | 3 |
| grey | \|\|\| | 4 |
| hazel | 𝍸 | 5 |

## Bar Charts




A bar chart has a horizontal axis and a vertical axis. The x axis is for the type of data and the y axis shows the frequency. The bars show the data value of each category. There must be a gap between each bar and the scale must increase in the same sized intervals and the axes must be labelled.

You must include gaps and labels.

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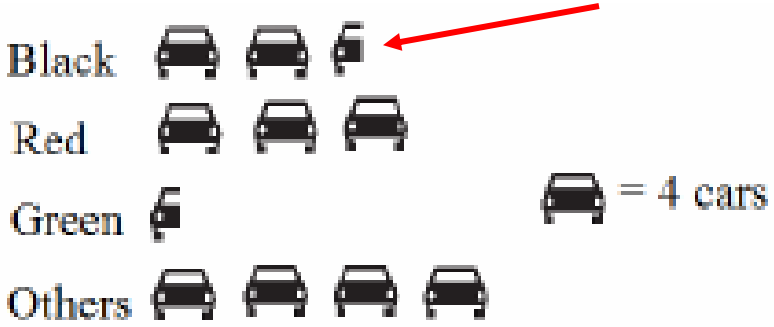
# Year 8 Knowledge Organiser DATA 1

## Pictograms

Pictograms are similar to bar charts, but the data is shown in pictures. A pictogram must have a key so that you know what a full image represents.
Looking at this diagram:
Black = 4 + 4 + 2 = 10 cars
Red = 4 + 4 + 4 = 12 cars
Green = 2 cars
Others = 4 + 4 + 4 + 4 = 16 cars

This represents 2 cars because it is half of the diagram in the key.




## Interpreting data

Information can be show in tables, charts or graphs. Interpreting data simply means understanding or working out what is being shown by a table, graph or chart and being able to answer questions about that information.

## Average and Range

Here is a list of numbers: 12, 15, 10, 8, 15

**Mean:** The mean is the average of a set of data.
Add all of the values together 12 + 15 + 10 + 8 + 15 = 60
Divide this by the number of values in your list 60 ÷ 5 = 12
The mean of this data is 12.

**Mode:** This is the value that appears the most times in the list. So if we look at the list above then the mode would be 15 because 15 appears twice in the list.

**Range:** This is the difference between the biggest and smallest numbers in the list.
15 – 8 = 7 so the range for the list above is 7.

**Median:** This is the middle number but only when the list is in order from smallest to biggest.

This is in the middle so it must be the median.

8 10 (12) 15 15

12 is in the middle of the list so the median must be 12.

# Year 8 Knowledge Organiser DATA 2

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

- Read and draw a pie chart using a protractor.
- Draw a stem and leaf diagram.
- Draw a scatter graph.
- Identify outliers on a scatter graph.
- Draw a line of best fit on a scatter graph.
- Estimate values from a scatter graph.

## Key Words

**Frequency:** The number which tells us how many pieces of data there are.
**Protractor:** This is a piece of equipment used to measure angles.
**Scatter graph:** This is a graph that shows the relationship between two variables.
**Correlation:** This describes if the data is increasing or decreasing.
**Line of best fit:** This is a line drawn on a scatter graph that follows the trend of the data.
**Outlier**: This is a data point that does not fit with the pattern of the rest of the data.

## Pie charts

Pie charts represent discrete data. A circle is divided into segments, where each segment represents a data category. The size of each segment matches its proportion of the total amount.

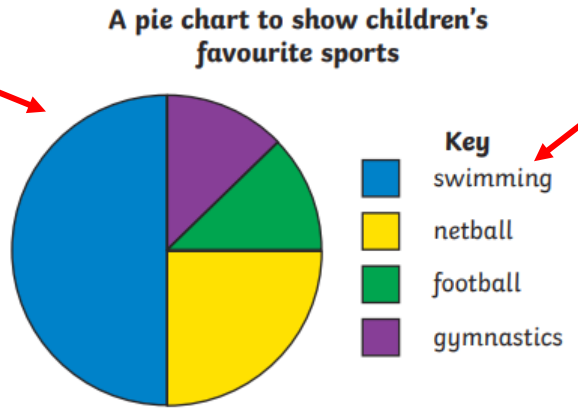
| Sport | Frequency | Angle |
|---|---|---|
| Swimming | 12 | 12 x 15 =180° |
| Netball | 6 | 6 x 15 =90° |
| Football | 3 | 3 x 15 =45° |
| Gymnastics | 3 | 3 x 15 =45° |

Total = 24

1. Find the total frequency.
2. Calculate one person by doing 360° ÷ frequency.
3. Multiply each frequency by this value to get the angle size for each section.

Each person: 360° ÷ 24 = 15°

You must use a protractor carefully to measure each section.




You must label each section or use a key.

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# Year 8 Knowledge Organiser DATA 2

## Stem and leaf diagrams

**Stem and leaf diagram**: This is a plot where each data value is split into a "leaf" (usually the last digit) and a "stem" (the other digits). The leaf part is only ever 1 digit, the stem can be several.

Here is a list of numbers and the stem and leaf diagram:

68, 75, 77, 79, 80, 82, 92, 96, 96, 97

| Stem | Leaf |
|---|---|
| 6 | 8 |
| 7 | 5 7 9 |
| 8 | 0 2 |
| 9 | 2 6 6 7 |

The 'leaves' must be from smallest to biggest in each row.

Key 6|8= 68

You must include a key to explain what the stem and leaf shows.

**Mode** = 96 because 96 appears twice.

**Median** = 81 because 81 is in the middle of 80 and 82.

**Range** = 97 – 68 = 29.

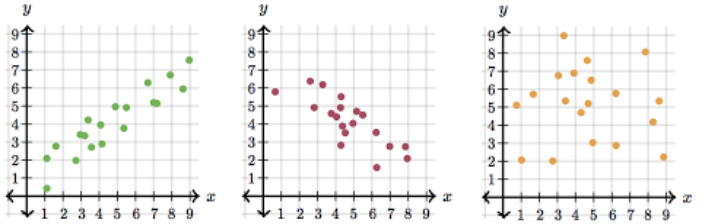
**Mean** = $\frac{68+75+77+79+80+82+92+96+96+97}{10}$ = 84.2

We calculate these in the same way we would from a list.

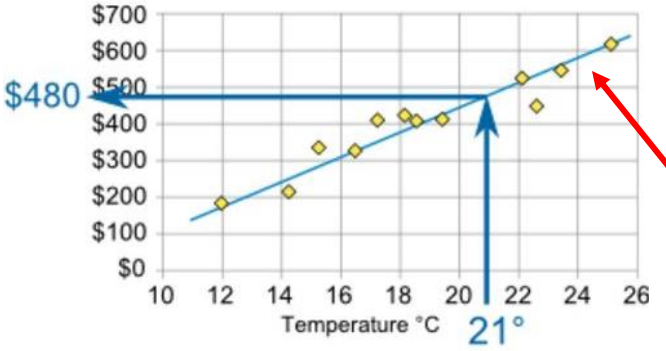
## Scatter graphs

**Scatter graph:** This is a graph of plotted points that show the relationship between two sets of data.

**Types of correlation:**



Positive Negative No correlation




The line of best fit needs to follow the trend of the data and have around half of the points either side. \it does not need to start from 0.

**Correlation:** Positive correlation.

**Description**: As the temperature increases so does the amount of money made.

**Estimate:** 21°C = $480.

# Year 8 Knowledge Organiser EXPRESSIONS & EQUATIONS

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

- Factorise an expression into a single bracket.
- Solve one step equations.
- Solve two step equations.
- Solve equations with brackets.
- Solve equations with unknowns on both sides.

