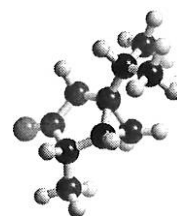


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JCoSS



# Chemistry Department

## Yr12 Induction Work



Bridging the gap between GCSE and Advanced level

Summer Preparation

# The Periodic Table of the Elements

1	2											3	4	5	6	7	0	
(1) 6.9 <b>Li</b> lithium 3	(2) 9.0 <b>Be</b> beryllium 4	<div style="border: 1px solid black; padding: 5px; display: inline-block;"> <b>Key</b>                      relative atomic mass  <b>symbol</b>                      name                      atomic (proton) number                 </div>										1.0 <b>H</b> hydrogen 1	(13) 10.8 <b>B</b> boron 5	(14) 12.0 <b>C</b> carbon 6	(15) 14.0 <b>N</b> nitrogen 7	(16) 16.0 <b>O</b> oxygen 8	(17) 19.0 <b>F</b> fluorine 9	20.2 <b>He</b> helium 2
23.0 <b>Na</b> sodium 11	24.3 <b>Mg</b> magnesium 12											(3)	(4)	(5)	(6)	(7)	(8)	(9)
39.1 <b>K</b> potassium 19	40.1 <b>Ca</b> calcium 20	45.0 <b>Sc</b> scandium 21	47.9 <b>Ti</b> titanium 22	50.9 <b>V</b> vanadium 23	52.0 <b>Cr</b> chromium 24	54.9 <b>Mn</b> manganese 25	55.8 <b>Fe</b> iron 26	58.9 <b>Co</b> cobalt 27	58.7 <b>Ni</b> nickel 28	63.5 <b>Cu</b> copper 29	65.4 <b>Zn</b> zinc 30	69.7 <b>Ga</b> gallium 31	72.6 <b>Ge</b> germanium 32	74.9 <b>As</b> arsenic 33	79.0 <b>Se</b> selenium 34	79.9 <b>Br</b> bromine 35	83.8 <b>Kr</b> krypton 36	
85.5 <b>Rb</b> rubidium 37	87.6 <b>Sr</b> strontium 38	88.9 <b>Y</b> yttrium 39	91.2 <b>Zr</b> zirconium 40	92.9 <b>Nb</b> niobium 41	96.0 <b>Mo</b> molybdenum 42	101.1 <b>Tc</b> technetium 43	101.1 <b>Ru</b> ruthenium 44	102.9 <b>Rh</b> rhodium 45	106.4 <b>Pd</b> palladium 46	107.9 <b>Ag</b> silver 47	112.4 <b>Cd</b> cadmium 48	114.8 <b>In</b> indium 49	118.7 <b>Sn</b> tin 50	121.8 <b>Sb</b> antimony 51	127.6 <b>Te</b> tellurium 52	126.9 <b>I</b> iodine 53	131.3 <b>Xe</b> xenon 54	
132.9 <b>Cs</b> caesium 55	137.3 <b>Ba</b> barium 56	138.9 <b>La *</b> lanthanum 57	178.5 <b>Hf</b> hafnium 72	180.9 <b>Ta</b> tantalum 73	183.8 <b>W</b> tungsten 74	186.2 <b>Re</b> rhenium 75	190.2 <b>Os</b> osmium 76	192.2 <b>Ir</b> iridium 77	195.1 <b>Pt</b> platinum 78	197.0 <b>Au</b> gold 79	200.6 <b>Hg</b> mercury 80	204.4 <b>Tl</b> thallium 81	207.2 <b>Pb</b> lead 82	209.0 <b>Bi</b> bismuth 83	[209] <b>Po</b> polonium 84	[210] <b>At</b> astatine 85	[222] <b>Rn</b> radon 86	
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Act</b> actinium 89	[267] <b>Rf</b> rutherfordium 104	[268] <b>Db</b> dubnium 105	[271] <b>Sg</b> seaborgium 106	[272] <b>Bh</b> bohrium 107	[270] <b>Hs</b> hassium 108	[276] <b>Mt</b> meitnerium 109	[281] <b>Os</b> darmstadtium 110	[280] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112 - 116 have been reported but not fully authenticated							

\* 58 - 71 Lanthanides

† 90 - 103 Actinides

140.1 <b>Ce</b> cerium 58	140.9 <b>Pr</b> praseodymium 59	144.2 <b>Nd</b> neodymium 60	(145) <b>Pm</b> promethium 61	150.4 <b>Sm</b> samarium 62	152.0 <b>Eu</b> europium 63	157.3 <b>Gd</b> gadolinium 64	158.9 <b>Tb</b> terbium 65	162.5 <b>Dy</b> dysprosium 66	164.9 <b>Ho</b> holmium 67	167.3 <b>Er</b> erbium 68	168.9 <b>Tm</b> thulium 69	173.1 <b>Yb</b> ytterbium 70	175.0 <b>Lu</b> lutetium 71
232.0 <b>Th</b> thorium 90	231.0 <b>Pa</b> protactinium 91	238.0 <b>U</b> uranium 92	[237] <b>Np</b> neptunium 93	[244] <b>Pu</b> plutonium 94	[243] <b>Am</b> americium 95	[247] <b>Cm</b> curium 96	[247] <b>Bk</b> berkelium 97	[251] <b>Cf</b> californium 98	[252] <b>Es</b> einsteinium 99	[257] <b>Fm</b> fermium 100	[258] <b>Md</b> mendelevium 101	(259) <b>No</b> nobelium 102	{262} <b>Lr</b> lawrencium 103

Advanced level Chemistry is a demanding and exciting course. In order to be prepared for your start in September a number of areas from GCSE Chemistry are needed to be **known and/or understood** thoroughly. To help you make the transition as smoothly as possible we have put together this series of exercises. When you start in September you will be expected to have completed the exercises within this booklet and know the material within. There will be a test on this material approximately one week into the course. It is by no means ALL you need to know but the very foundations of the exciting journey you are about to start. If you have difficulties or confusions there are a number of suggested online resources you could try. There will be opportunities to discuss concerns with staff at the beginning of the year but you should have made significant headway independently.

This booklet contains some undetailed notes to act as a reminder. If you struggle with a particular area you should investigate the suggested support resources, your GCSE notes and your local library. There are exercises for you to complete, the answers are at the end.

Section A is on chemistry aspects, section B on mathematical aspects. These are the foundations and not the entire required skill set.

