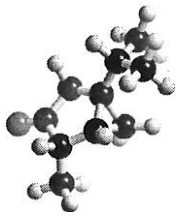
JCoSS



Chemistry Department

Yr12 Induction Work

Bridging the gap between GCSE and Advanced level

Summer 2024

The Periodic Table of the Elements

1	2											3	4	5	6	7	0
(1)	(2)											(13)	(14)	(15)	(16)	(17)	4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4						1.0 H hydrogen 1					10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 0 oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulfur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	96.0 Mo molybdenum 42	technetium 43	101.1 Ru ruthenium 44	102.9 Rh rhodium 45	106.4 Pd palladium 46	107.9 Ag silver 47	112.4 Cd cadmium 48	114.8 In indium 49	118.7 Sn tin 50	121.8 Sb antimony 51	127.6 Te tellurium 52	126.9 I iodine 53	131.3 Xe xenon 54
132.9 Cs caesium 55	137.3 Ba barium 56	138.9 La * lanthanum 57	178.5 Hf hafnium 72	180.9 Ta tantalum 73	183.8 W tungsten 74	186.2 Re rhenium 75	190,2 Os osmium 7ci	192.2 Ir iridium 77	195.1 Pt platinum 78	197.0 Au gold 79	200.6 Hg mercury 80	204.4 Tl thallium 81	207.2 Pb lead 82	209.0 Bi bismuth 83	[209] Po polonium 84	[210) At astatine 85	[222] Rn radon 86
[223) Fr francium 87	[226) Ra radium 88	[227) Act actinium 89	[267) Rf rutherfordrJm 104	(268] Db dubnium 105	(271) Sg seaborgium 106	[272] Bh bohrium 107	[270] Hs hassium 108	[276] Mt meitnerium 109	[281] Os dcrmstl1tull 110	[280] Rg roentgenii.m 111	Elem ents w ith atom ic numbe rs 112 -116 have been reported but not fully authent icated						

Key

relative atomic mass
symbol
name
atomic (proton) number

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

* 58 - 71 Lanthanides

t 90 - 103 Actinides

N

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.

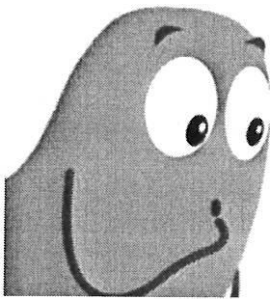
Contents

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

Useful resources:

- Use your GCSE notes.
- 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!
- Essential Maths Skills for A-Level Chemistry by CGP ISBN 978 **4** 78294 472 0

WHERE AM I?



Use these warm up questions to evaluate where you are now and what you can do already. If you get something right through guessing, you do not necessarily know it!
Check with the answers at the end of the booklet to assess which topics you need to develop your understanding of.
The expectation is that youcan do this with ease.
It is your responsibility to address any issues and seek support where necessary.

Magnesium reacts with nitric acid to produce a salt and a gas. The salt is used in chemical agriculture and is produced naturally when guano reacts with magnesium containing rocks.

a) Write a balanced symbol equation reaction for the reaction.

b) Give the structure types of the two products formed.

c) The experiment produced 7.00g of the salt. This was 85.0% of the expected yield. Assuming the magnesium was the limiting factor what mass of magnesium was used in the initial reaction?

d) 1.30dm^3 of gas was produced in 7.00 minutes. What is the rate of gas production in cm^3s^{-1}?

e) Name a suitable base which would produce the same salt as the original reaction with nitric acid. Write a balanced symbol equation for this reaction.

f) At 298K the solubi lity of the salt is 125g/100ml in water. What is the mass of the saturated solution at 25°C if the volume of water used is 1.85 x $10^{1}dm^3$?

{ANSWERS ARE ON THE LAST PAGE}

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.

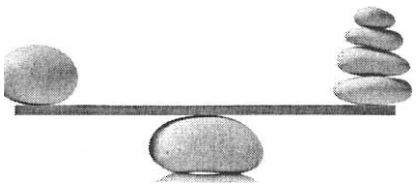
You are expected to **KNOW** the information on these two pages and will be tested on it frequently. You **WILL** do far better in Chemistry if you are formula literate.