## Key Words

**Inverse:** This is another word for opposite. We complete the opposite operation to the one shown in the question.
**Expression:** Shows a mathematical relationship whereby there is no solution.
**Equation:** A mathematical statement that shows that two expressions are equal.
**Factorise:** Putting an expression into brackets by finding the HCF.
**Solve:** To get the solution or answer to a question.

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## Factorising

**Factorising**: To factorise an expression we need to find the highest common factor of all of the terms in the expression.

**Expression**: 6x + 15
The HCF of 6x and 15 = 3

6x and 15 are both in the 3 times table.

6x ÷ 3 = 2x
15 ÷ 3 = 5

The terms from dividing by the HCF.

Answer: 3( 2x + 5)

HCF

**Expression**: $4x^2$ - 6x
The HCF of $4x^2$ and 6x = 2x

$4x^2$ and 6x are both in the 2 times table and both contain an x.

$4x^2 \div 2x = 2x$
6x ÷ 2x = 3

The terms from dividing by the HCF.

Answer: 2x( 2x - 3)

HCF

## Solving one step equations

To solve any equation we need to do the inverse of the operation that we see.

t + 4 = 10
-4 -4
t = 6

The inverse of add is subtract and vice versa.

c - 3 = 6
+3 +3
c = 9

6y = 30
÷6 ÷6
y = 5

The inverse of multiply is divide and vice versa.

$\frac{m}{7} = 4$
x7 x7
m = 28

# Year 8 Knowledge Organiser EXPRESSIONS & EQUATIONS

## Solving two step equations

To solve a two step equation we need to complete 2 inverse calculations in a specific order.

$6y + 2 = 32$
$-2 \quad -2$
$6y = 30$
$\div 6 \quad \div 6$
$y = 5$

Subtract first because the 2 is separate from the y.

Divide because it is the inverse of multiplying.

$\frac{w-5}{3} = 4$
$x3 \quad x3$
$w - 5 = 12$
$+5 \quad +5$
$w = 17$

Multiply first because the entire expression is divided by 3.

Add because it is the inverse of subtracting.

## Solving equations with brackets

We must expand the bracket first and then solve by doing the inverse of the operations.

$3(2x + 5) = 39$

Expand brackets first.

$6x + 15 = 39$
$-15 \quad -15$
$6x = 24$
$\div 6 \quad \div 6$
$x = 4$

The inverse of +15 is -15.

The inverse of x 6 is ÷6.

## Solving with unknowns on both sides

To solve an equation with unknowns on both sides we need to collect all of the same terms together, still by looking at the inverse.

$5x - 20 = 3x + 4$
$-3x \quad -3x$
$2x - 20 = 4$
$+20 \quad +20$
$2x = 24$
$\div 2 \quad \div 2$
$x = 12$

We subtract 3x from both sides because it is the smaller term of x.

Then solve like a normal two step equation.

$2x - 10 = 5x + 2$
$-2x \quad -2x$
$-10 = 3x + 2$
$-2 \quad -2$
$-12 = 3x$
$\div 3 \quad \div 3$
$-4 = x$

We subtract 2x from both sides because it is the smaller term of x.

Then solve like a normal two step equation.

**Top tip**: Always subtract/add the smaller number of terms to avoid getting a negative term at the end.

# Year 8 Knowledge Organiser EXPRESSIONS & FORMULAE

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

- Simplify expressions by collecting like terms.
- Write an expression from a given sentence.
- Expand a single bracket.
- Substitute into an expression or formula.

## Key Words

**Formula:** A rule written using symbols that describe a relationship between different quantities.
**Expression:** Shows a mathematical relationship whereby there is no solution.
**Equation:** A mathematical statement that shows that two expressions are equal.
**Term:** This is a number and a letter put together, for example 3x is a term.

## Expanding brackets

Each term inside the bracket it multiplied by this value.

$2(3a - 4)$
$= 6a - 8$
$= 6a - 8$

**Expanding**: To expand a bracket you multiply each term on the inside of the bracket by the term on the outside of the bracket. It is very important that you multiply all of the terms.

## Simplifying expressions

The operation symbol in front of the term tells you what to do.

Simplify:

$4a + 3b - a + 2b$
$= 3a + 5b$

**Collecting like terms:** You can only collect terms with the same letter together. The 'a' terms can only be collected with other 'a' terms. The operation symbol in front of the terms tells you what to do with it.

Expand and simplify:

$2(4a + 2b) - 2(a + 3b)$

$8a + 4b - 2a - 6b$
$6a - 2b$

**Expanding and collecting like terms:** You need to first expand the brackets separately and then collect the terms with the same letter like you would in the previous question.

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# Year 8 Knowledge Organiser EXPRESSIONS & FORMULAE

## Expressions

**Expression:** An expression is a group of numbers, letters and operation symbols. It is important that you read the words carefully and work out their meaning before deciding on the most suitable operation. It never has an equals sign.

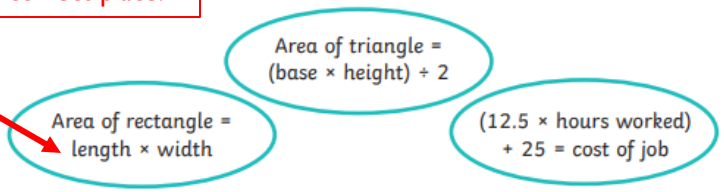
More than = add
Less than = subtract
Always check the wording carefully.

| | |
|---|---|
| Add 14 to $a$ | $a + 14$ |
| Subtract 20 from $b$ | $b - 20$ |
| Multiply $c$ by 4 | $4c$ |
| 12 more than $d$ | $d + 12$ |
| Multiply $e$ by 3 and subtract 5 | $3e - 5$ |
| Add 12 to $f$ and then multiply by 2 | $2(f + 12)$ |

## Formulae

**Formulae:** The word formula has two possible plural forms, formulae and formulas.
A formula is a special type of equation that shows the relationship between different variables. Formulae are often used in geometry topics to find area and volume.

Values would be substituted into the formula in the correct place.




## Equations

**Equation:** An equation is a number statement with an equals sign. Expressions on either side of the equals sign are of equal value. There is always a solution or answer to an equation.

To solve the equation you would then do the inverse of the calculation you can see. Inverse means the opposite.

$d + 12 = 30$
$d = 30 - 12$
$d = 18$

$a + 14 = 20$
$b - 20 = 15$
$4c = 28$
$d + 12 = 30$
$3e - 5 = 10$
$2(f + 12) = 44$

## Substitution

**Substitution:** This is where we replace the letter we see for the number that it is worth.

Remember that 3y means 3 multiplied by the value of y.

For example: If w = 6 and y = 5

a) $w + 5 = 6 + 5 = 11$

b) $3y - 2 = 3 \times 5 - 2 = 15 - 2 = 13$

c) $8w + 2y = 8 \times 6 + 2 \times 5 = 48 + 10 = 58$

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# Year 8

# Term 2

# Knowledge Organiser

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# Year 8 Knowledge Organiser REAL LIFE GRAPHS

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

- Plot a given coordinate.
- Read a given coordinate.
- Read information from a distance-time graph.
- Complete a distance-time graph.
- Read information from a conversion graph and use this to solve problems.
- Explain what a real life graph is showing.

