S1-S3

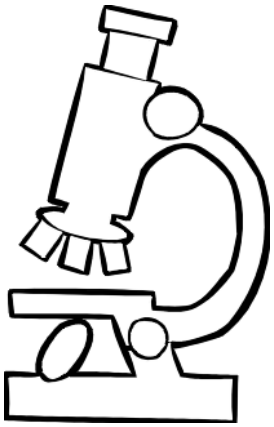
Science

Skills Booklet

Name: _____

_____

Class: _____



Gleniffer High School

- Science Department -

Contents Page

Lab Safety Rules

In order for us to enjoy Science **safely** there are some simple rules of a Science lab classroom we need to follow. Below is space for you to write some of the rules you have discussed in class.

Lab Equipment

From the apparatus shown in the classroom name these common pieces of laboratory equipment

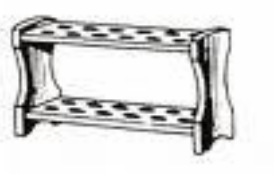
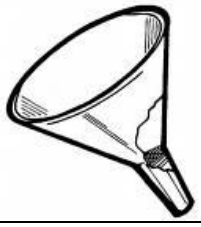
Diagram	Name
	
	
	
	
	
	
	

Diagram	Name
	
	
	
	
	
	
	

Measuring

How do we measure.....?

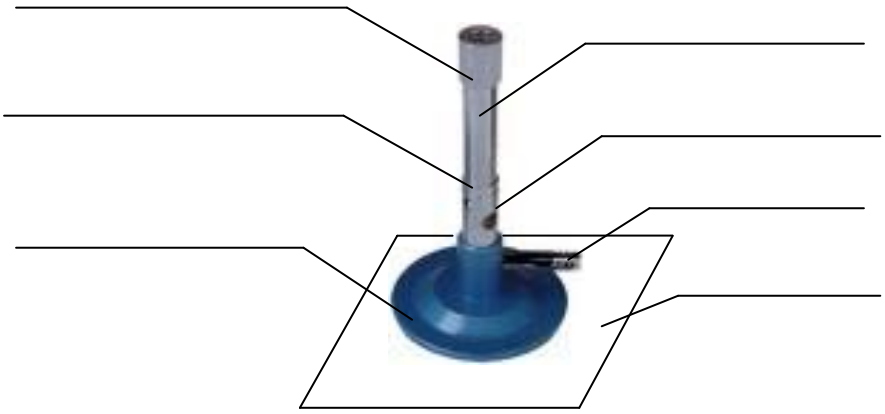
Mass

Volume

Time

Temperature

Using a Bunsen Burner



Word Bank
Collar
Bunsen Mat
Barrel
Base
Air Hole
Gas Supply
Chimney

Open Air Hole (_____ flame)

Closed Air Hole (_____ flame)

SAFETY:

Unit Conversions

Time

1 day = 24 hours (days → hours x 24)
(hours → days ÷ 24 take remainder)

1 hour = 60 minutes (hours → minutes x 60)
(minutes → hours ÷ 60 take remainder)

1 min = 60 seconds (minutes → seconds x 60)
(seconds → minutes ÷ 60 take remainder)

Example 1: A competitor takes 120 seconds to complete a race.
How many minutes is this?

Solution: Number of minutes = number of seconds ÷ 60
= 120 ÷ 60
= **2 minutes**

Example 2: A train leaves Glasgow at 13:40 and arrives in London at 20:00.
How many minutes did the journey take?

Solution: From taking the departure time from the arrival time we can calculate that the journey took <u>6 hours and 20 minutes</u>

6 hours:	6 x 60 minutes	= 360 minutes
Total time:	360 + 20	= **380 minutes**

TO DO: Complete the table below:

Seconds	Minutes	Hours	Days
			2
		24	
	360		
3600			

Mass

1tonne = 1000kg (tonnes → kilograms x 1000)
(kilograms→ tonnes ÷ 1000)

1kg = 1000g (kilograms → grams x 1000)
(grams → kilograms ÷ 1000)

Example 1: The mass of 20 mice is 5000g. What is the mass of 1 mouse in kilograms?

Solution: Mass of 1 mouse $= \frac{\text{Mass of 20 mice}}{\text{No. of mice}} = \frac{5000}{20} = 250\text{g}$

Mass in kilograms = mass in grams ÷ 1000
= 250 ÷ 1000
= 0.25kg

Example 2: Assuming the mass of one paper clip is 0.19g what is the mass of 10,000 paperclips to the nearest kilogram?