## Contents

Topic	Page	Additional help sources (linked)
Formula literacy	5-7	<a href="#"><u>You tube writing formulae</u></a>
Identifying Structure types	8	<a href="#"><u>Youtube How To Speak Chemistrian: Crash Course Chemistry #11</u></a>
Identifying acids, bases and salts	9-10	
Common reaction types	11-12	
Balancing equations	13-14	<a href="#"><u>You tube Fuse school Balancing eqns Pt 1</u></a> <a href="#"><u>You tube Fuse school Balancing eqns Pt 2</u></a>
Rearranging equations	15	<a href="#"><u>You tube GCSE Physics support!</u></a>
Significant figures	16-17	<a href="#"><u>Unit Conversion &amp; Significant Figures : Crash Course Chemistry #2</u></a>
Standard form	17-19	<a href="#"><u>Writing a number in standard form</u></a>
Indices	19	
Graph skills	20-21	
Scales	22	

### Useful resources:

- o Use your GCSE notes.
- o There are a few selected video clips listed above in the contents table. There is a great wealth of other information on the internet (and some of it is useful and/or correct). These resources have been specifically selected for your viewing pleasure!
- o Essential Maths Skills for A-Level Chemistry by CGP ISBN 978 4 78294 472 0





# Formula Literacy



It is vital to be formula literate as a chemist. You should be able to name substances from their formulas, and should know or be able to work out the formula of many substances.

You are expected to **KNOW** the information on these two pages and will be tested on it frequently. You **WILL** do far better in Chemistry if you are formula literate.

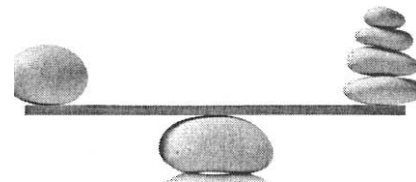
Elements				Compound s	
H <sub>2</sub>	hydrogen	Ti	titanium	H <sub>2</sub> O	water
He	helium	V	vanadium	NH <sub>3</sub>	ammonia
Li	lithium	Cr	chromium	H <sub>2</sub> SO <sub>4</sub>	sulfuric acid
C	carbon	Mn	manganese	HNO <sub>3</sub>	nitric acid
N <sub>2</sub>	nitrogen	Fe	iron	HCl	hydrochloric acid
O <sub>2</sub>	oxygen	Co	cobalt	NaOH	sodium hydroxide
F <sub>2</sub>	fluorine	Ni	nickel	CO	carbon monoxide
Ne	neon	Cu	copper	CO <sub>2</sub>	carbon dioxide
Na	sodium	Zn	zinc	NO	nitrogen monoxide
Mg	magnesium	Br <sub>2</sub>	bromine	NO <sub>2</sub>	nitrogen dioxide
Al	aluminium	Ag	silver	SO <sub>2</sub>	sulfur dioxide
Si	silicon	Sn	tin	SO <sub>3</sub>	sulfur trioxide
P <sub>4</sub>	phosphorus	I <sub>2</sub>	iodine	H <sub>2</sub> S	hydrogen sulfide
S <sub>8</sub>	sulfur	W	tungsten	CH <sub>4</sub>	methane
Cl <sub>2</sub>	chlorine	Pt	platinum	NaCl	sodium chloride
Ar	argon	Au	gold	CuSO <sub>4</sub>	copper sulfate
K	potassium	Hg	mercury	AgNO <sub>3</sub>	silver nitrate
Ca	calcium			CaCO <sub>3</sub>	calcium carbonate

	Group 1 ions		Group 2 ions		Group 3 ions		Others	
	<b>POSITIVE IONS</b>	Li <sup>+</sup>	lithium	Mg <sup>2+</sup>	magnesium	Al <sup>3+</sup>	aluminium	NH <sub>4</sub> <sup>+</sup>
Na <sup>+</sup>		sodium	Ca <sup>2+</sup>	calcium			Ag <sup>+</sup>	silver
K <sup>+</sup>		potassium	Ba <sup>2+</sup>	barium			Cu <sup>2+</sup>	copper (II)
							Fe <sup>2+</sup>	iron (II)
							Fe <sup>3+</sup>	iron (III)
							Zn <sup>2+</sup>	zinc
							Pb <sup>2+</sup>	lead
	Group 6 ions		Group 7 ions		Others			
	O <sup>2-</sup>	oxide	F <sup>-</sup>	fluoride	OH <sup>-</sup>	hydroxide		
<b>NEGATIVE IONS</b>	S <sup>2-</sup>	sulfide	Cl <sup>-</sup>	chloride	NO <sub>3</sub> <sup>-</sup>	nitrate		
			Br <sup>-</sup>	bromide	SO <sub>4</sub> <sup>2-</sup>	sulfate		
			I <sup>-</sup>	iodide	CO <sub>3</sub> <sup>2-</sup>	carbonate		
					HCO <sub>3</sub> <sup>-</sup>	hydrogencarbonate		

## Putting together an ionic formula:

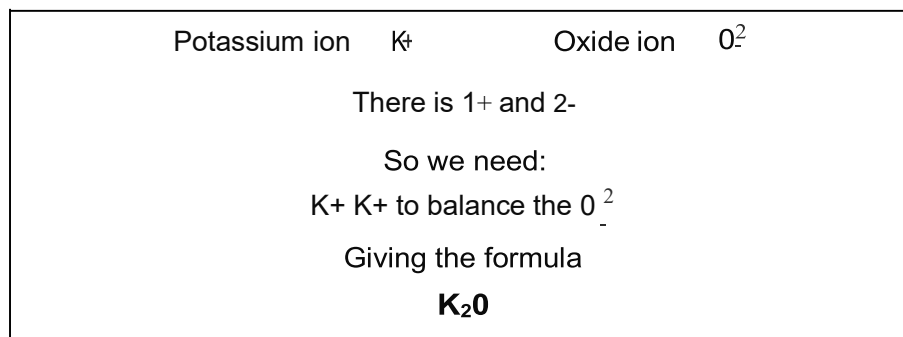
The charges must balance.

Molecular ions will need to be contained in brackets.

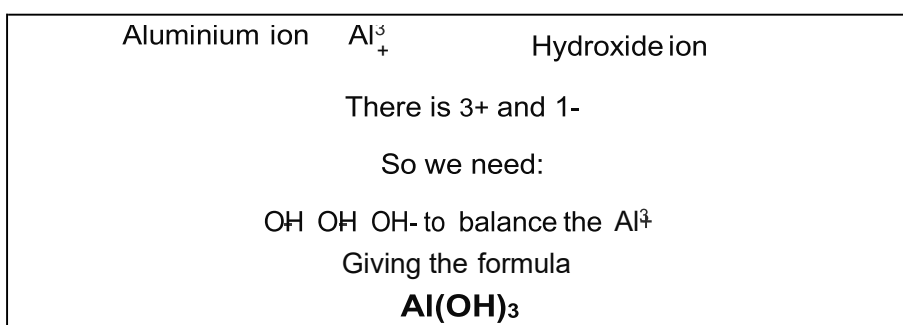


e.g.