Elements				**Compounds**	
H_2	hydrogen	Ti	titanium	H_2O	water
He	helium	**V**	vanadium	**NH_3**	ammonia
Li	lithium	Cr	chromium	H_2SO_4	sulfuric acid
C	carbon	Mn	manganese	HNO_3	nitric acid
N_2	nitrogen	Fe	iron	HCl	hydrochloric acid
O_2	oxygen	Co	cobalt	NaOH	sodium hydroxide
F_2	fluorine	**Ni**	nickel	CO	carbon monoxide
Ne	neon	**Cu**	copper	CO_2	carbon dioxide
Na	sodium	Zn	zinc	**NO**	nitrogen monoxide
Mg	magnesium	**Br_2**	bromine	NO_2	nitrogen dioxide
Al	aluminium	Ag	silver	SO_2	sulfur dioxide
Si	silicon	Sn	tin	SO_3	sulfur trioxide
P_4	phosphorus	I2	iodine	H_2S	hydrogen sulfide
S_8	sulfur	**W**	tungsten	CH_4	methane
Cl_2	chlorine	Pt	platinum	**NaCl**	sodium chloride
Ar	argon	**Au**	gold	**$CuSO_4$**	copper sulfate
K	potassium	Hg	mercury	$AgNO_3$	silver nitrate
Ca	calcium			**$CaCO_3$**	calcium carbonate

	Group 1 ions	Group 2 ions	Group 3 ions	Others
POSITIVE IONS	Li^+ lithium Na^+ sodium K^+ potassium	Mg^{2+} magnesium Ca^{2+} calcium Ba^{2+} barium	Al^{3+} aluminium	NH_3 ammonium Ag^+ silver Cu^{2+} copper (II} Fe^{2+} iron (II) Fe^{3+} iron (III } Zn^{2+} zinc Pb^{2+} lead

	Group 6 ions	Group 7 ions	Others
NEGATIVE IONS	O^{2-} oxide S^{2-} sulfide	F^- fluoride Cl^- chloride Br^- bromide I^- iodide	OH^- hydroxide NO_3^- nitrate SO_4^{2-} sulfate CO_3^{2-} carbonate HCO_3^- hydrogencarbonate

Putting together an ionic formula:



The charges must balance.
Molecular ions will need to be contained in brackets.

e.g.

Potassium Oxide

Potassium ion K^+ Oxide ion O^{2-}

There is 1+ and 2-

So we need:

K+ K+ to balance the O^{2-}

Giving the formula

K_2O

Aluminium Hydroxide

Aluminium ion Al^{3+} Hydroxide ion

There is 3+ and 1-

So we need:

OH- OH- OH- to balance the Al^{3+}

Giving the formula

$Al(OH)_3$

Ammonium Phosphate

Ammonium ion NH_4^+ Phosphate ion PO_4^{3-}

There is 1+ and 3-

So we need:

NH_4^+ NH_4^+ NH_4^+ to balance the PO_4^{3-}

Giving the formula

$(NH_4)_3PO_4$

Lithium Nitride

Lithium ion Li^+ Nitride ion N^{3-}

There is 1+ and 3-

So we need:

Li+ Li+ Li+ to balance the N^{3-}

Giving the formula

Li_3N

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
2. CO
3. NH_3
4. NaH
5. CH_4
6. HNO_3
7. $NaNO_3$
8. $CaCl_2$
9. SO
10. Li_2S
11. Li_2SO_4
12. CuSO4
13. $AgNO_3$
14. $(NH_4)_2SO_4$
15. NH_4VO_3
16. $KMnO_4$
17. Co
18. KI
19. $Co(NO_3)$
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 O elements
Simple molecular	Some non-metal elements (e.g. H_2, N_2, O_2, F_2, P_4, S_8, Cl_2, Br_2, I_2) Compounds made from non-metals (e.g. NH_3, CO_2, H_2O, $C_6H_{12}O_6$, CH_4)
Giant covalent *or Macromolecular*	Diamond (C), graphite (C), graphene (C), silicon (Si), silicon dioxide (SiO_2)
Ionic	Compounds made from metal+ non-metals (e.g. NaCl, Fe_2O_3, $CuSO_4$)
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
2. Graphite
3. Bromine
4. Copper nitrate
5. Argon
6. Iron chloride
7. Calcium
8. Oxygen
9. Fluorine
10. . Water
11. CO
12. Co
13. $NaNO_3$
14. Fe
15. S
16. $CaSO_4$
17. H_2
18. SiO_2
19. Na
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) *react to form chloride salts* Sulfuric acid (H2S04) *react to form sulfate salts* Nitric acid ($HN0_{3)}$ *react to form nitrate salts* Phosphoric acid (H_3P0_4) *react to form phosphate salts*
Base	Substances that react with acids to form a salt & water (and sometimes CO_2) 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 ($NH_{3)}$
Alkali	Substances that release OH-(aq) ions when added to water, e.g. Metal hydroxides (e.g. sodium hydroxide, calcium hydroxide, potassium hydroxide) Ammonia ($NH_{3)}$
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, ammo' nium 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:

a) give its name or formula if missing (use the ion charges on the data sheet to help)

b) 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	H_3PO_4				
	CaO				
	KOH				
ethanoic acid	CH_3COOH				
sodium ethanoate	CH_3COONa				
	Na NO_3				
	HNO_3				
hydrochloric acid					
ammonia					
ammonium nitrate					
ammonium sulfate					
barium hydroxide					
lead bromide					
zinc phosphate	$Zn_3(PO_4)_2$				
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:

acid + alkali + salt + water

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

Acid and metal oxide:

acid + metal oxide + salt + water

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

Acid and metal carbonate:

acid + metal carbonate + salt + water+ carbon dioxide

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

Acid and metal:

acid + metal+ salt + hydrogen

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

Metal and oxygen:

metal + oxygen + metal oxide

- An example is magnesium + oxygen → magnesium oxide

Metal and sulfur:

metal + sulfur + metal sulfide

- An example is iron + sulfur → iron sulfide

Metal and water:

metal + water + metal hydroxide + hydrogen

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

Combustion of hydrocarbon:

hydrocarbon + oxygen + carbon dioxide + water

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

Ionic equations of some common reactions	
Acid + metal hydroxide salt + water	H+ + O-H H20
Acid + metal carbonate salt + water + carbon dioxide	$2H^+ + CO_3^{2-}$ $H_2O + CO_2$
Acid + metal hydrogencarbonate salt + water + carbon dioxide	$H^+ + HCO_3^-$ $H_2O + CO_2$
Acid + ammonia ammonium salt	$H^+ + NH_3$ 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_3 CH_3) burning completely in oxygen

4. Ethanol (CH_3CH_20 H) 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

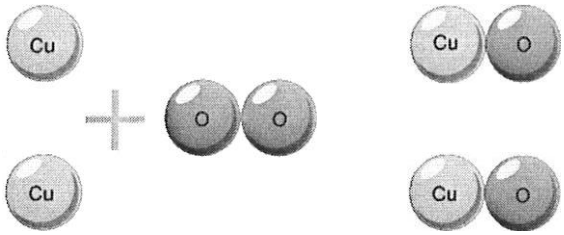
9. The reaction of sodium oxide with sulphuric acid

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



$2Cu + 0_2 \quad 2Cu0$

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.

EXERCISE 7

Write balanced equations for the following reactions (including state symbols):

Remember:	**(s) solid**	**(l) liquid**	**(g) gas**	**(aq) aqueous - dissolved in water**

1. Zinc metal reacts with copper (II) sulphate solution to produce solid copper metal and znc sulphate solution

2. Solid calcium hydroxide reacts with solid ammonium chloride on heating to produce solid calcium chloride, steam and ammonia gas.

3. When lead(II) nitrate is heated in a dry tube lead (II) oxide, nitrogen dioxide gas and oxygen are produced.

4. Silicon tetrachloride reacts with water to produce solid silicon dioxide and hydrogen chloride gas.

5. When octane (C_8H_{18}) vapour is burnt with excess air in a car engine carbon dioxide and water vapour are produced through a complete combustion reaction.

6. All the halogens apart from fluorine react with concentrated sodium hydroxide solution to produce a solution of NaX, $NaXO_3$ and water . Write an equation for the reaction of bromine with concentrated sodium hydroxide.

7. The elements of group 1 of the periodic table all react with water to produce a solution of the metal hydroxide and hydrogen gas. Write an equation for the reaction of lithium with water.