Solution: Mass of 10,000 paperclips = mass of 1 paperclip x 10,000
= 0.19 x 10,000
= 1900g

Mass in kilograms = mass in grams ÷ 1000
= 1900 ÷ 1000
= 1.9 kg

Mass to the **nearest** kilogram = **2kg**

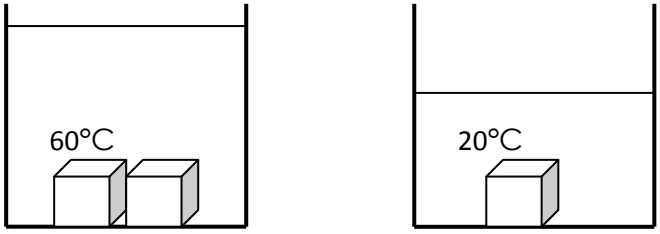
TO DO: Complete the table below:

Grams	Kilograms	Tonnes
50000		
	40	
		5

Making Experiments Fair

Fair tests allow for accurate experiments to produce reliable results.

Consider the experiment below to find out which liquid (A or B) is best at dissolving a sugar cube

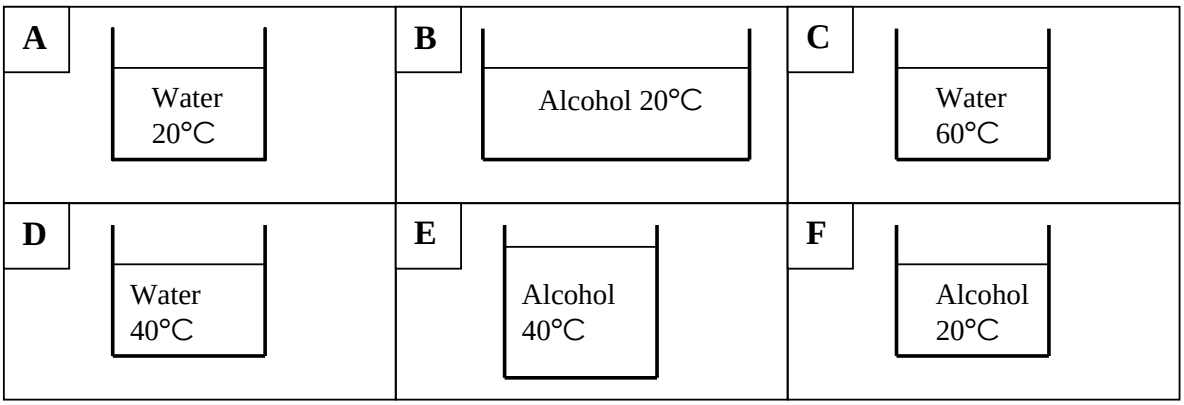


Liquid A Liquid B

Is this a fair test? Why not?

The factor we are investigating is the **type of liquid**. That means that all of the other factors should be kept the same to make this a **fair test**. In the diagram above we can see that the experiment is not fair because the temperature, number of sugar cubes and the volumes of liquid are not the same. Differences in these values could affect the outcome of the experiment e.g. a high temperature liquid is likely to dissolve sugar faster and so this may lead to an inaccurate result.

TO DO: Look at the boxes below, they are sets of apparatus which could be used to test which evaporates fastest – water or alcohol. Circle the two boxes that could be used for a fair test.



Complete before making a bar graph on page 17

Tables

Extracting information from text

Read the following passage about the nutritional content of a packet of crisps:

"Carbohydrates make up 50% of the average packet of crisps. A typical 100g portion also contains 40g of fat, compared to just 20g for chips. Crisps also contain 5g of protein, 4g of fibre and 1g of sodium. Gram for gram, chips are a healthier a snack than crisps…"

What are the key pieces of information here? Underline or highlight anything you think is important.

Choosing suitable headings

- The key pieces of information can be presented in the form of a **table**.
- In order to construct a table, you must first choose **appropriate headings** – labels for your information.
- As the main pieces of information in the passage above are the values for each of the 'nutrients' in a packet of crisps, the two headings **Nutritional Content** and **Mass per 100g** can be used.

TO DO: Using these headings, construct a table for the nutritional content of a typical packet of crisps**.**

Complete before completing exercises on pages 11-14

Data collection and Interpretation

Collecting Data

During this lesson you will have to collect a large amount of data from around the class (height, eye colour, hair colour etc). We have to make sure that we have a good way to collect and present data - we do this using a table. Below is an example the table you may wish to use to collect your data.