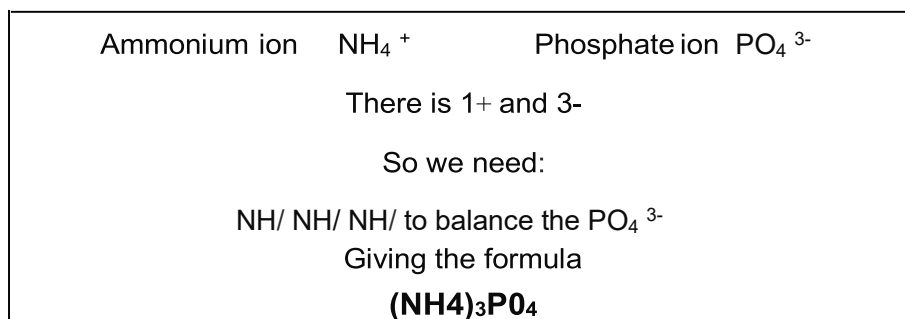
### Potassium Oxide



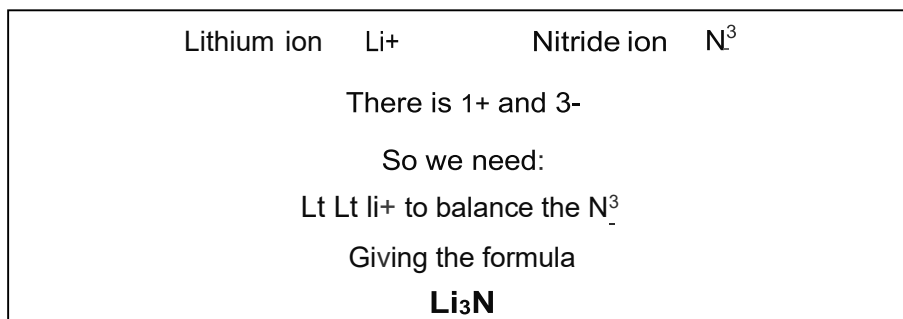
### Aluminium Hydroxide



### Ammonium Phosphate



### Lithium Nitride



**EXERCISE 1 Write the formulae of the following substances (a mixture of structure types, not just ionic)**

1. Sodium Chloride

2. Sodium Hydroxide

3. Sodium Carbonate

4. Sodium Sulfate

5. Magnesium Chloride

6. Carbon Dioxide

7. Magnesium Hydroxide

8. Aluminium Chloride

9. Aluminium Sulfate

10. Copper (II) Sulfate

11. Copper (I) Oxide \_\_\_\_\_

12. Nitrogen \_\_\_\_\_

13. Sulfur trioxide \_\_\_\_\_

14. Iron (II) Oxide \_\_\_\_\_

15. Iron (III) Oxide \_\_\_\_\_

16. Ammonium Nitrate \_\_\_\_\_

17. Ammonium Sulfate \_\_\_\_\_

18. Silver \_\_\_\_\_

19. Aluminium Oxide \_\_\_\_\_

20. Calcium \_\_\_\_\_

**EXERCISE 2 Give the names of these substances**

1.  $H_2O$

11.  $Li_2SO_4$

2. CO

12

.  $CuSO_4$

3.  $NH_3$

13

.  $AgNO_3$

4. NaH

14.  $(NH_4)_2SO_4$

5.  $CH_4$

15 .  $NH_4VO_3$

6.  $HNO_3$

16.  $KMnO_4$

7.  $NaNO_3$

17.  $Co$

8.  $CaCl_2$

18.  $KI$

9. SO

19.  $Co(NO_3)$

10 .  $Li_2S$

20 .  $KAt$

# Identifying structure types



*Structure types often called crystal types*

You should also be able to identify what type of structure a substance has from just its name/ formula - this is a **KEY SKILL**.

At GCSE level we are introduced to the concept that non-metals are held together (usually) by covalent bonds and that metal and non-metals are (usually) held together by ionic bonds. This will be developed further at advanced level. But let's get the GCSE sorted first!

Structure type	Which substances
Monatomic	Group 0 elements
Simple molecular	Some non-metal elements (e.g. H <sub>2</sub> , N <sub>2</sub> , O <sub>2</sub> , F <sub>2</sub> , P <sub>4</sub> , S <sub>8</sub> , Cl <sub>2</sub> , Br <sub>2</sub> , I <sub>2</sub> ) Compounds made from non-metals (e.g. NH <sub>3</sub> , CO <sub>2</sub> , H <sub>2</sub> O, C <sub>6</sub> H <sub>12</sub> O <sub>6</sub> , CH <sub>4</sub> )
Giant covalent <i>or Macromolecular</i>	Diamond (C), graphite (C), graphene (C), silicon (Si), silicon dioxide (SiO <sub>2</sub> )
Ionic	Compounds made from metal+ non-metals (e.g. NaCl, Fe <sub>2</sub> O <sub>3</sub> , CuSO <sub>4</sub> )
Metallic	Metals (e.g. Cu, Fe, Al, Na, Ca, Mg, Au, Ag, Pt)

## EXERCISE 3 Identify the structure types of the following substances

1. Sodium oxide	11. CO	_____
2. Graphite	12. Co	_____
3. Bromine	13. NaNO <sub>3</sub>	_____
4. Copper nitrate	14. Fe	_____
5. Argon	15. S	_____
6. Iron chloride	16. CaSO <sub>4</sub>	_____
7. Calcium	17. H <sub>2</sub>	_____
8. Oxygen	18. SiO <sub>2</sub>	_____
9. Fluorine	19. Na	_____
10. Water	20. Kr	_____

# Identifying acids, bases and salts



Many substances are acids, bases or salts. It is another **KEY SKILL** for any chemist that you can identify which substances are which (not all substances are acids, bases or salts).

Nature	Which substances
Acid	Substances that release $H^+$ (aq) ions when added to water, e.g. Hydrochloric acid (HCl) <i>react to form chloride salts</i> Sulfuric acid (H <sub>2</sub> SO <sub>4</sub> ) <i>react to form sulfate salts</i> Nitric acid (HNO <sub>3</sub> ) <i>react to form nitrate salts</i> Phosphoric acid(H <sub>3</sub> PO <sub>4</sub> ) <i>react to form phosphate salts</i>
Base	Substances that react with acids to form a salt & water (and sometimes CO <sub>2</sub> ) Metal oxides (e.g. calcium oxide, iron oxide, copper oxide, nickel oxide, etc.) Metal hydroxides (e.g. sodium hydroxide, calcium hydroxide, potassium hydroxide) Metal carbonates (e.g. sodium carbonate, copper carbonate, calcium carbonate) Metal hydrogencarbonates (e.g. calcium hydrogencarbonate, sodium hydrogencarbonate) Ammonia (NH <sub>3</sub> )
Alkali	Substances that release OH <sup>-</sup> (aq) ions when added to water, e.g. Metal hydroxides (e.g. sodium hydroxide, calcium hydroxide, potassium hydroxide) Ammonia (NH <sub>3</sub> )
Salt	Ionic substances made when acids react with bases, e.g. Nitrates (e.g. calcium nitrate, silver nitrate, potassium nitrate, ammonium nitrate) Sulfates (e.g. copper sulfate, sodium sulfate, calcium sulfate, ammonium sulfate) Chlorides (e.g. sodium chloride, potassium chloride, calcium chloride, ammonium chloride) Bromides (e.g. lead bromide, potassium bromide, iron bromide) Iodides (e.g. potassium iodide, magnesium iodide, calcium iodide) Phosphates (e.g. sodium phosphate, calcium phosphate, ammonium phosphate)

#### EXERCISE 4

For each of the substances below:

- give its name or formula if missing (use the ion charges on the data sheet to help)
- decide whether it is an acid, a base, an alkali or a salt ( the colum(s) - some may belong to more than category).