## Key Words

**Conversion graph:** A graph which converts between two variables.

**Distance-time graph:** A graph that shows a journey and the relationship between the distance reached in a given time.

**Real - life graph:** This is a graph that represents a situation that we would see in real life.

**Intercept:** Where two graphs cross.

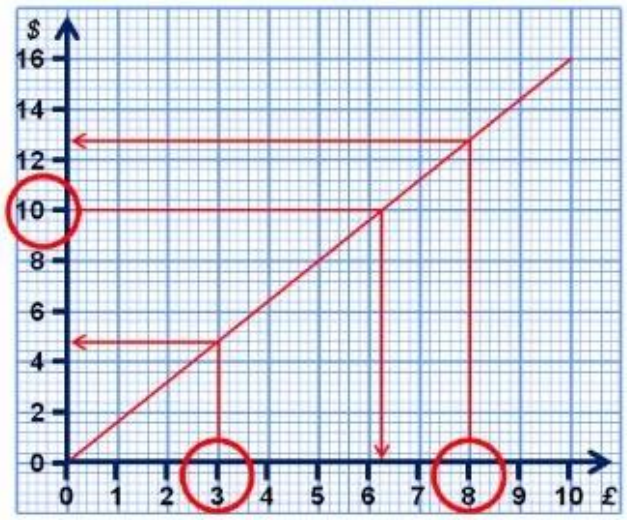
**y-intercept:** Where a graph crosses the y-axis.

**Gradient:** The rate of change of one variable with respect to another. This can be seen by the steepness.

**Stationary**: A person/vehicle is not moving.

## Conversion graphs

**Conversion graphs**: These are line graphs that allow use to convert from one unit to another. They can be used to convert the units for distance (miles to kilometres) or currency (£ to $).




**To read information:** Find the value you know on one axis, read up/across to the conversion line and read the equivalent value from the other axis.

Use the graph to convert £3 into dollars.

*£3 = $4.80*

We find £3 along the x axis, draw a line up to the graph and then draw a line across to the y axis to get the equivalent dollars.

Use the graph to convert £8 into dollars.

*£8 = $12.80*

Use the graph to convert $10 into pounds.

*$10 = £6.25*

We find $10 along the y axis, draw a line across to the graph and then draw a line down to the x axis to get the equivalent pounds.

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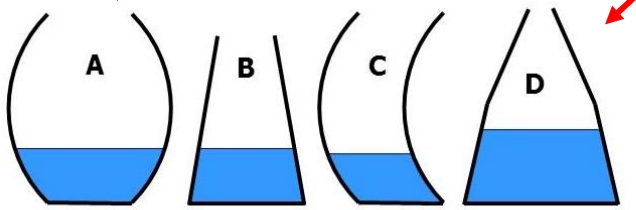
# Year 8 Knowledge Organiser REAL LIFE GRAPHS

## Real-life graphs

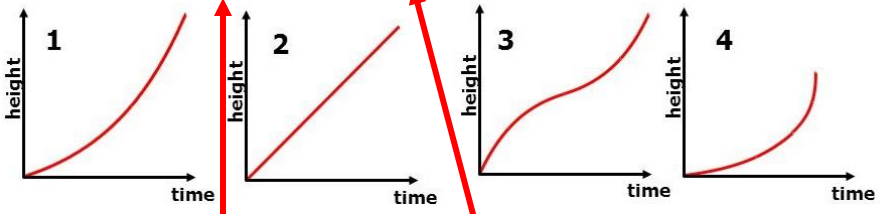
The cross section of 4 containers is shown below.
Water is poured into the empty containers at a constant rate and their graphs showing the height of the water is shown.

Container A = graph 3 because it starts narrow, gets wider and then narrows again.

Container D = graph 4 because it starts wider and then narrows quickly.




| | |
|---|---|
| A | 3 |
| B | 1 |
| C | 2 |
| D | 4 |



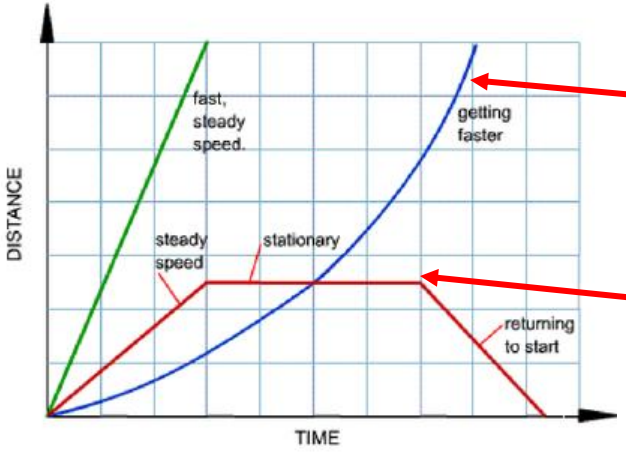

Container B = graph 1 because it starts wider and then narrows.

Container C = graph 2 because it is a constant size all the way up.

It is important to read the questions carefully to check what they are graphing. This question is measuring the depth.

## Distance-time graphs

**Distance-time graph:** This is a graph of a journey. You can calculate the distance in a given amount of time, the time taken to travel a given distance or the Speed = Distance ÷ Time.

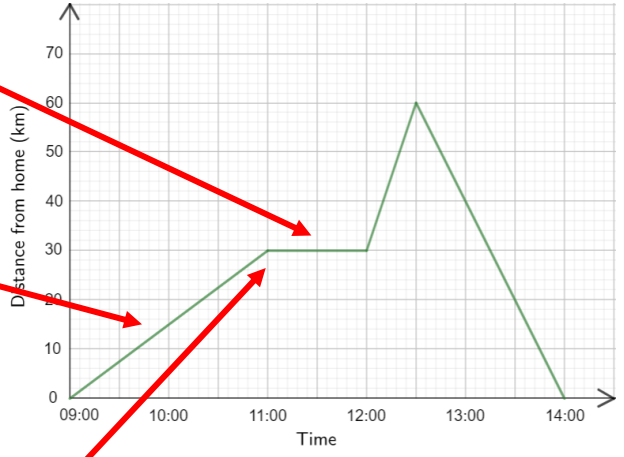



The steeper the line is the fast the speed.

Horizontal line = no movement.

Between 11:00 and 12:00 they were stationary.

The speed in the first 2 hours = 30 ÷ 2 = 15km/h




After 2 hours (11:00) the distance was 30km.

# Year 8 Knowledge Organiser DECIMALS

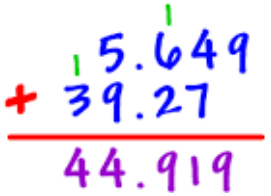
## What do I need to be able to do?

- Add and subtract decimals using the column method.
- Multiply decimals by whole numbers and decimals by decimals using a written method.
- Divide decimals using the bus stop method.
- Use rounding to estimate values to calculations.
- Order decimals from smallest to biggest.

## Key Words

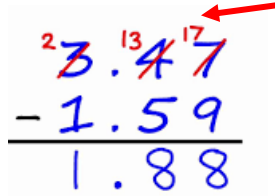
**Add:** Finding the total of 2 or more number.
**Subtract:** Finding the difference between 2 numbers.
**Multiply:** Increasing a value by a given times table.
**Divide**: Share a given number using a specific times table.
**Decimal:** A number that has digits that are smaller than one whole. It has a decimal point.
**Round:** Changing the given number to a value that it is close to.

## Column addition and subtraction




**Addition**: Starting with the digit on the right, add each column in turn. Regroup tenths, tens, hundreds etc as required.

You must remember to borrow if you can't subtract with the numbers you have.




**Subtraction**: Starting with the digit on the right, subtract each column in turn. Exchange tenths, tens, hundreds etc as required.