Pupil's name	Male or Female	Height (cm)	Shoe size	Hair colour	Eye colour	Left- or Right-handed

Interpreting Data

Mean (Average)

The mean of a set of numbers is found by dividing the sum of all the values of a variable by the number of times it has been measured.

Formula:

$$\textbf{Mean} = \frac{\textbf{sum of all values}}{\textbf{number of values}}$$

Example: The heights of some pupils in a class were recorded in the table below and the average height found

Pupil	Jordan	David	Calum	Jade	Rachel
Height (cm)	130	120	130	110	140

$$\text{Mean} = \frac{(130+120+130+110+140)}{5} = \frac{630}{5} = \mathbf{126cm}$$

TO DO: Look back at the data collected on page 10

Find the average height of a pupil in your class

TO DO: **Find the average shoe size of the pupils in your class**

(You may have to round your mean value up or down to get a whole number)

Calculating Percentages

Sometimes we like to present figures as a <u>percentage</u> of a total number e.g. 50% of 20 is 10. For this we use the following equation:

$$\% \text{ Value} = \frac{\text{Value}}{\text{Total}} \times 100$$

Example: A drawer holds 5 pairs of black socks, 4 pairs of brown socks, 3 pairs of blue socks, 2 pairs of red socks and 1 pair of yellow socks. What percentage of socks are blue?

Solution: Total number of pairs of socks = 15

$$\% \text{ Value} = \frac{\text{Value}}{\text{Total}} \times 100 \rightarrow \quad \% \text{ blue} = \frac{3}{15} \times 100$$

$$= 20\%$$

TO DO: Look back at the data collected on page 10

Using the eye-colour column, calculate the percentages of pupils with different eye colours

To help with this task, it may be useful to put the eye colours into a new table:

Eye Colour	Number of pupils
Blue	
Brown	
Green	
Other	

Total number of pupils = _____

Calculate the percentage for each eye colour:

% Blue _____x 100 =

% Brown _____x 100 =

% Green _____x 100 =

% Other _____x 100 =

Representing Data

Pie Charts

A pie chart can be used to present percentages in a visual form.

In a pie chart a circle (which represents 100% or 360°) can be split up into 'slices' like a pie. In Science, we make each slice represent a percentage of a whole value.

Example: In a class of 20 pupils it was found that 5 pupils were left-handed and the rest were right-handed. Show this data in a pie chart.

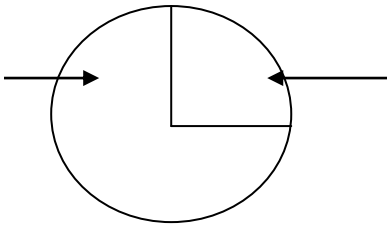
Step 1: **Find the percentages. REMEMBER:** $\% \text{ Value} = \frac{\text{Value}}{\text{Total}} \times 100$

% left-handed: $\frac{5}{20} \times 100 = 25\%$

% right-handed: $100 - 25 = 75\%$

Step 2: **Draw a circle and split up into percentages:**

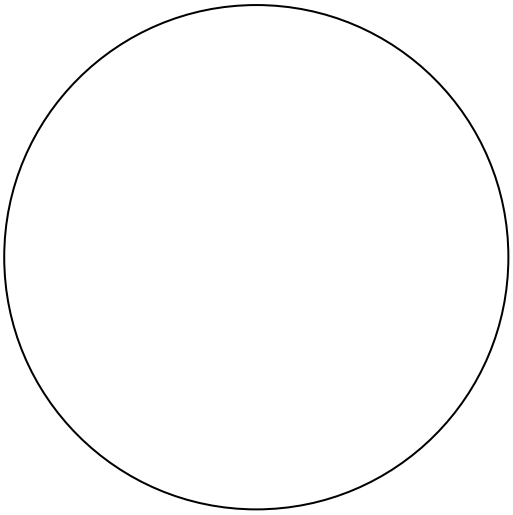
75% (three quarters) right-handed



25% (one quarter) left-handed

TO DO: Look back at the percentages of eye colours you calculated on page 13.

Make a pie chart to represent the percentages of pupils with different eye colours



Ratios

Ratios allow us to determine proportionality between two variables. For example, a ratio of 1:3 of apples to pears in a fruit bowl tells us that for every apple in the bowl, there will be three pears.

Ratios should always be reduced to their simplest form

A ratio of 4 : 10 can be reduced by dividing each side by 2, making it 2 : 5. Ratios are normally whole numbers.