Rearranging equations

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

So,

$$moles \quad concentration \times volume$$

and

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

and

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

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

$$mass = Mr \times moles$$

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

$$\frac{mass}{moles} \quad \frac{Mr \times moles}{moles}$$

So,

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

EXERCISE 8

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

$q = mcT$	**T=**	$x^2 + bx - 1$	b=
$pV - nRT$	R=	$x - b^2 - 4ac$	b=
$G = H-TS$	S =	$2a - 3(b - 4c)$	b=
$f = ma$	m=	$x^2 + b - 1$	x=
$d - \frac{g}{v}$	v=	$x - b^2 - 4ac$	a=
$r = -t$	t=	$2a - 3(b - 4c)$	c=
$K_C = \frac{[PCl_3][Cl_2]}{[PCl_5]}$	$[Cl_2] =$	$H - -\log K$	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^3 has been measured using equipment which can be read to 0.1cm^3,whereas a volume of 5.00cm^3 cm^3 has been measured using equipment which can be read to 0.01cm^3. 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		3.6×10^{-6}	
5.38000		4.25×10^{7}	
9.20		82×10^{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)

$$Moles = \frac{mass}{Ar}$$

$$\frac{43.85}{24.3}$$

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 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 {H_20) 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.

5366000	5.36×10^{6}
0.00000000897	8.97×10^{-9}

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	

Convert these values to ordinary form

6.02×10^{3}		3.65×10^{6}	
4.2×10^{-2}		6.778×10^{-3}	
1.99×10^{5}			

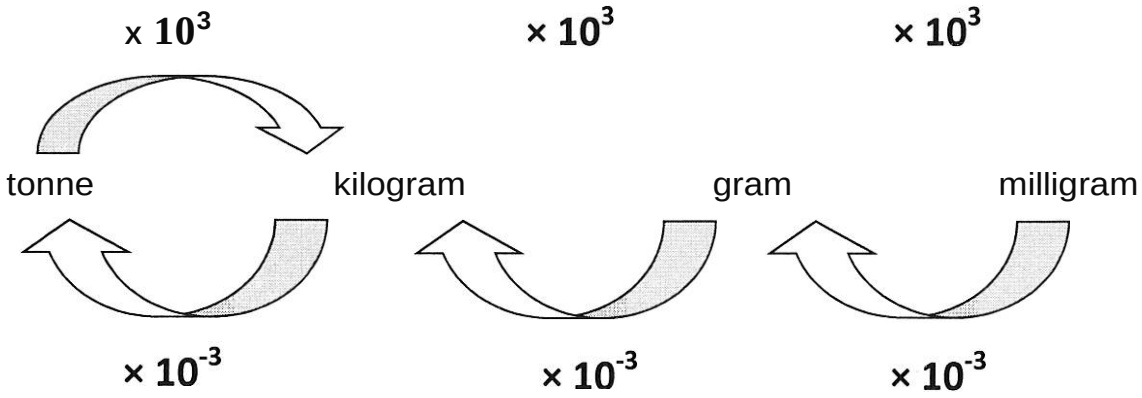
Prefixes

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.

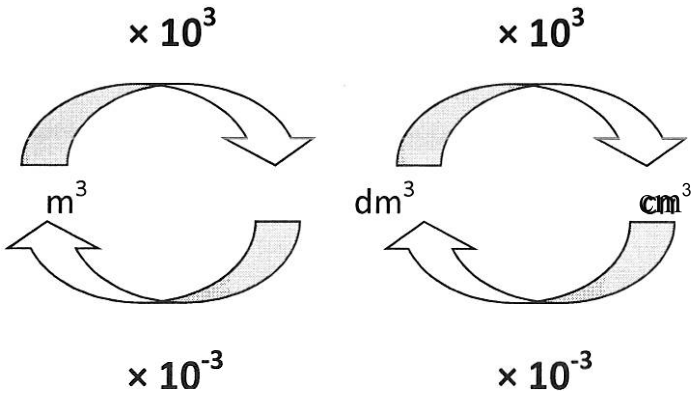
The most common in advanced level chemistry are:

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^3
13.5 tonnes		$0.025dm^3$	
0.000235kg		$14.3m^3$	
315mg		$0.000412m^3$	
0.567t		256dm3	

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

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

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

$\frac{az}{a3}$ =		$\frac{a^{-6}}{a^7 \times a^2}$ =	
$\frac{a^2 \times a^3}{az}$ =		$\frac{ab^{-3}c^{-1}}{(ab^{-3})^3}$ =	

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.