Name	Formula	Acid	Base	Alkali	Salt
calcium carbonate					
copper (II) chloride					
sulphuric acid					
sodium sulfate					
silver nitrate					
phosphoric acid	$\text{H}_3\text{PO}_4$				
	$\text{CaO}$				
	$\text{KOH}$				
ethanoic acid	$\text{CH}_3\text{COOH}$				
sodium ethanoate	$\text{CH}_3\text{COONa}$				
	$\text{Na NO}_3$				
	$\text{HNO}_3$				
hydrochloric acid					
ammonia					
ammonium nitrate					
ammonium sulfate					
barium hydroxide					
lead bromide					
zinc phosphate	$\text{Zn}_3(\text{PO}_4)_2$				
nickel carbonate					
Copper (II) oxide					
lithium hydroxide					
iron (III) sulphate					
magnesium chloride					

# Common reaction types



You will very rarely be asked to write word equations at Advanced Level. This is because you are expected to **always** write balanced symbol equations. However, to be able to write the symbol equations you need to know your word equations first!

## Some common reaction equations:

### Acid and alkali:



- An example is hydrochloric acid + sodium hydroxide → sodium chloride + water

### Acid and metal oxide:



- An example is sulfuric acid + copper oxide → copper sulphate + water

### Acid and metal carbonate:



- An example is hydrochloric acid + calcium carbonate → calcium chloride + water + carbon dioxide

### Acid and metal:



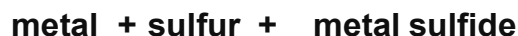
- An example is sulfuric acid + zinc → zinc sulphate + hydrogen

### Metal and oxygen:



- An example is magnesium + oxygen → magnesium oxide

### Metal and sulfur:



- An example is iron + sulfur → iron sulfide

### Metal and water:



- An example is calcium + water → calcium hydroxide + hydrogen

### Combustion of hydrocarbon:



- An example is methane + oxygen → carbon dioxide + water

Ionic equations of some common reactions		
Acid + metal hydroxide	salt + water	$H^+ + OH^- \rightarrow H_2O$
Acid + metal carbonate	salt + water + carbon dioxide	$2H^+ + CO_3^{2-} \rightarrow H_2O + CO_2$
Acid + metal hydrogencarbonate	salt + water + carbon dioxide	$H^+ + HCO_3^- \rightarrow H_2O + CO_2$
Acid + ammonia	ammonium salt	$H^+ + NH_3 \rightarrow NH_4^+$

## EXERCISE 5

Write complete word equations for the following reactions:

1. Aluminium reacting with sulfur
2. Copper burning in oxygen
3. Ethane (CH<sub>3</sub>CH<sub>3</sub>) burning completely in oxygen
4. Ethanol (CH<sub>3</sub>CH<sub>2</sub>OH) burning completely in oxygen
5. Lithium reacting with water
6. Magnesium reacting in nitric acid
7. Potassium oxidising in the air
8. The reaction of calcium hydroxide with hydrochloric acid
9. The reaction of sodium oxide with sulphuric acid
10. Zinc carbonate reacting with hydrochloric acid

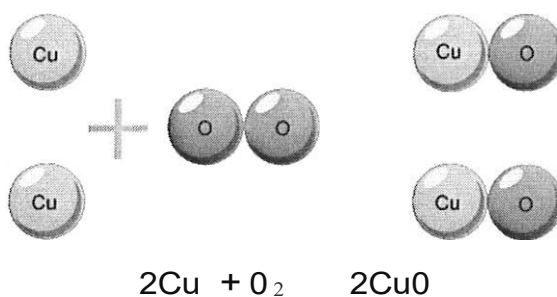


# Balancing equations



## Balancing equations

In a chemical reaction atoms are rearranged. They can't disappear or appear from nowhere. You must have the same number of each type of atom on each side of the equation



**REMINDER:** There are a number of video clips to explain this principle linked on the contents page.

### EXERCISE 6

Write balanced equations for the reactions in EXERCISE 5

- 1.
- 2.
- 3.
- 4.
- 5.
- 6.
- 7.
- 8.
- 9.
- 10.



# Rearranging equations



Rearranging allows us to show the same relationship in a different way.

So,

$$\text{moles} = \text{concentration} \times \text{volume}$$

and

$$\text{concentration} = \frac{\text{moles}}{\text{volume}}$$

and

$$\text{volume} = \frac{\text{moles}}{\text{concentration}}$$

When rearranging, whatever you do to one side of the equation you must do to the other side.

$$\text{mass} = Mr \times \text{moles}$$

Rearranging to make Mr the subject involves multiplying both sides by moles

$$\frac{\text{mass}}{\text{moles}} = \frac{Mr \times \text{moles}}{\text{moles}}$$

So,

$$Mr = \frac{\text{mass}}{\text{moles}}$$

## EXERCISE 8

Rearrange the following equations to give the letter shown as the subject:

$q = mcT$	<b>T</b> =	$x^2 + bx - 1$	b=
$pV = nRT$	R=	$x^2 - b^2 - 4ac$	b=
$G = H - TS$	<b>S</b> =	$2a - 3(b - 4c)$	b=
$f = ma$	m=	$x^2 + b - 1$	x=
$d = \frac{g}{v}$	v=	$x^2 - b^2 - 4ac$	a=
$r = \frac{1}{t}$	t=	$2a - 3(b - 4c)$	c=
$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$	<b>[Cl<sub>2</sub>]</b> =	$H - \log K$	K=

# Significant figures



You will generate many long numbers in chemistry over the next two years! It is important to round these correctly using significant figures. When you make a measurement in chemistry you can indicate how uncertain it is by the number of significant figures. For example a volume of 5.0 cm<sup>3</sup> has been measured using equipment which can be read to 0.1cm<sup>3</sup>, whereas a volume of 5.00cm<sup>3</sup> has been measured using equipment which can be read to 0.01cm<sup>3</sup>. The numbers are different.

## To find the number of significant figures of a value

- *Count the number of significant figures from the first non-zero digit.*
- *Stop at the last non-zero digit OR the last digit after a decimal point.*

484.23	5 sig fig
20.9	3 sig fig
290	2 sig fig
29.0	3 sig fig (A zero after a decimal point is significant)

## EXERCISE 9

To how many significant figures are these values recorded?

1.74		133.0	
436		$3.6 \times 10^{-6}$	
5.38000		$4.25 \times 10^7$	
9.20		$82 \times 10^9$	

When combining numbers in a calculation (using multiplication and division) your final answer can be no more certain than the least certain of the information you used to calculate the value.

Example: Calculate the number of moles in 43.85g of Mg (Ar= 24.3)

$$\text{Moles} = \frac{\text{mass}}{\text{Ar}}$$
$$\frac{43.85}{24.3}$$

*the calculator value is 1.804526749*

*We need to round the value to the data value with the fewest significant figures in the calculation.*

$$= 1.80 \text{ to 3s.f.}$$

## EXERCISE 10

Give the answers to these calculations to the appropriate number of significant figures.