Example: Look back at the **example data** on page 13

Find the ratio of left-handed people to right-handed people in the class

Step 1: Write down the number of pupils in each category:

Number right-handed = 15

Number left-handed = 5

Step 2: Put the numbers into ratio form

Ratio of right- pupils to left-handed pupils is:

15 : 5

Step 3: Simplify

15 : 5 (divide both sides by 5)

3 : 1

TO DO: Look back at the data collected on page 10

Calculate the ratio of boys to girls in your class

Step 1:

Step 2:

Step 3:

Drawing Graphs

All graphs must include labels, units if appropriate, an appropriate scale and a title.
REMEMBER: Labels, **U**nits, **S**cales, **T**itle (**LUST**)

Labels & Units: Have a look back at the Tables section (page 9). In that section we made a table. If we were making a graph of the results in the table, the table headings would now become our labels i.e. **nutritional value** and **mass per 100g**. The units in this example are the grams (g) in the mass per 100g.

Scales

The scale for a graph depends on the size of the graph/squared paper being used and the values being used. You should always try to make best use of the graph paper provided by making the graph as large as possible in the space provided.

- Count how many spaces/divisions there are on the graph paper
- Check to see what your highest value is
- Divide the scale evenly starting from zero. i.e. 0,1,2,3,4,5, or 0,10,20,30,40 making sure that the spaces between these value are the same all the way up the scale
- Mark in your scale on the axis of the graph with a ruler.
- Make sure the scale is clearly shown.

Title

Every graph should have a title, and this title should reflect what your graph is about This can either be by describing the type of values in the table e.g. 'Graph of Temperature against Time' or could be the title of the experiment from where you got the values e.g. 'Cooling Curve'

Always check LUST – Labels, Units, Scales and Title

Drawing Bar Graphs

Bar Graphs

For this section we will use values from the <u>Tables</u> section (page 9) to make a bar graph of nutritional content in a packet of crisps

L – Labels: The labels for this graph will be nutritional content (on the horizontal x-axis) and mass per 100g (on the vertical y-axis)

U – Units: For this graph there are only units for the y-axis (what are they?)

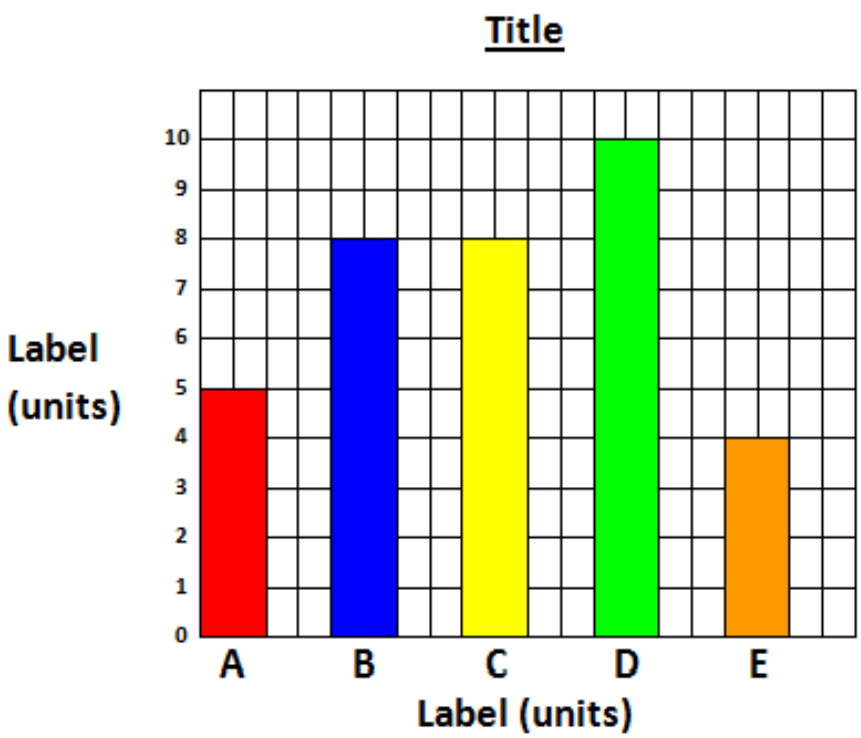
S – Scale: A suitable scale for the values given in your table

T – Title: Choose an appropriate title for this graph given the information above

Drawing the graph:

Once LUST has been completed, you now need to put your data into the graph.

In a bar graph we separate each of the values in the x-axis into evenly spaced bars. Each bar should be the same width and there should be an equal space between each bar. An example of a good bar graph is shown below:



TO DO: Use the squared paper below to draw a bar graph for **shoe sizes** in your class using the data collected in the table on **page 10 '***Data collection and Interpretation'*

Drawing Line Graphs

Line Graphs

If the two variables in a table can be measured on a scale, a line graph should be used to represent the data.