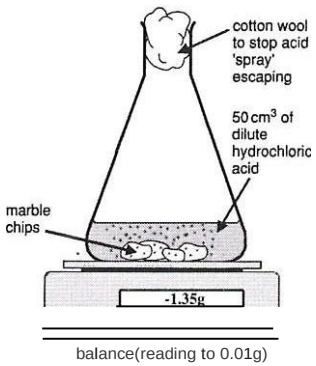
- Identify your independent variable *(x* axis) and the dependent variable *(y* axis).
- Choose a sensible scale and if necessary allow for extrapolation.
- Draw and label your axes including the units (in the form variable/units)
- Plot your points with a neat sharp point.
- Draw a line of best fit.

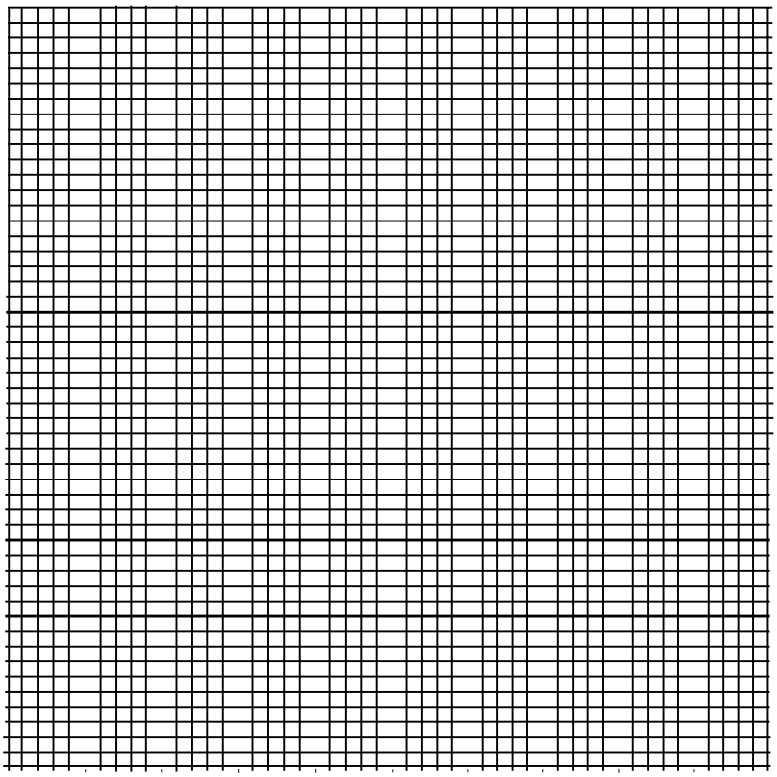
Then you need to be able to manipulate and use that data!

EXERCISE 14

Experiment: Marble chips were added to a conical flask containing 2.0 moldm^{-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