## Column multiplication

**Question:** 1.54 x 2.6

Now 154 x 26

| | | | |
|---|---|---|---|
| 1 | 3 | 2 | |
| | 1 | 5 | 4 |
| × | | 2 | 6 |
| | 9 | 2 | 4 |
| 3 | 0 | 8 | 0 |
| 4 | 0 | 0 | 4 |
| 1 | 1 | | |

We multiplied by 1000 to get rid of the decimal points because there are 3 numbers in total after the point in the question.

Multiply the whole numbers.

Divide your answer by 1000.

Answer = 4.004

**Multiplication:** Remove any decimal points from your values before multiplying. Then multiply as you would normally. When you have finished multiplying and have added to get your total remember to then divide by the multiple of 10 that you multiplied by to remove the decimal point at the beginning.

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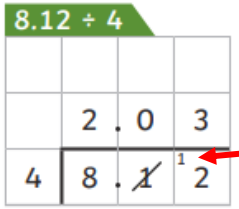
# Year 8 Knowledge Organiser DECIMALS

## Division

**Division**: Set up your question as shown. Starting from the left divide the number under the bus stop by the number on the outside. Any remainders must be carried to the next value along. Continue this process until you have got to the end of the number you are dividing.




You must carry any remainders here.

## Rounding decimals

To make a number simpler but keep its value close to what it was.

If the digit to the right of the rounding digit is less than 5, round down. If the digit to the right of the rounding digit is 5 or more, round up.

For example:

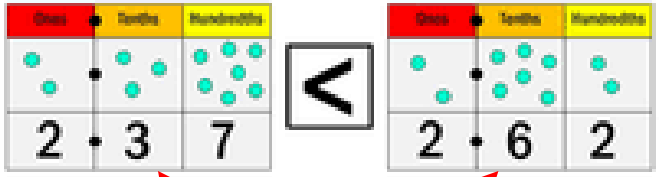
7.44 rounded to 1 decimal place is 7.4, because 7.44 is closer to 7.4 than 7.5.

0.38 rounded to 1 decimal place is 0.4 because 0.38 is closer to 0.4 than 0.3.

Always read what you are asked to round to carefully.

## Comparing and ordering decimals

**Comparing decimals**: It is important when comparing decimals to compare each digit which is in the same place value. For example, compare the tenths with each other because they are in the same place.




Compare the tenths – 3 is less than 6 so we know that 2,37 must be smaller than 2.62.

**Ordering decimals:** When ordering decimals it is important to ensure that all of the decimals have the same number of digits.

For example:

0.3, 0.43, 0.03, 0.043 would become 0.300, 0.430, 0.030, 0.043

It is then easy to order them: 0.03, 0.043, 0.3, 0.43

You must only use the additional zeros to help you order the decimals, they must be written as they were in the question as your answer.

# Year 8 Knowledge Organiser RATIO & PROPORTION

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

- Write a ratio in the correct form.
- Write a ratio as a fraction.
- Write a ratio in the form 1:n or n:1.
- Simplify a ratio.
- Share an amount in a given ratio.
- Work backwards when given links between the parts of a ratio.
- Scale a recipe up or down to calculate the quantity of ingredients needed.

## Key Words

**Ratio:** Relationship between two or more numbers.
**Part:** This is the numeric value '1' of, would be equivalent to.
**Simplify:** Divide all parts of a ratio by the same number.
**Equivalent:** Equal in value.
**Convert:** Change from one form to another.
**Scale:** The ratio of the length in a drawing to the length of the real thing.
**Proportion:** A name we give to a statement that two ratios are equal.
**Exchange rate:** The value of one currency for the purpose of conversion to another.

## Writing a ratio

**Ratio**: The is the relationship between two or more numbers and each number is separate by a colon.

The ratio of footballs to rugby balls: 1:4

The ratio of rugby balls to footballs: 4:1

Football is mentioned first so that is why the 1 comes before 4.

Rugby is mentioned first so that is why the 4 comes before 1.

**As fractions:** If we wanted to represent the ratio as fractions then:

**1 : 4**

$= \frac{1}{5} : \frac{4}{5}$

The denominator comes from adding the two parts of the ratio together.

## Simplifying a ratio

You must make sure that your ratio has been simplified fully by finding the highest common factor.

Simplify 12 : 20

÷ 4

= 3 : 5

This could have been done in two steps by dividing by 2 and then by 2 again.

Simplify 60 : 40 : 100

÷ 10

= 6 : 4 : 10

÷ 2

= 3 : 2 : 5

This could have been done in one step by dividing by 20.

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# Year 8 Knowledge Organiser RATIO & PROPORTION

## Writing ratios as 1:n or n:1

This means that the ratio needs to be simplified in a specific way. You may end up with fractions or decimals as part of your answer.

Write 2: 5 in the form 1 : n

2 : 5

÷ 2 ÷ 2

1 : 2.5

Write 2: 5 in the form n : 1

2 : 5

÷ 5 ÷5

0.4 : 1

You must end up with a 1 in the correct place - read the question carefully!

## Scaling recipes

When you are given a recipe you need to check carefully how many people it serves. There are lots of methods you can use, here is one idea.

Here is a cake recipe for 6 people.

÷ 3 ×4

| | 6 | 2 | 8 |
|---|---|---|---|
| eggs | 3 | 1 | 4 |
| flour | 300g | 100g | 400g |
| sugar | 150g | 50g | 200g |

3 eggs
300g flour
150g sugar

What would you need for 8 people?

## Sharing in a ratio

**Sharing in a ratio:** To share in a ratio we can use bar modelling to visualise the steps.

Share £45 in the ratio 2:7.

Add the parts of the ratio together.

2 + 7 = 9 parts

Divide the total by the number of parts.

45 ÷ 9 = 5

x

2 : 7

Multiply each part of the ratio by the value of one part,

= £10:£35

2 : 7

5 5
5 5
=10 5
5
5
5
5
=35

**Looking at connections:** When you are not given the total you need to use a slightly different method.

Joy and Martin share money in the ratio 2:5. Martin gets £18 more than Joy. How much do they each get?

2 : 5

5 -2 = 3 parts difference

Find how many parts difference there are and then divide.

18 ÷ 3 = 6

x

2: 5

6 6
6 6
6
6
6
6
=12 =30

= £12: £30

# Year 8 Knowledge Organiser COMPLEX ANGLES

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

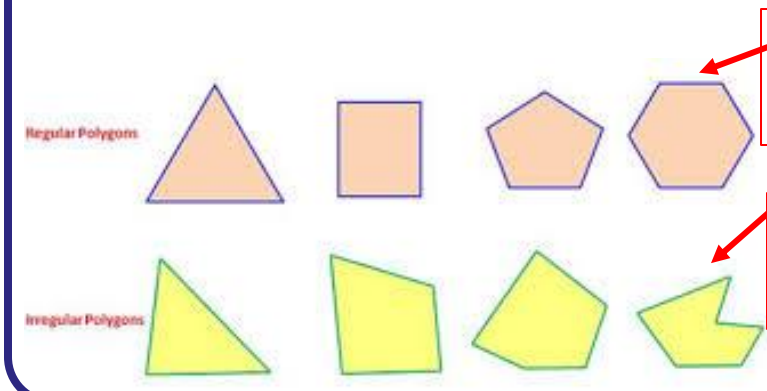
- Identify a pair of parallel lines.
- Calculate missing angles inside parallel lines.
- Calculate the interior angle of a regular polygon.
- Calculate the exterior angle of a regular polygon.
- Calculate the number of sides a polygon has when given the interior or exterior angle.