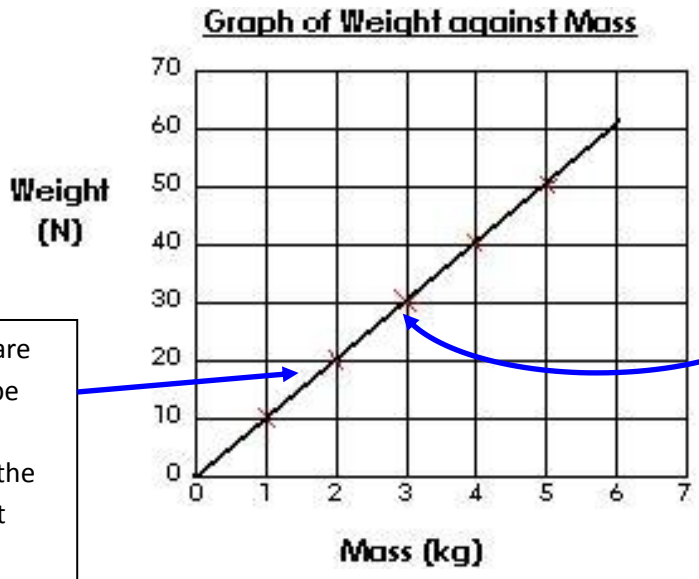
The first part of drawing a line graph is the same as it is for drawing a bar graph – follow **LUST**. Once this is done you will need to put your data into the graph by **plotting points**.

Example: **Plot the data given in the table (shown below) on to the graph given.**

Table:

Mass of object (kg)	Weight of object (N)
1	10
2	20
3	30
4	40
5	50

Graph



Each point on the graph (marked with a small cross) represents one row in the table

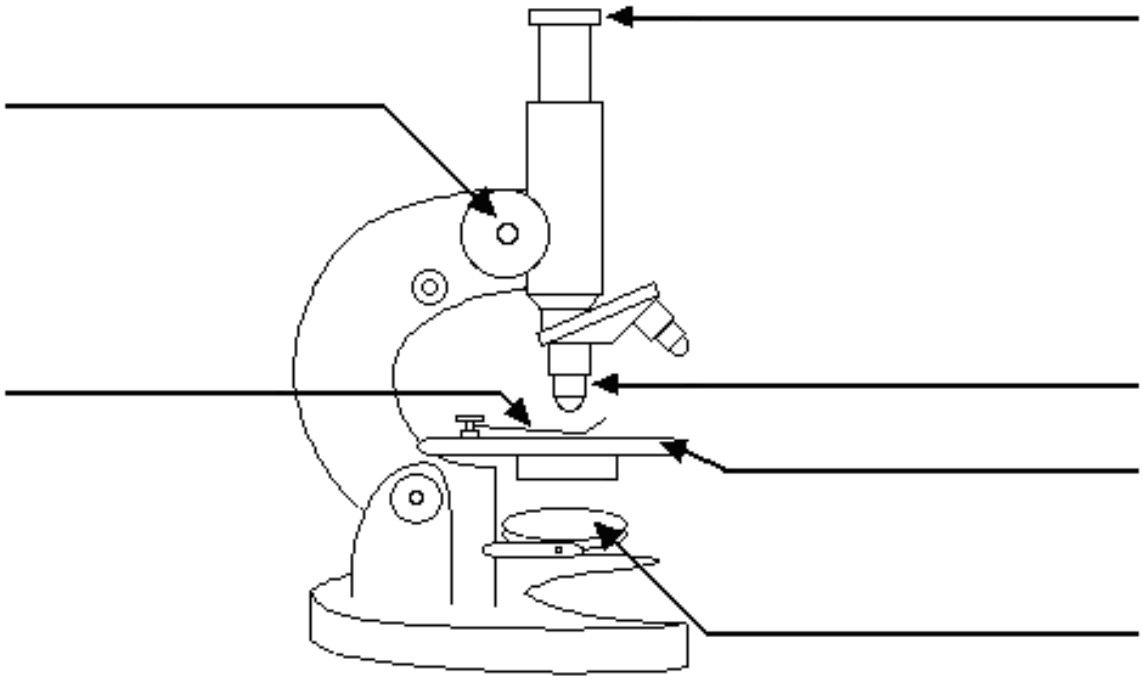
Once all the points are plotted, a line can be drawn through the points. In this case the line is straight, but it may also be curved.