- 1) What is the mass of 2 moles of water ( $\text{H}_2\text{O}$ ) Mr 18.0?
- 2) What is the rate of a reaction which produces 25 ml of gas in 42 seconds?
- 3) A reaction produced a 3.886g yield of cyclohexene. The theoretical yield was 4.25g. What is the percentage yield of cyclohexene?
- 4) How much mass is lost per second if a reaction loses 23.995g in 48 seconds?

---

# Standard form



Standard form is used to express very large and very small numbers.

$$\begin{array}{ll} 5366000 & 5.36 \times 10^6 \\ 0.00000000897 & 8.97 \times 10^{-9} \end{array}$$

Standard form must always be presented like this:

$$A \times 10^n$$

Where A is a number between 1 and 10

and n is the number of places the decimal point has 'moved'.

The same number of significant figures must be kept when converting between forms.

### EXERCISE 11

Convert these values to standard form

156 000 000		0.03445	
0.000345		481 000	
100.3		0.000689012	

17

Convert these values to ordinary form

$6.02 \times 10^3$		$3.65 \times 10^6$	
$4.2 \times 10^{-2}$		$6.778 \times 10^{-3}$	
$1.99 \times 10^5$			

### Prefixes

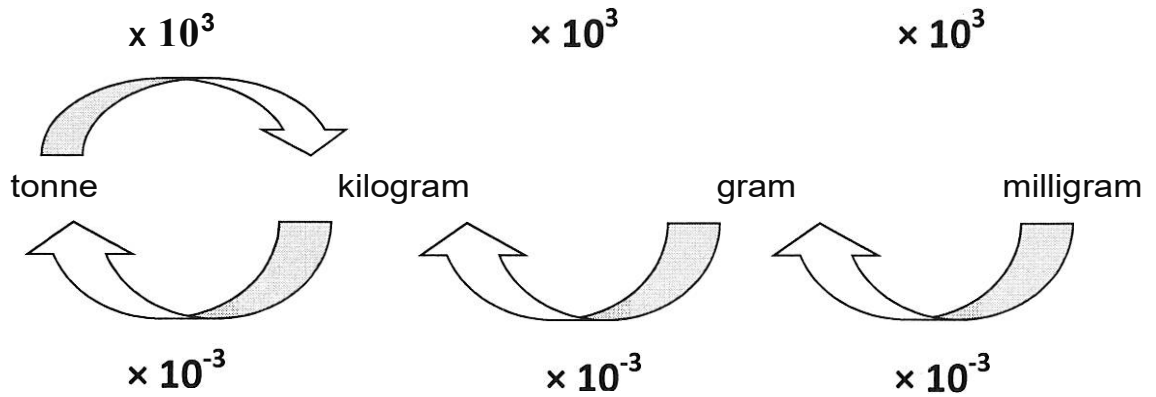
Unit prefixes are used to give information about the standard form of a value. You will often need to convert different units for different equations, or just to make them easier to handle.

The most common in advanced level chemistry are:

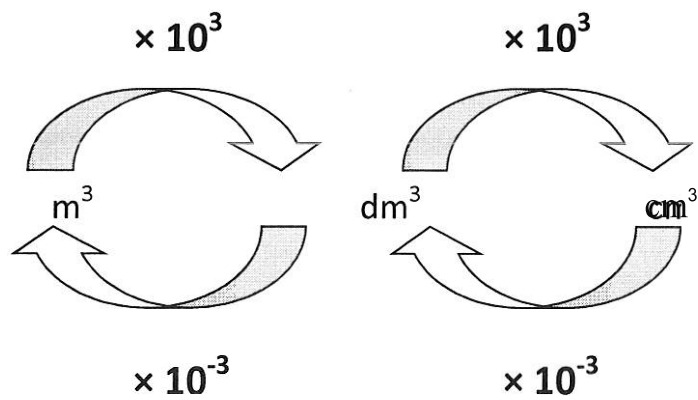
Prefix	Conversion fact or	Symbol
milli	$10^{-3}$	m
centi	$10^{-2}$	c
deci	$10^{-1}$	d
kilo	$10^3$	k

To convert a number to a base unit, convert the number into standard form and then multiply by the conversion factor.

This diagram shows the common mass conversions:



Other common conversions are between these **volume** prefixes:



## EXERCISE 12

Convert these values into the units given, give answers in standard form.

	in grams		in cm <sup>3</sup>
13.5 tonnes		0.025dm <sup>3</sup>	
0.000235kg		14.3m <sup>3</sup>	
315mg		0.000412m <sup>3</sup>	
0.567t		256dm <sup>3</sup>	

# Indices



Indices or powers tell you how many times to multiply a number by it self.

$$3^6 = 3 \times 3 \times 3 \times 3 \times 3 \times 3 = 729$$

A negative power is the same as 1 over the positive version of the power

$$A^{-n} = \frac{1}{A^n} \quad [r^{-2} = \frac{1}{r^2} = 0.111 \text{ to 3s.f.}]$$

When multiplying two numbers with the same base add the powers together

$$A^n \times A^p = A^{n+p}$$

When dividing two numbers with the same base, subtract the powers.

$$\frac{A^n}{A^p} = A^{n-p}$$

And finally,

$$(A^n)^p = A^{np}$$

## EXERCISE 13

$\frac{a^2}{a^3} =$		$a^{-6}$ $a^7 \times a^2 =$	
$a^2 \times a^3 =$		$\frac{ab^{-3}c^{-1}}{(ab-3)^3} =$	

# Graph skills



Graphs show us the relationship (or lack of) between variables.

General rules are listed below, there may be deviations from these on occasion but changes will usually be highlighted to you.