## Key Words

**Polygon:** A 2D shape.
**Regular Polygon:** A shape where all of the sides are equal length.
**Irregular Polygon:** A shape where all of the sides are not equal lengths.
**Parallel lines**: Two lines that never meet.
**Co-interior angles**: Two angles inside a pair of parallel lines that add up to 180°.
**Alternate angles:** Two angles that make a z shape are equal.
**Corresponding angles**: Two angles that make an F shape are equal.
**Interior angle**: An angle that is inside the polygon.
**Exterior angle**: An angle that is outside the polygon.

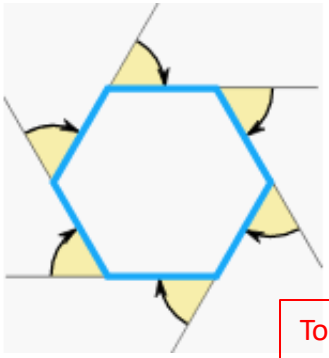
## Polygons

**Polygon:** This means any 2D shape. A regular polygon means that all of the sides and angles are equal. An irregular polygon means that all of the angles and sides are not equal.




## Exterior angles

**Exterior angles:** Exterior angles of a polygon add up to 360°. If the polygon is regular then we know that all of these angles will be the same size.



To calculate the size of one exterior angle here we would do the following calculation:

360° ÷ 6 = 60°.

Total of the exterior angles.

Number of sides.

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# Year 8 Knowledge Organiser COMPLEX ANGLES

## Number of sides of a polygon

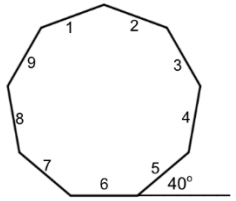
To calculate the number of sides a polygon has we can use the size of one exterior angle.

If the exterior angle of a polygon was 40° then we would do:

360° ÷ 40° = 9 so the polygon has 9 sides and is a nonagon.

Total of the exterior angles.

One exterior angle.

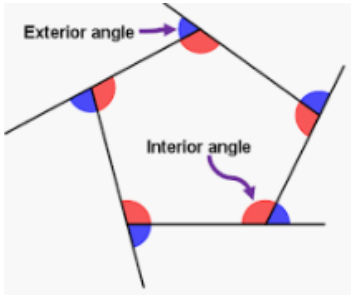



## Interior angles

**Interior angles:** Interior angles are the angles inside the polygon. If it is regular then all of the interior angles are equal.

$$\frac{(n-2) \times 180°}{n}$$

where n is the number of sides.




A pentagon has 5 sides so to calculate one interior angle:

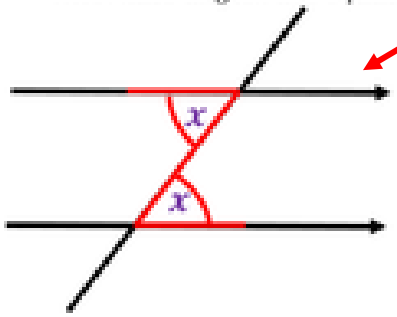
No. of sides.

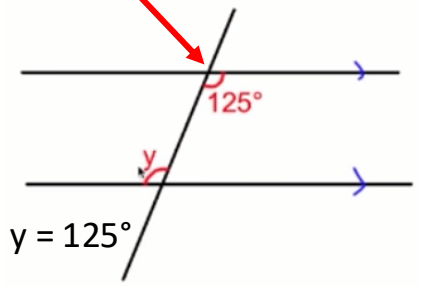
$$\frac{(5-2) \times 180°}{5} = 108°$$

## Angles in parallel lines

*Alternate angles are equal*

The z can go in any direction.



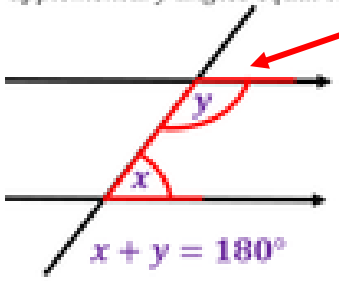




y = 125°

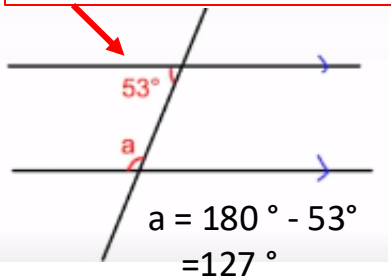
Z

*Supplementary angles equal to 180°*

The C can go in any direction.



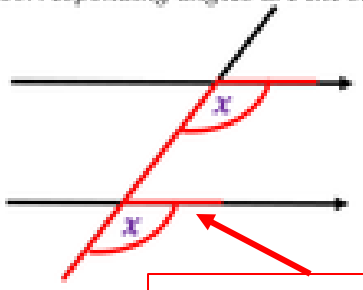

$x + y = 180°$

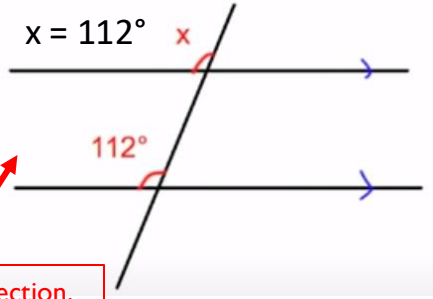



a = 180 ° - 53°
=127 °

C

*Corresponding angles are the same.*




The F can go in any direction.

F

# Year 8 Knowledge Organiser ANGLES

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

- Identify different types of angles.
- Calculate missing angles on a straight line.
- Calculate missing angles around a point.
- Calculate missing angles in a triangle.
- Calculate missing angles in a quadrilateral.
- Use a protractor to draw and measure angles.

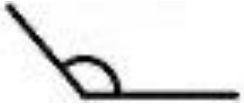
## Key Words

**Quadrilateral:** A 4 sided shape.
**Polygon:** A 2D shape.
**Regular Polygon:** A shape where all of the sides are equal length.
**Irregular Polygon:** A shape where all of the sides are not equal lengths.
**Isosceles:** A triangle that has 2 equal sides and 2 equal angles.
**Scalene:** A triangle that has all different side lengths and angles.
**Equilateral:** A triangle where all of the sides and angles are equal.
**Vertically opposite:** The 2 angles that are facing each other are equal where 2 lines cross.

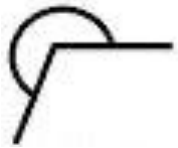
## Types of angles

There are 4 main types of angles that you need to know:

**Acute angles** – Any angle that is less than 90°.



**Obtuse angles** – Any angle that is more than 90° but less than 180°.

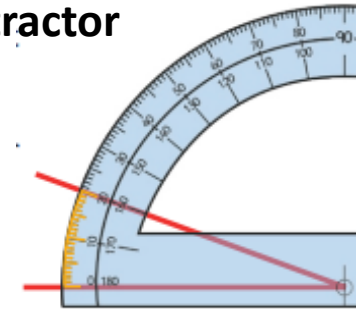


**Reflex angles** – Any angle that is more than 180° but less than 360°.

**Right angle** – Any angle that is exactly 90°.

## Using a protractor

**Measuring:**
Place the cross or circle at the point of the angle you are measuring.
Read from the zero on the outer scale of your protractor.
Make sure you check the degree lines carefully to get an accurate answer.



The centre of the protractor need to be on the point of the angle.

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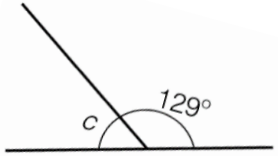
# Year 8 Knowledge Organiser ANGLES

## Angles on a straight line

Angles on a straight line add up to 180°.