TO DO: Use the squared paper below to make a line graph of the '*Cooling Curve*' experiment you have done in science

_____

Using a Microscope

Label the parts of the microscope using the word bank opposite



How to use

WORD BANK
Eyepiece
Mirror
Objective lens
Stage clip
Stage
Focus knob

Significant Figures

Often on calculators we find numbers like 6.3429178. In Science we normally reduce this to *three significant figures.*

Here is a rule for converting numbers to three significant figures

Rule

Your final answer should only have three numbers in it.

If 4th figure on calculator is
- Less than 5, leave 3rd figure as it is
- More than 5, round 3rd figure up

e.g. 2.451 becomes 2.45 rounded down to three significant figures

e.g. 2.458 becomes 2.46 rounded up to three significant figures

Worked Examples

Calculator number	**Number to 3 sig. Figs.**
6.8	6.8
4.1421	4.14
62.452	62.5
1239.23	1240 or 1.24×10^3
124567	1250 or 1.25×10^3
32.59452	32.6

TO DO: *Now try these….*

(a) 54.294 _____ (b) 0.82541 _____

(c) 257.218 _____ (d) 7.2555 _____

Scientific Notation

Small Numbers can be represented in the following way:-

0.01 = $\frac{1}{100}$ = $\frac{1}{10^2}$ = 10^{-2} or 1×10^{-2}

0.001 = $\frac{1}{1000}$ = $\frac{1}{10^3}$ = 10^{-3} or 1×10^{-3}

e.g. 1 millimetre is one thousandth of a metre

1mm = $\frac{1}{1000}$ of a metre = 1×10^{-3} m

Worked examples:

0.398 = $\frac{3.98}{10}$ = 3.98×10^{-1}

0.0802 = $\frac{8.02}{100}$ = 8.02×10^{-2}

Large Numbers can be represented in the following way:-

1**00** = 1**0** x 1**0** = 10^2 or 1×10^2

1**000** = 1**0** x 1**0** x 1**0** = 10^3 or 1×10^3

e.g. 1 kilometre is one thousand metres

1km = 1**000**m = 1×10^3 m

Worked examples:

(a) 4820 = 4.820 x 1000 = 4.82×10^3

(b) 633 = 6.33 x 100 = 6.33×10^2

Prefixes

Prefix	Scientific notation	Decimal Value		Examples
pico (**p**)	1×10^{-12}	0.000000000001	$\frac{1}{1000000000000}$	picoFarad (**p**F)
nano (**n**)	1×10^{-9}	0.000000001	$\frac{1}{1000000000}$	nanometer (**n**m)
micro (**µ**)	1×10^{-6}	0.000001	$\frac{1}{1000000}$	microamp (**µ**A)
milli (**m**)	1×10^{-3}	0.001	$\frac{1}{1000}$	millisecond (**m**s)
centi (**c**)	1×10^{-2}	0.01	$\frac{1}{100}$	centimetre (**c**m)
kilo (**k**)	1×10^{3}	1000		kilogramme (**k**g)
Mega (**M**)	1×10^{6}	1000000		Megahertz (**M**Hz)
Giga (**G**)	1×10^{9}	1000000000		Gigawatts (**G**W)
Tera (**T**)	1×10^{12}	1000000000000		Terabytes (**T**B)

<u>Examples</u>

(a) 1 millisecond (1ms) = 1×10^{-3} s = 0.001s

(b) 50 milliseconds (50ms) = 50×10^{-3} s = 0.05s

(c) 700 kilowatts (700kw) = 700×10^{3} w = 700,000W

TO DO: *Now try these….*

(d) 8 centimetres = _____ = _____ m

(e) 12 microamps = _____ = _____ A

(f) 2.5 megahertz = _____ = _____ Hz

Using Formulae

Change of Subject

Consider the following equation: $\frac{A}{B} = \frac{C}{D}$

This can be rearranged (cross multiplied) to form **AD = BC**. From this we can **change the subject** to any term we wish to calculate.

i.e.

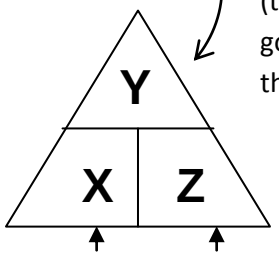
AD = BC	AD = BC	AD = BC
D = $\frac{BC}{A}$	$\frac{AD}{B}$ = **C**	$\frac{AD}{C}$ = **B**

Using a Triangle

A triangle can be used to help change the subject of an equation, however triangles will not be given in any data booklets and will not be accepted instead of a formula in an exam. You must be able to put an equation into a triangle.