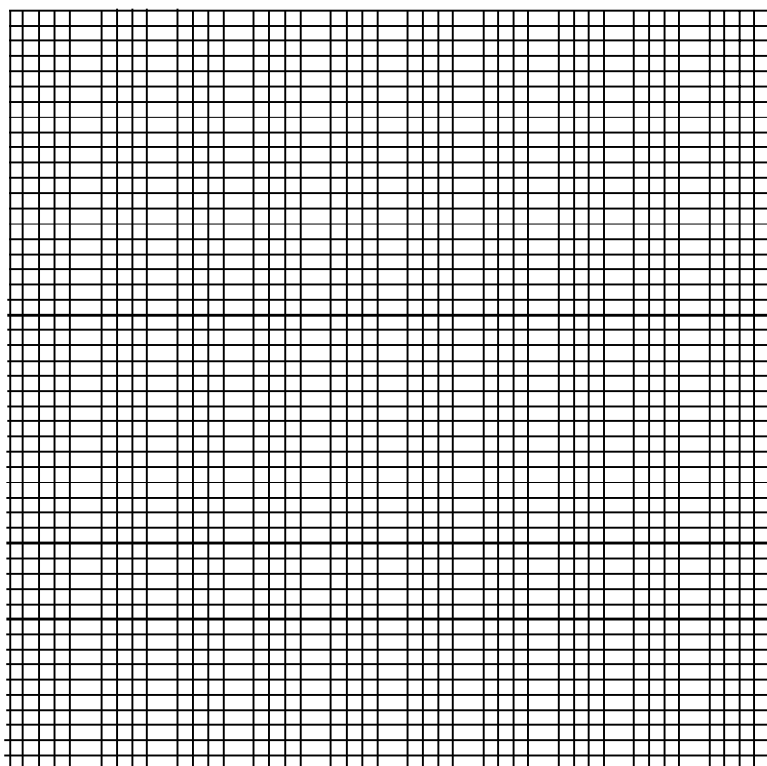
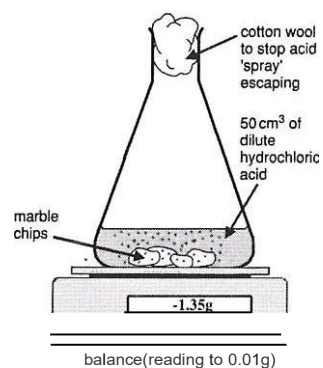
- o Identify your independent variable (x axis) and the dependent variable (y axis).
- o Choose a sensible scale and if necessary allow for extrapolation.
- o Draw and label your axes including the units ( in the form variable/units)
- o Plot your points with a neat sharp point.
- o Draw a line of bestfit.

Then you need to be able to manipulate and use that data!

## EXERCISE 14

Experiment: Marble chips were added to a conical flask containing  $2.0 \text{ mol dm}^{-3}$  hydrochloric acid. The mass change was measured over time and recorded in a table.

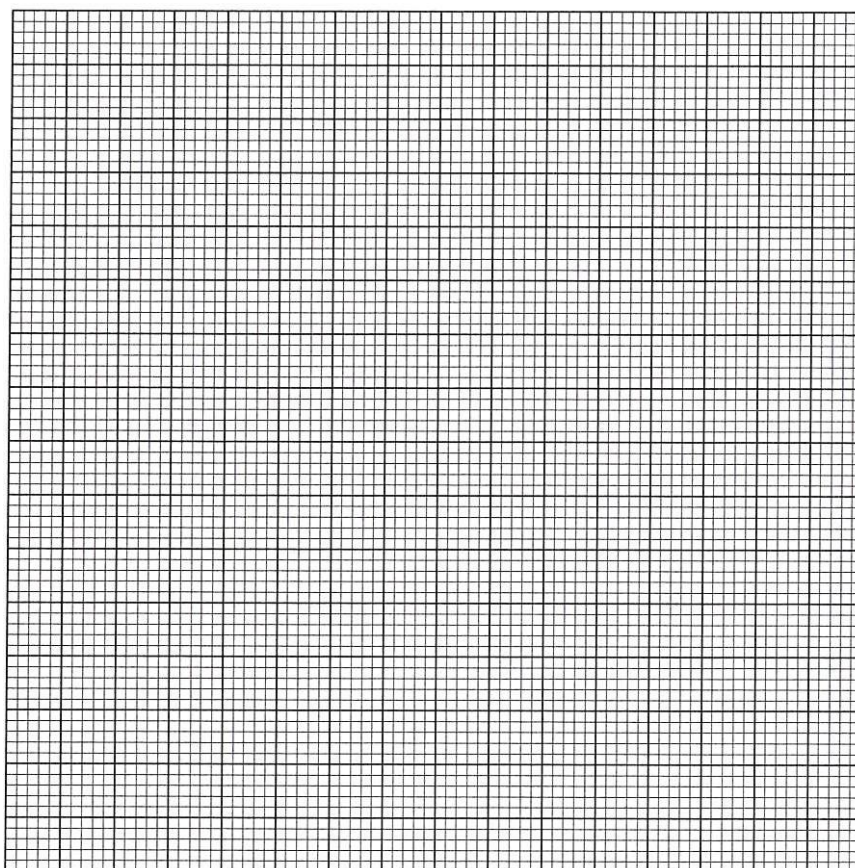
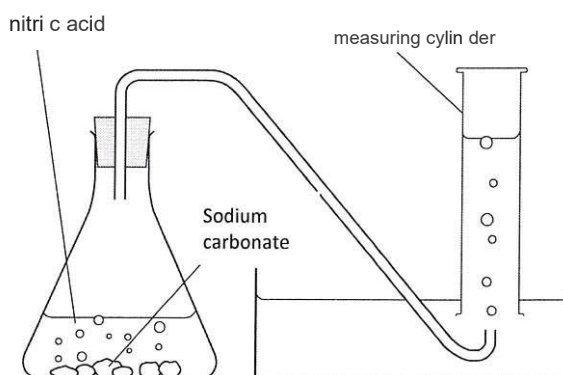
Time/s	Loss in mass/g
0	0.000
10	0.018
20	0.048
30	0.081
40	0.116
50	0.143
60	0.158
70	0.165
80	0.165
90	0.165



- 1) Draw a graph of this data
- 2) How long would it take to lose 0.150g of mass?
- 3) Between 20 and 50 seconds what is the rate of mass loss?
- 4) What is the rate of mass loss between 75 and 85 seconds?

Experiment: Sodium carbonate was reacted with nitric acid and the gas produced collected over time. The following results were obtained:

Time/s	Volume of gas produced/ cm <sup>3</sup>
0	0
10	8
20	28
30	52
40	78
<b>50</b>	<b>87</b>
60	106
70	123



- 1) Plot a graph of time/s against volume of gas produced / m<sup>3</sup>
  - 2) What would you expect the gas volume to be at 80seconds?
  - 3) What would you expect the gas volume produced to be at 43 seconds?
  - 4) What would you expect the gas volume to be at 10seconds?
- S) What is the rate of gas production between 42 and 62 seconds?



## ANSWERS TO EXERCISES

### Answers Ex 1 Writing formulae from names:

1. Sodium Chloride	NaCl	11. Copper(I) Oxide	Cu <sub>2</sub> O
2. Sodium Hydroxide	NaOH	12. Nitrogen	N <sub>2</sub>
3. Sodium Carbonate	Na <sub>2</sub> CO <sub>3</sub>	13. Sulfur trioxide	SO <sub>3</sub>
4. .	Sodium Sulphate	Na <sub>2</sub> SO <sub>4</sub>	14. Iron (II) Oxide FeO
5. Magnesium Chloride	MgCl <sub>2</sub>	15. Iron (III) Oxide	Fe <sub>2</sub> O <sub>3</sub>
6. Magnesium Nitrate	Mg(NO <sub>3</sub> ) <sub>2</sub>	16. Ammonium Nitrate	NH <sub>4</sub> NO <sub>3</sub>
7. Magnesium Hydroxide	Mg(OH) <sub>2</sub>	17. Ammonium Sulphate	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>
8. Aluminium Chloride	AlCl <sub>3</sub>	18. Silver	Ag
9. Aluminium Sulphate	Al <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>	19. Aluminium Oxide	Al <sub>2</sub> O <sub>3</sub>
10. Copper (II) Sulphate	CuSO <sub>4</sub>	20. Calcium	Ca