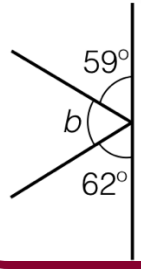
We always subtract from 180° in this case.




To calculate c:

180° - 129° = 51°

Make sure that you use an appropriate method to subtract..




To calculate b:

62° + 59° = 121°

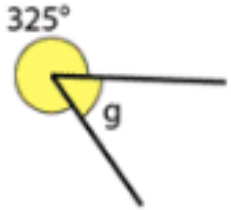
Add the angles we know together first then subtract from 180°.

180° - 121° = 59°

## Angles around a point

Angles around a point or in a circle add up to 360°.

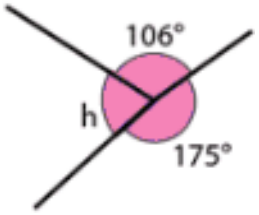
We always subtract from 360° in this case.




To calculate g:

360° - 325° = 35°

Add the angles we know together first then subtract from 360°.




To calculate h:

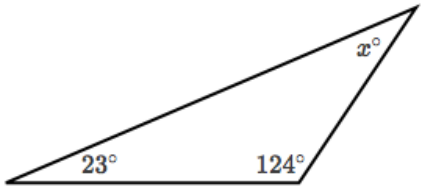
175° + 106° = 281°

360° - 281° = 79°

## Angles in shapes

Angles in a triangle add up to 180°.

Add the angles we know together first then subtract from 180°.

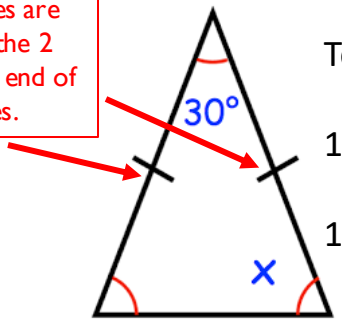



To calculate x:

23° + 124° = 147°

180° - 147° = 33°

This means that these 2 sides are equal and the 2 angles at the end of the sides.




To calculate x:

Subtract from 180°.

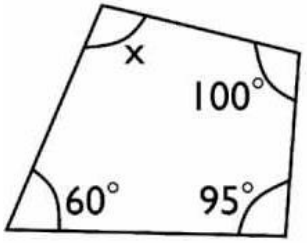
180° - 30° = 150°

Divide by 2 to calculate 1 angle.

150° ÷ 2 = 75°

Angles in a quadrilateral add up to 360°.

Add the angles we know together first then subtract from 360°.




To calculate x:

60° + 100° + 95° = 255°

360° - 255° = 105°

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# Year 8

# Term 3

# Knowledge Organiser

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# Year 8 Knowledge Organiser FRACTIONS

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

- Add and subtract fractions with different denominators.
- Multiply and divide fractions.
- Simplify a fraction and identify equivalent fractions.
- Calculate a fraction of an amount.
- Convert between fractions, percentages and decimals.

## Key Words

**Fraction:** A fraction is made up of a numerator (top) and a denominator (bottom).
**Integer:** Whole number.
**Simplify:** Divide the numerator and denominator by a common times table.
**Ascending Order:** Place in order, smallest to largest.
**Descending Order:** Place in order, largest to smallest.
**Equivalent**: Of equal value.
**Mixed number**: A whole number with a fraction.
**Improper fraction**: A fraction where the numerator is bigger than the denominator.

## Adding and subtracting fractions

To add and subtract fractions you must make the denominator the same.

$$\frac{1}{2} + \frac{2}{3}$$

Cross multiply to get your new denominators. Pink multiplied by pink, blue by blue.

Multiply the 2 denominators to get a common denominator.

$$= \frac{1}{2} + \frac{2}{3}$$

$$= \frac{3}{6} + \frac{4}{6} = \frac{7}{6} = 1\frac{1}{6}$$

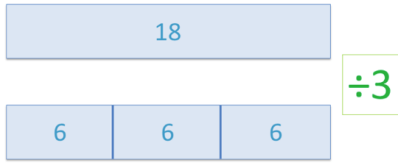
Add the numerators together then convert into a mixed number.

The method for subtracting fractions is exactly the same, we just subtract our two fractions at the last stage instead of adding them.

## Fractions of amounts

We need to divide by the denominator to calculate one part and then multiply by the numerator to work out x parts.

Calculate $\frac{2}{3}$ of 18.




$18 \div 3 = 6$ this is equal to $\frac{1}{3}$

$2 \times 6 = 12$ this is equal to $\frac{2}{3}$

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# Year 8 Knowledge Organiser FRACTIONS

## Simplifying fractions

$\frac{9}{12}$

Factors of 9: 1, 3, 9

Factors of 12: 1, 2, 3, 4, 6, 12

$\frac{9}{12} = \frac{3}{4}$ (÷3)

**Simplifying:** You need to identify factors of the numerator and denominator. Once the factors have been identified you need to find the highest number that appears in both lists, this is the number you will divide your fraction by. Divide the numerator and denominator by this divisor separately to get your answer.

## Multiplying and dividing fractions

When multiplying and dividing fractions the denominator does not have to be the same.

$\frac{1}{2} \times \frac{2}{3} = \frac{1}{2} \times \frac{2}{3} = \frac{2}{6}$

Multiply the numerators together and then multiply the denominators.

Change the whole number to a fraction and then multiply.

$\frac{2}{5} \times 3 = \frac{2}{5} \times \frac{3}{1} = \frac{2}{5} \times \frac{3}{1} = \frac{6}{5} = 1\frac{1}{5}$

To divide fractions we use KFC, keep flip change.

Keep the same

$\frac{3}{9} \div \frac{1}{2} = \frac{3}{9} \times \frac{2}{1} = \frac{6}{9}$

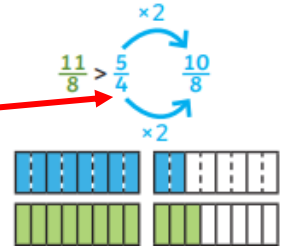
Change from ÷ to x

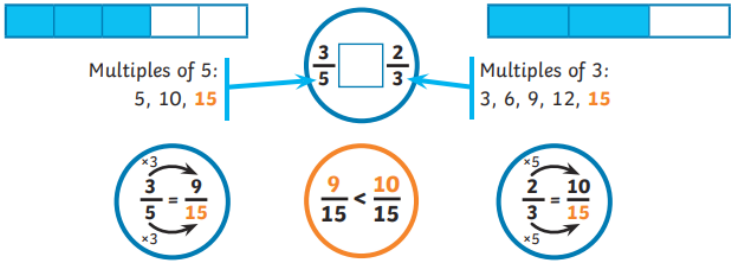
Flip over

## Comparing and ordering fractions

**Comparing fractions**: To compare two fractions you need to make the denominators the same.

The second fraction can be changed into eighths by multiplying by 2.

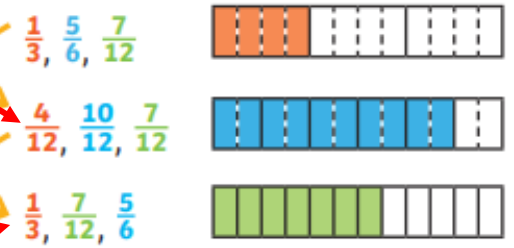



**Ordering fractions**: To compare a list of fractions you need to make the denominators the same. Below all of the denominators have been turned into 12 because 3,6 and 12 are all factors of 12.