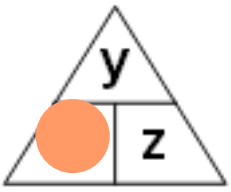
Example: Consider the equation: $X = \frac{Y}{Z}$

the term on the top line of the equation (the numerator) goes in the peak of the triangle

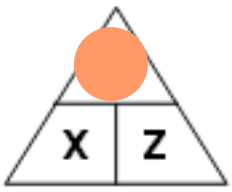


the other two terms go at the bottom of the triangle

To change the subject of the formula for any term, simply cover that term with your finger, e.g. cover **x** with your finger - this is what you see:



so $X = \frac{Y}{Z}$



Similarly, cover **y** and you get:

Y = X x Z

Using Formulae Problems

Change of Subject

Change the subject of each of these equations to <u>a</u>

(a) $\frac{a}{x} = \frac{y}{z}$	**(b)** $\frac{x}{a} = \frac{y}{z}$	**(c)** $\frac{x}{y} = \frac{a}{z}$	**(d)** $\frac{x}{y} = \frac{z}{a}$

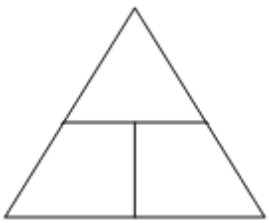
Using a Triangle

Consider the equation $a = \frac{F}{m}$

(a) put this formula into a triangle

(b) using the triangle, re-arrange the formula for F and m

(a)



(b)

Algebra

Balancing equations

Algebraic equations can be solved by **balancing**. When an equation is balanced, both sides of the equation has terms added, subtracted, divided or multiplied from or to them in order to simplify and solve the equation**.**

This is shown in the examples below:

Example (i)	**2a**	**+**	**4**	**=**		**10**	
take 4 from both sides			-4			-4	
	2a			=		6	
divide each side by 2	$\frac{2a}{2}$			=		$\frac{6}{2}$	
			a	**=**	**3**		
Example (ii)	**3a**	**-**	**1**	**=**		**18**	
add 1 each side			+1			+1	
	3a			=		19	
divide each side by 3	$\frac{3a}{3}$			=		$\frac{19}{3}$	
			a	**=**	$\frac{19}{3}$	**(6.33)**	
Example (iii)	**7a**	**+**	**1**	**=**	**3a**	**-**	**5**
add 5 each side			+5				+5
	7a	+	6	=	3a		
take 3a from each side	-3a				-3a		
	4a	+	6	=	0		
take 6 from each side			-6		-6		
	4a			=	-6		
divide each side by 4	$\frac{4a}{4}$			=	$\frac{-6}{4}$		
			a	**=**	$\frac{-3}{2}$	**(-1.5)**	

Algebra Problems

Balancing Equations

Balance and solve the following equations

(a) $4a + 6 = 10$

(b) $3b - 5 = 6b + 13$

(c) $2 - 3c = 6c - 10$

(d) $4 + 6d = 9 - 4d$

Percentage Change

Percentage Change

Percentage change is a measure of how much something gains or loses value. A percentage change is useful for people to understand changes in value over time.

The general equation for percentage change is:

$$\text{Percent Change} = \frac{\text{New Value - Old Value}}{\text{Old Value}} \times 100$$

Percentage Increase

Example (i): Ann works in a supermarket for £10.00 per hour. If her pay is increased to £12.00, then what is her percent increase in pay?

Solution: When finding the percent increase, we take the difference between the value before and after, divide it by the original value and multiply by 100 to get a percentage.

$$\frac{12 - 10}{10} = \frac{2}{10} = 0.20 = 20\%$$

The percentage increase in Ann's pay is **20%**.

Percentage decrease

Example (ii): The staff at a company went from 40 to 29 employees. What is the percent decrease in staff?

Solution: When finding the percent decrease, we take the difference between the original value and the new value, divide it by the original value and multiply by 100 to get a percentage.

$$\frac{40 - 29}{40} = \frac{11}{40} = 0.275 = 27.5\%$$

There was a **27.5%** decrease in staff.

Percentage Change

Calculating new values given a percentage change

Example (i): Jacqui is told her mobile phone tariff, currently £20 is going up by 5%. What will Jacqui's new bill be?

Solution: When finding the new value, we need to re-arrange the formula for percent change as follows:

$$\frac{Percent\ Change}{100} \times \text{Old Value} = \text{Difference in Value}$$

$$\frac{5}{100} \times 20 = 21$$

Jacqui's new bill will be £20 + £1 = **<u>£21</u>**

TO DO: Percentage Change Exercises

(a) Find the percentage increase in the price of fuel if the cost of filling up was £60 this week and £50 last week.