### Answers Ex 2 Writing names from formulae:

1. H <sub>2</sub> O	Water	11. Li <sub>2</sub> SO <sub>4</sub>	Lithium Sulphate
2. CO <sub>2</sub>	Carbon Dioxide	12. CuSO <sub>4</sub>	Copper Sulfate
3. .	NH <sub>3</sub>	Ammonia	13. AgNO <sub>3</sub> Silver nitrate
4. NaH	Sodium Hydride	14. (NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>	Ammonium sulphate
5. CH <sub>4</sub>	Methane	15. NH <sub>4</sub> VO <sub>3</sub>	Ammonium vanadate
6. HNO <sub>3</sub>	Nitric Acid	16. KMnO <sub>4</sub>	Potassium Manganate
7. NaNO <sub>3</sub>	Sodium Nitrate	17. Co	Cobalt
8. CaCl <sub>2</sub>	Calcium chloride	18. KI	Potassium Iodide
9. SO <sub>2</sub>	Sulphur Dioxide	19. Co(NO <sub>3</sub> ) <sub>2</sub>	Cobalt Nitrate
10. Li <sub>2</sub> S	Lithium Sulfide	20. K <sup>+</sup> .At <sup>-</sup>	Potassium Astatide

### Answers Ex 3

1. Sodium oxide	Ionic	11. CO	Simple Molecular
2. Graphite	Giant Covalent	12. Co	Monatomic
3. Bromine	Simple Molecular	13. NaNO <sub>3</sub>	Ionic
4. Copper nitrate	Ionic	14. Fe	Monatomic
5. Argon	Monatomic	15. Sa	Simple Molecular
6. Iron chloride	Ionic	16. CaSO <sub>4</sub>	Ionic
7. Calcium	Metallic	17. H <sub>2</sub>	Simple Molecular
8. Oxygen	Simple Molecular	18. SiO <sub>2</sub>	Giant Covalent
9. Fluorine	Simple Molecular	19. Na	Monatomic
10. Water	Simple Molecular	20. Kr	Monatomic

### Answers Ex 4

Name	Formula	Acid	Base	Alkali	Salt
calcium carbonate	CaCO <sub>3</sub>				
copper (II) chloride	CuCl <sub>2</sub>				
sulphuric acid	H <sub>2</sub> SO <sub>4</sub>				
sodium sulfate	Na <sub>2</sub> SO <sub>4</sub>				
silver nitrate	AgNO <sub>3</sub>				
phosphoric acid	H <sub>3</sub> PO <sub>4</sub>				
calcium oxide	CaO				
potassium hydroxide	KOH				
ethanoic acid	CH <sub>3</sub> COOH				
sodium ethanoate	CH <sub>3</sub> COONa				
Sodium nitrate	NaNO <sub>3</sub>				
nitric acid	HNO <sub>3</sub>				
hydrochloric acid	HCl				
ammonia	NH <sub>3</sub>				
ammonium nitrate	NH <sub>4</sub> NO <sub>3</sub>				
ammonium sulfate	(NH <sub>4</sub> ) <sub>2</sub> SO <sub>4</sub>				
barium hydroxide	Ba(OH) <sub>2</sub>				
lead bromide	PbBr <sub>2</sub>				
zinc phosphate	Zn <sub>3</sub> (PO <sub>4</sub> ) <sub>2</sub>				
nickel carbonate	NiCO <sub>3</sub>				
Copper (II) oxide	CuO				
lithium hydroxide	LiOH				
iron (III) sulphate	Fe <sub>2</sub> (SO <sub>4</sub> ) <sub>3</sub>				
magnesium chloride	MgCl <sub>2</sub>				

### Answers Ex 5 and 6

Aluminium + Sulfur      Aluminium Sulfide

Copper + Oxygen      Copper (II) Oxide

Ethane + Oxygen      Carbon dioxide + Water

Ethanol + Oxygen      Carbon dioxide + Water

Lithium + Water      Lithium hydroxide + Hydrogen

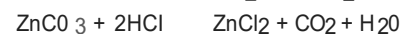
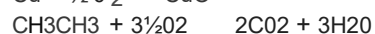
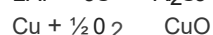
Magnesium + Nitric acid      Magnesium nitrate + Hydrogen

Potassium + Oxygen      Potassium Oxide

Calcium Hydroxide + Hydrochloric acid      Calcium chloride + Water

Sodium Oxide + Sulphuric acid      Sodium Sulphate + Water

Zinc Carbonate + Hydrochloric acid      Zinc chloride + Carbon dioxide + Water



**Ex7**

1.  $Zn(s) + CuSO_4(aq) \rightarrow ZnSO_4(aq) + Cu(s)$
2.  $Ca(OH)_2(s) + 2NH_4Cl \rightarrow CaCl_2(s) + 2H_2O(g) + 2NH_3(g)$
3.  $Pb(NO_3)_2(s) \rightarrow PbO(s) + 2NO_2(g) + O_2(g)$
4.  $SiCl_4(l) + 2H_2O(l) \rightarrow SiO_2(s) + 4HCl(g)$
5.  $CaH_2(s) + 12\frac{1}{2}O_2(g) \rightarrow 8CO_2(g) + 9H_2O(g)$
6.  $3Br_2 + 6NaOH(aq) \rightarrow 3NaBr(aq) + NaBrO_3(aq) + 3H_2O(l)$
7.  $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$

**Ex8**

$q = mc\Delta T$	$T = \frac{E}{k_B}$	$x^2 + bx = 1$	$b = \frac{1-x^2}{x}$
$pV = nRT$	$R = E_{III}$	$x = \frac{b' - 4ac}{b^2 - 4ac}$	$b = \frac{x + 4ac}{b^2 - 4ac}$
$G = H - TS$	$S = \frac{H-G}{T}$	$2a = 3(b - 4c)$	$b = \frac{2a}{3} + 4c$
$f = ma$	$m = \frac{f}{a}$	$x^2 + b = 1$	$x = -\frac{b}{2} \pm \sqrt{\frac{b^2}{4} - 1}$
$d = \frac{f}{v}$	$v = \frac{f}{d}$	$x = \frac{b^2 - 4ac}{b^2 - 4ac}$	$a = \frac{b^2 - x}{4c}$
$r = \frac{v}{t}$	$t = \frac{v}{r}$	$2a = 3(b - 4c)$	$b = \frac{2a}{3} + 4c$
$K_c = \frac{[PbCl_2][Cl_2]}{[PbCl_2]}$	$[Cl_2] = \frac{K_c [PbCl_2]}{[PbCl_2]}$	$H = -\log K$	$K = 10^{-H}$

**Ex9**

1.74	3	133.0	4
436	3	$3.6 \times 10^{-6}$	2
5.38000	6	$4.25 \times 10^7$	3
9.20	3	$82 \times 10^9$	2