Making the denominators the same is important. Here we multiplied the red fraction by 4 and the blue by 2.

We then order from smallest to biggest writing them as the original fractions.



# Year 8 Knowledge Organiser MIXED NUMBERS

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

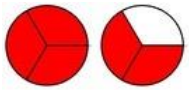
- Convert between mixed numbers and improper fractions.
- Add mixed numbers with different denominators.
- Subtract mixed numbers with different denominators.
- Multiply mixed numbers.
- Divide mixed numbers.
- Simplify mixed numbers.

## Key Words

**Fraction:** A fraction is made up of a numerator (top) and a denominator (bottom).
**Integer:** Whole number.
**Numerator**: The top number of a fraction.
**Denominator:** The bottom number of a fraction.
**Simplify:** Divide the numerator and denominator by a common times table.
**Equivalent**: Of equal value.
**Mixed number**: A whole number with a fraction.
**Improper fraction**: A fraction where the numerator is bigger than the denominator.

## Mixed numbers and improper fractions

**Mixed numbers**: This is when you have a whole number and a fraction. When calculating with mixed numbers we need to be able to change them into improper fractions first.



$$1\frac{2}{3} = \frac{1 \times 3+2}{3} = \frac{5}{3}$$

The denominator does not change.

Multiply the whole number by the denominator and add the numerator of the fraction.

**Improper fractions**: This is when the numerator is bigger than the denominator. It can be changed into a mixed number.

The denominator does not change. → $\frac{13}{5}$

$13 \div 5 = 2$ remainder 3

There are 2 fives in 13 so the whole number is 2.

$= 2\frac{3}{5}$.

The remainder is 3 so there are 3 fifths left.

## Simplifying mixed numbers

**Simplifying:** We need to check that the fraction or mixed number is in the smallest numbers possible.

20 and 24 are both in the 4 times table so we must divide both by 4 to simplify.

$$5\frac{20}{24} = 5\frac{5}{6}$$

Change to a mixed number then divide 2 and 4 by 2 to simplify it.

$$\frac{18}{4} = 4\frac{2}{4} = 4\frac{1}{2}$$

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# Year 8 Knowledge Organiser MIXED NUMBERS

## Multiplying mixed numbers

**Multiplying:** To multiply mixed numbers we must change them into improper fractions first.

Change the mixed numbers to improper fractions.

$$1\frac{2}{3} \div 2\frac{1}{5}$$

Multiply as normal.

$$= \frac{5}{3} \times \frac{11}{5}$$

Change back into a mixed number and check your fraction is fully simplified.

$$= \frac{55}{15} = 3\frac{10}{15} = 3\frac{2}{3}$$

## Dividing mixed numbers

**Dividing:** To divide mixed numbers we must change them into improper fractions first. We then use KFC to calculate the answer.

Change the mixed numbers to improper fractions.

$$2\frac{1}{4} \div 1\frac{2}{3}$$

Change from ÷ to x

Keep the same

$$= \frac{9}{4} \div \frac{5}{3}$$

Flip over

$$= \frac{9}{4} \times \frac{3}{5}$$

$$= \frac{27}{20} = 1\frac{7}{20}$$

Change back into a mixed number and check your fraction is fully simplified.

## Adding and subtracting mixed numbers

**Adding mixed numbers**: We need to change them into improper fractions and then make the denominators the same.

Change the mixed numbers to improper fractions.

$$1\frac{1}{2} + 2\frac{1}{3}$$

Multiply the 2 denominators to get a common denominator.

$$= \frac{3}{2} + \frac{7}{3}$$

Add the numerators together then convert into a mixed number.

$$= \frac{9}{6} + \frac{14}{6} = \frac{23}{6} = 3\frac{5}{6}$$

**Subtracting mixed numbers** The method for subtracting fractions is exactly the same, we just subtract our two fractions at the last stage instead of adding them.

Change the mixed numbers to improper fractions.

$$4\frac{1}{2} - 2\frac{1}{3}$$

Multiply the 2 denominators to get a common denominator.

$$= \frac{9}{2} - \frac{7}{3}$$

Subtract the numerators then convert into a mixed number.

$$= \frac{27}{6} + \frac{14}{6} = \frac{13}{6} = 2\frac{1}{6}$$

# Year 8 Knowledge Organiser LINEAR GRAPHS

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

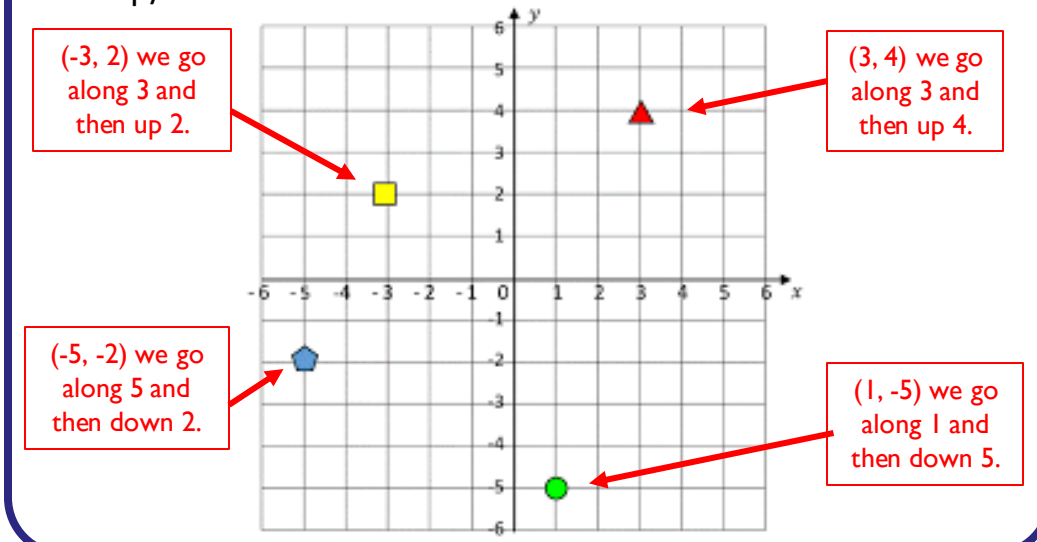
- Plot a given coordinate.
- Read a given coordinate.
- Calculate the midpoint of two coordinates.
- Generate y values for a linear graph.
- Draw a linear graph by calculating y values.
- Recognise x= and y= graphs and explain them.

## Key Words

**Coordinate:** These are values written in pairs where the x value comes first and is the movement across and the y value comes second and is the movement up or down.
**Midpoint:** The centre point between 2 coordinates.
**Intercept:** Where two graphs cross.
**Gradient:** This describes the steepness of the line.
**y-intercept:** Where the graph crosses the y-axis.
**Linear:** A linear graph is a straight line.
**Parallel**: Where 2 lines never meet. They have the same gradient.
**Substitute:** When a letter is replaced by a number.

## Reading and plotting coordinates

When reading or plotting coordinates the x value comes first and the y value comes second. Remember 'along the corridor and up/down the stairs.'




## Calculating the midpoint

**Midpoint:** The midpoint is the middle coordinate between two coordinates.

Calculate the midpoint of: (3, 5) and (9, 11)

(3, 5)
+ (9, 11)
=(12,16)

Add the x values together then add the y values together.

(12,16) ÷ 2 = (6,8)

Divide both the x and y values by 2 to find the middle point.