(b) The cost of the average shopping trolley is £90. If the cost of living increases by 15% in the next 2 years, how much will average shopping trolley cost?

Proportions

We can use proportions to help us calculate new values given known relationships.

Example 1: An apple costs 20p, how much will six apples cost?

Solution: Ratio of apples to cost: **1 apple : 20p**

6 x 1 = 6 apples : 6 x 20p = **£1.20**

Example 2: There are on average 9 cats for every 5 dogs in the UK. If there are 7 million dogs in the U.K how many cats are there?

Solution: Ratio of cats to dogs in the U.K: 9 cats : 5 dogs

To find the number of cats there are in the U.K, we need to find the proportion of cats to dogs. We do this by dividing both sides of the ratio by the number of dogs (5):

$$\frac{9}{5} : \frac{5}{5}$$

=

$$1.8 : 1$$

This means there are 1.8 cats for every dog. So if there are 7 million dogs in the U.K, there must be 7 million x 1.8 cats. i.e. **12.6 million**.

Example3:
50g of 'Andy's Antacids' are needed to neutralise 1 litre of stomach acid.
Calculate the mass of antacid needed to neutralise 45ml of stomach acid.

Solution: Ratio of antacid to stomach acid: 50g : 1000ml (1L)

Mass of antacid per 1ml = $\frac{50}{1000}$ = 0.05g

Mass of antacid requires to neutralise 45ml of stomach acid = 0.05 x 45

= **2.25g**

TO DO: Proportions Exercises

(a) When 34 g of hydrogen peroxide decomposes, 12 litres of oxygen is produced.

Calculate the volume of oxygen produced when 1·7 g of hydrogen peroxide decomposes.

(b) A chocolate bar contains 260 calories. If a person burns an average of 100 calories per mile walking, how far would you have to walk to 'burn off' eating the chocolate bar?

(c) Copper coins made before 1992 have a 97% copper content. The current price for copper is £2.20 per kilogram.
A copper penny has a mass of 3.56g.

(i) Find the mass of copper in a pre-1992 penny
(ii) What would be the scrap value of a pre-1992 penny?

Conducting Research

Researching a topic

When researching a topic it is important that you:

- **Organise and Plan:** make sure you know the deadline for submitting your project, decide what topic you are to research and if necessary break that topic into smaller parts (e.g. Jupiter instead of planets of the solar system). Dividing a topic into **key words** will be particularly useful when using internet search engines or looking for books in a library catalogue

- **Gather information:** try to collect information from a range of sources e.g. newspapers, magazines, books and the internet to make sure your information is accurate and not biased (not just presenting one point of view)

- **Make notes:** making notes while you are researching will help you to gather important pieces of information from sources and put that information into **your own words**. Copying text from sources is called **plagiarism** and if discovered will mean that you will lose all the marks for your work. It is also against the law!

- **References:** it is important to state where you got your main information from, especially if you are going to quote text. You can list your references in a **bibliography** (sources of information) at the end of a project. Different sources of information must be referenced appropriately:

  Books: author's name, full name of book, date of publication, pages used

  Newspapers/magazines: author's name, title of article, name of newspaper/magazine, date of publication

  Internet sources: author's name, title of article, full web address (URL), date the source was looked at

- **Present:** Your research should be presented in a clear format. Which format used will depend on the task you have been given

Further practice in these skills will be covered during your literacy period using the '**Research Skills: An introduction to finding out…**" booklet

Writing a Report

Reporting on a topic

You may wish to use a report to present your research findings. All reports follow the same basic structure:

Cover Page: Subject of report and possibly an illustration/picture which represents the topic

Contents Page: A list of the contents of the report with page numbers if possible

Introduction: A few sentences or a paragraph explaining what your report is about and how/why it has been conducted

Main findings: Divided up into sections with appropriate sub-headings, your main findings display the information you have gathered

References: Your sources of information properly reference (see previous section on *'Conducting Research'*)

Writing reports is part of many subjects and as your reporting writing skills develop it is expected that you will be able to:

- fully organise your report
- ensure no important information is left out or repeated
- use the correct terminology and tone for the task
- attempt to explain processes and ideas which help in the understanding of your report
- use and acknowledge primary and secondary quotes/sources
- use your own words as often as you can in your report

Further practice in these skills will be covered during your literacy period

Glossary

Word	Meaning

Gleniffer High School

- Science Department -