**Ex 10**

- 1) 40g to 1 sf (sf very important!)
- 2)  $0.60 \text{ ml} \cdot \text{s}^{-1}$  to 2 sf
- 3) 91.4% to 3sf
- 4) 40.50g to 2sf

**Ex11**

156 000 000	$1.56 \times 10^8$	0.03445	$3.445 \times 10^{-2}$
0.000345	$3.45 \times 10^{-4}$	481 000	$4.81 \times 10^5$
100.3	$1.003 \times 10^2$	0.000689012	$6.89012 \times 10^{-4}$

$6.02 \times 10^3$	6020	$3.65 \times 10^{-6}$	3650000
$4.2 \times 10^{-2}$	0.042	$6.778 \times 10^{-3}$	0.006778
$1.99 \times 10^5$	199000		

**Ex 12**

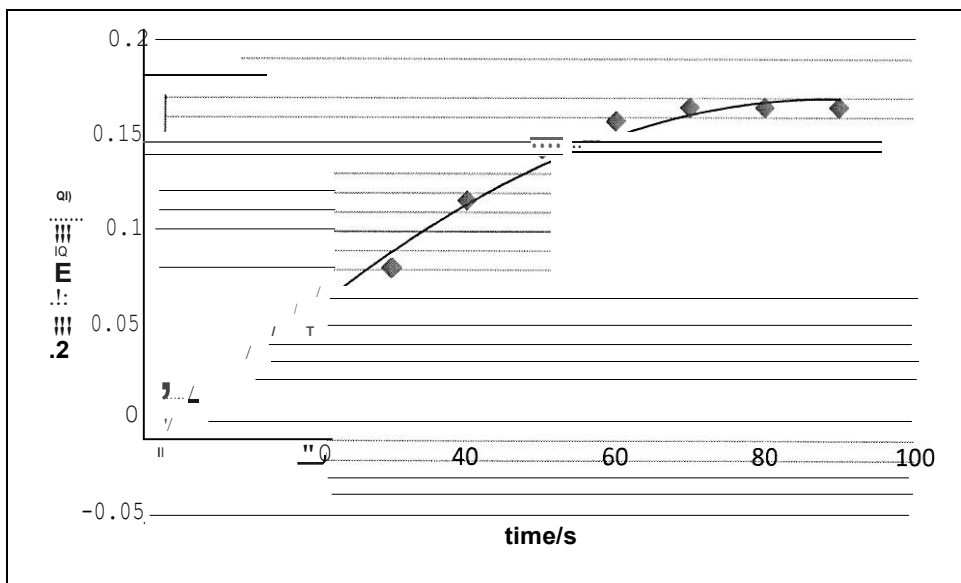
	in grams		in $\text{cm}^3$
13.5 tonnes	$1.35 \times 10^7$		$0.025 \text{ dm}^3$
			$2.5 \times 10^1$

0.000235kg	$2.35 \times 10^{-1}$	$14.3\text{m}^3$	$1.43 \times 10^7$
315mg	$3.15 \times 10^{-1}$	0.000412m <sup>3</sup>	$4.12 \times 10^2$
0.567t	$6.67 \times 10^5$	256dm <sup>3</sup>	$2.56 \times 10^5$

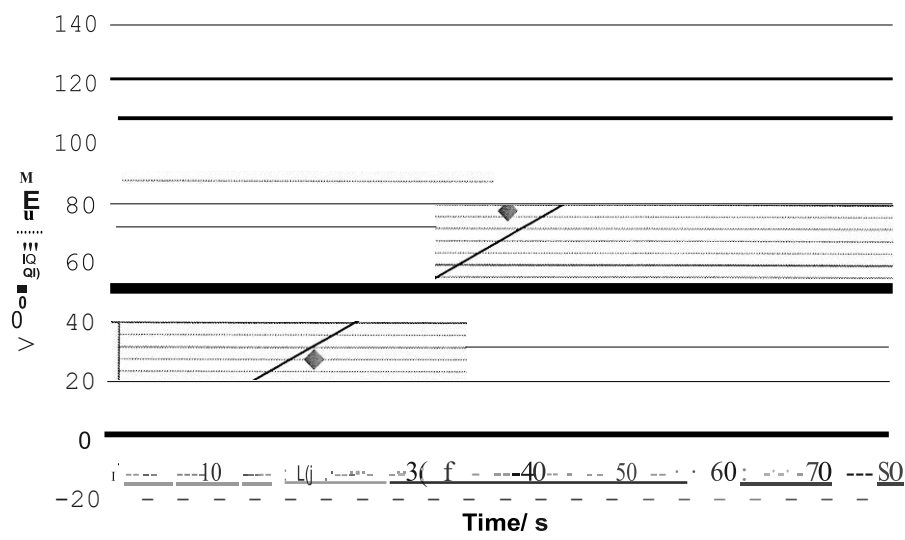
**EXERCISE 13**

$a^2 \times a^3$	$a^{-1}$	$a^{-6}$	$a^{-1} s$
$a^2$	$a^3$	$a^7 \times a^2$	
		$(a^b - 3)c^{-1}$	$a^{-2} b^6 c^{-1}$

**EXERCISE 14**



- 2) 55s
- 3)  $3.17 \times 10^{-3} \text{g}\cdot\text{s}^{-1}$
- 4)  $0.00 \text{g}\cdot\text{s}^{-1}$



- 2)  $140 \text{cm}^3$
- 3)  $76 \text{cm}^3$
- 4) 14 s (from the graph not the data table)
- 5)  $1.7 \text{cm}^3\cdot\text{s}^{-1}$

### Ex 15 Reading Scales

- 1) 0.23
- 2) -0.06
- 3) -2.6
- 4) 6.65cm<sup>3</sup>
- 5) 27.75 cm<sup>3</sup>
- 6) 87.5 °C
- 7) 36 .50 cm<sup>3</sup>
- 8) 3300cm<sup>1</sup>
- 9) 2.6ppm

## WHERE AM I? ANSWERS

- a)  $\text{Mg} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2$
- b) Magnesium nitrate is an ionic compound, hydrogen is a simple molecular substance.
- c)  $\therefore \frac{0.0}{50} = 8.24\text{g}$  of magnesium nitrate is the theoretical yield

Therefore, moles of Magnesium nitrate and thus Magnesium =  $\frac{0.0555}{148.3} = 0.0555$

Mass of magnesium =  $0.0555 \times 24.3 = 1.35\text{g to } 3\text{sf}$  **MUST BE TO 3 SF**

- d)  $\frac{1300}{420} = 3.10 \text{ cm}^3 \text{ s}^{-1}$  **MUST BE TO 3 SF**
- e) Magnesium oxide or Magnesium hydroxide
- f)  $\text{MgO} + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O}$   
or  $\text{Mg}(\text{OH})_2 + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + 2\text{H}_2\text{O}$   
or  $\text{MgCO}_3 + 2\text{HNO}_3 \rightarrow \text{Mg}(\text{NO}_3)_2 + \text{H}_2\text{O} + \text{CO}_2$
- g) 416g **MUST BE TO 3 SF**