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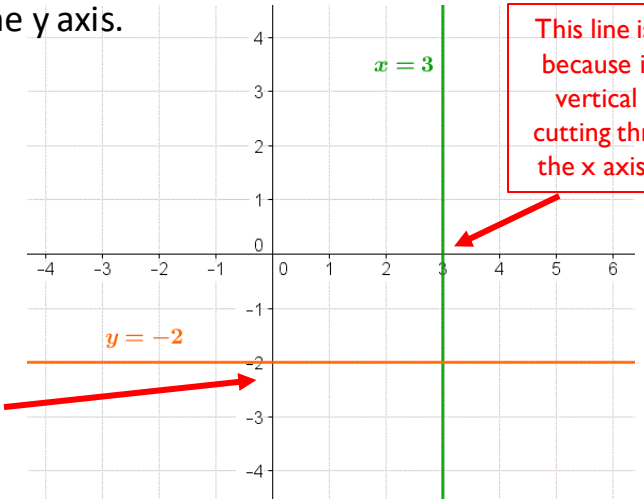
# Year 8 Knowledge Organiser LINEAR GRAPHS

## x = and y = linear graphs

Graphs in the form x =? are vertical lines that cut through the x axis.

Graphs in the form y =? are horizontal lines that cut through the y axis.




This line is x=3 because it is a vertical line cutting through the x axis at 3,

This line is y=-2 because it is a horizontal line cutting through the y axis at -2.

## Substitution

**Substitution**: This is where you replace a number with a letter.

For example if a = 5 and b = 2:

| | |
|---|---|
| a + b = | 5 + 2 = 7 |
| a – b = | 5 – 2 = 3 |
| 3a = | 3 × 5 = 15 |
| ab = | 5 × 2 = 10 |
| $a^2$ = | $5^2$ = 25 |

Remember a letter and a number or a letter and a letter next to each other means we need to multiply.

## Linear graphs

Linear graphs are straight line graphs. We substitute the x value into the equation to get the y value. Once we have both we can then plot the coordinates and draw the graph.

Draw the graph of y = 2x – 1.

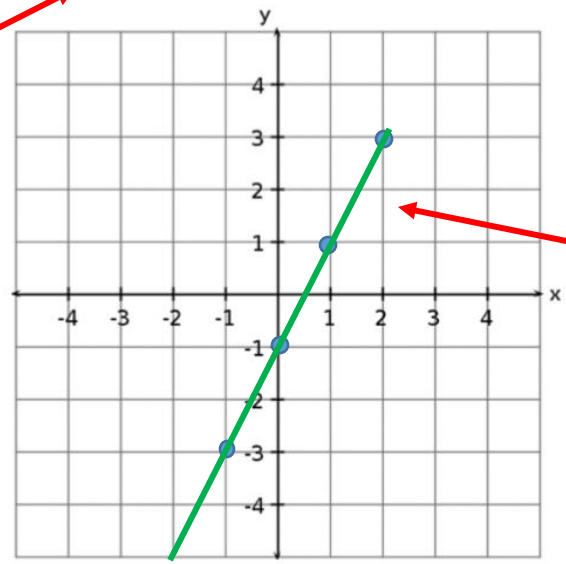
To do this we multiply the x value by 2 and then subtract 1 to get the y value.

y = 2x – 1

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| Y | -5 | -3 | -1 | 1 | 3 |

Multiply this value by 2 and then subtract 1 to get the y value.

This coordinate would be (-2,-5).




Don't forget to draw a straight line through all of the coordinates you have plotted.

Notice this graph has a gradient of 2 (the y values go up by 2 each time) and a y-intercept of -1 (the graph cuts through the y axis at -1).

# Year 8 Knowledge Organiser LINEAR GRAPHS 2

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

- Generate y values for a linear graph.
- Draw a linear graph by calculating y values.
- Recognise x= and y= graphs and explain them.
- Calculate the equation of a line.
- Identify parallel and perpendicular equations.
- Calculate the negative reciprocal.

## Key Words

**Intercept:** Where two graphs cross.
**Gradient:** This describes the steepness of the line.
**y-intercept:** Where the graph crosses the y-axis.
**Linear:** A linear graph is a straight line.
**Parallel**: Where 2 lines never meet. They have the same gradient.
**Perpendicular:** Two lines that meet at 90°, the gradient is the negative reciprocal.
**Substitute:** When a letter is replaced by a number.
**Reciprocal:** This is found by doing 1 divided by the number.

## Linear graphs

Linear graphs are straight line graphs. We substitute the x value into the equation to get the y value. Once we have both we can then plot the coordinates and draw the graph.
Draw the graph of y = 2x – 1.

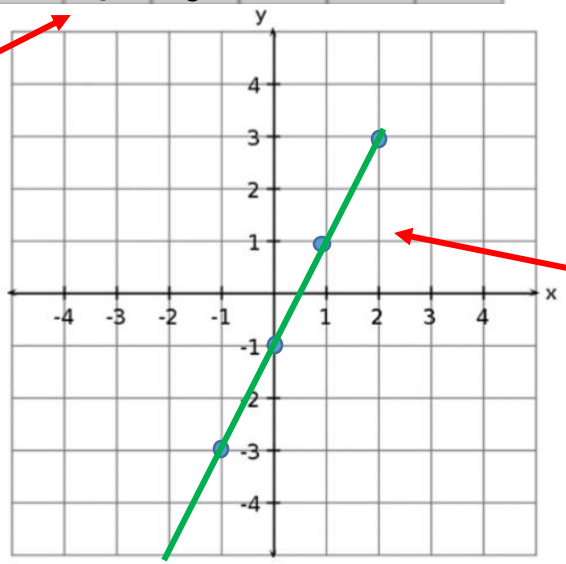
To do this we multiply the x value by 2 and then subtract 1 to get the y value.

y = 2x – 1

| X | -2 | -1 | 0 | 1 | 2 |
|---|---|---|---|---|---|
| Y | -5 | -3 | -1 | 1 | 3 |

Multiply this value by 2 and then subtract 1 to get the y value.

This coordinate would be (-2,-5).

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# Year 8 Knowledge Organiser LINEAR GRAPHS 2

## Calculating the gradient

**Gradient**: This is the steepness of the line. The highest the number the steeper the line. We use the formula before to calculate it:

$$Gradient = \frac{difference\ in\ y}{difference\ in\ x}$$

(3, 4) and (5, 10)

Subtract the two y values.

Gradient = $\frac{10-4}{5-3} = \frac{6}{2} = 3$

Subtract the two x values.

Gradient = 3

## Parallel and perpendicular lines

**Parallel lines**: The gradient of parallel lines is the same, this is why they never meet.

y = 2x + 1 y = 2x - 4 y = 2x

The gradients are all 2 here so they are all parallel.

**Perpendicular lines**: The gradient of perpendicular lines is the negative reciprocal, this is why they meet at right angles.

y = 2x y = $-\frac{1}{2}$x

The negative reciprocal of 2 is $-\frac{1}{2}$.

## Equation of a line

**Linear equation**: The general equation for a linear (straight line) graph is:

y = mx + c

m = gradient and c = the y intercept

We need to calculate the gradient first and then substitute one of the coordinates into the general equation to calculate the value of c.

**Example:**

Find the equation of the line going through (3, 4) and (5, 10).

Calculate the gradient and then put it in the place of the m in the general equation.

Gradient = $\frac{10-4}{5-3} = \frac{6}{2} = 3$

y = 3x + c

Substitute in (3, 4)

Substitute one of the coordinates into the general equation. x=3 and y=4.

4 = 3 x 3 + c

4 = 9 + c

Rearrange to find c.

-5 = c

Put c into the general equation.

Equation: y = 3x - 5