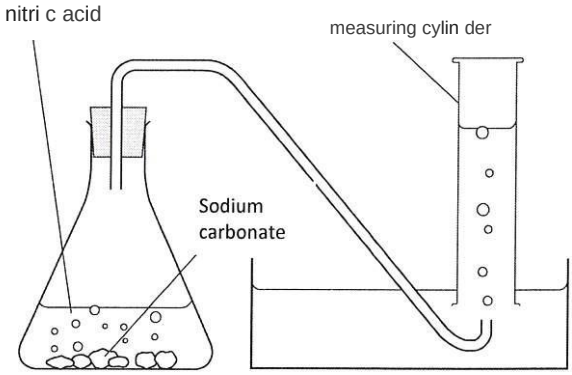


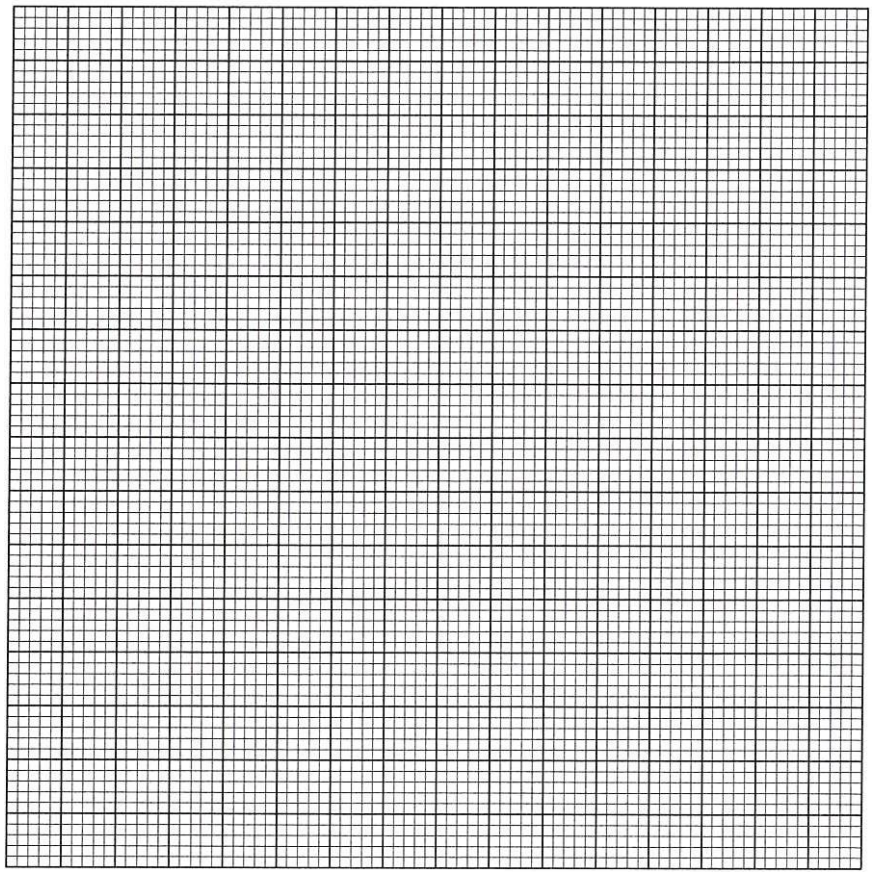


1) Draw a graph of this data
2) How long would it take to lose 0.150g of mass?
3) Between 20 and 50 seconds what is the rate of mass loss?
4) What is the rate of mass loss between 75 and 85 seconds?

Experim ent: 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^3
0	0
10	8
20	28
30	52
40	78
SO	87
60	106
70	123





1) Plot a graph of time/s against volume of gas produced / m^3.
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 lOseconds?

S) What is the rate of gas production between 42 and 62 second s?

ANSWERS TO EXERCISES

Answers Ex 1 Writing formulae from names:

1.	Sodium Chloride	NaCl	11.	Copper (I) Oxide	Cu_20
2.	Sodium Hydroxide	NaOH	12.	Nitrogen	N_2
3.	Sodium Carbonate	Na_2C03	13.	Sulfur trioxide	S03
4.	.	Sodium Sulphate	Na_2S04	14. Iron (II) Oxide	FeO
5.	Magnesium Chloride	$MgCl_2$	15.	Iron (III) Oxide	Fe_203
6.	Magnesium Nitrate	Mg(N03)i	16.	Ammonium Nitrate	NH_4N03
7.	Magnesium Hydroxide	Mg(OH)i	17.	Ammonium Sulphate	$(NH_4)i$ S04
8.	Aluminium Clhoride	$AlCl_3$	18.	Silver	Ag
9.	Aluminium Sulphate	$Al_2(S04h$	19.	Aluminium Oxide	Al_20_3
10.	Copper (II) Sulphate	CuS04	**20.**	Calcium	Ca

Answers Ex 2 Writing names from formulae:

1.	H20	Water	11.	Li_2S04	Lithium Sulfate
2.	CO_2	Carbon Dioxide	12.	CuS04	Copper Sulfate
3.	.	NH_3	Ammonia	13.	AgN03 Silver nitrate
4.	NaH	Sodium Hydride	14.	$(NH_4)i$ S04	Ammonium sulphate
5.	CH_4	Methane	15.	NH_4V0_3	Ammonium vanadate
6.	$HN0_3$	Nitric Acid	16.	$KMn0_4$	Potassium Manganate
7.	$NaN0_3$	Sodium Nitrate	17.	Co	Cobalt
8.	$CaCl_2$	Calcium chloride	18.	KI	Potassium Iodide
9.	S02	Sulphur Dioxide	19.	$Co(N0_3)i$	Cobalt Nitrate
10.	Li_2S	Lithium Sulfide	20.	k'.Al	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.	NaN03	Ionic
4.	Copper nitrate	Ionic	14.	Fe	Monatomic
5.	Argon	Monatomic	15.	Sa	Simple Molecular
6.	Iron chloride	Ionic	16.	CaS04	Ionic
7.	Calcium	Metallic	17.	H2	Simple Molecular
8.	Oxygen	Simple Molecular	18.	$Si0_2$	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	$CaCO_3$				
copper (II) chloride	$CuCl_2$				
sulphuric acid	H_2SO_4				
sodium sulfate	Na_2SO_4				
silver nitrate	$AgNO_3$				
phosphoric acid	H_3PO_4				
calcium oxide	cao				
potassium hydroxide	KOH				
ethanoic acid	CH_3COOH				
sodium ethanoate	CH_3COONa				
Sodium nitrate	$NaNO_3$				
nitric acid	HNO_3				
hydrochloric acid	HCl				
ammonia	NH_3				
ammonium nitrate	NH_4NO_3				
ammonium sulfate	$(NH_4)_2SO_4$				
barium hydroxide	$Ba(OH)_2$				
lead bromide	$PbBr_2$				
zinc phosphate	$Zn_3(PO_4)_2$				
nickel carbonate	$NiCO_3$				
Copper (II) oxide	CuO				
lithium hydroxide	LiOH				
iron (III) sulphate	$Fe_2(SO_4)_3$				
magnesium chloride	$MgCl_2$				

Answers Ex S 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

$2Al + 3S \rightarrow Al_2S_3$
$Cu + \frac{1}{2}O_2 \rightarrow CuO$
$CH_3CH_3 + 3\frac{1}{2}O_2 \rightarrow 2CO_2 + 3H_2O$
$CH_3CH_2OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$
$Li + H_2O \rightarrow LiOH + \frac{1}{2}H_2$
$Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$
$2K + \frac{1}{2}O_2 \rightarrow K_2O$
$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + H_2O$
$Na_2O + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
$ZnCO_3 + 2HCl \rightarrow ZnCl_2 + CO_2 + H_2O$

Ex 7

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. $C_3H_8(g) + 5O_2(g) \rightarrow 3CO_2(g) + 4H_2O(g)$
6. $3Br_2 + 6NaOH(aq) \rightarrow 5NaBr(aq) + NaBrO_3(aq) + 3H_2O(l)$
7. $2Li(s) + 2H_2O(l) \rightarrow 2LiOH(aq) + H_2(g)$

Ex8

$q = mc\Delta T$	$c = \frac{q}{m\Delta T}$	$x^2 + bx = 1$	$b = -\frac{1}{2} \pm \sqrt{\frac{1}{4} + c}$
$pV = nRT$	$R = \frac{pV}{nT}$	$x = \sqrt{b + 4ac}$	$b = x^2 \pm 4ac$
$G = H - TS$	$S = \frac{H - G}{T}$	$2a = 3(b - 4c)$	$b = \frac{2}{3}a + 4c$
$f = ma$	$m = \frac{f}{a}$	$x^2 + b = 1$	$x = \pm\sqrt{1 - b}$
$d = \frac{m}{V}$	$V = \frac{m}{d}$	$x = \sqrt{b^2 - 4ac}$	$a = \frac{b^2 - x}{4c}$
$r = \frac{\Delta x}{t}$	$t = \frac{\Delta x}{r}$	$2a = 3(b - 4c)$	$b = \frac{2a}{3} + 4c$
$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$	$[Cl_2] = \frac{K_c[PCl_5]}{[PCl_3]}$	$H = -\log K$	$K = 10^{-H}$

Ex9

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

Ex 10

1) 40g to 1 sf (sf very important!)
2) $0.60\ m1 \cdot s^{-1}$ to 2 s f
3) 91.4% to 3sf
4) 40.S0g to 2sf

Exll

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

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

Ex12

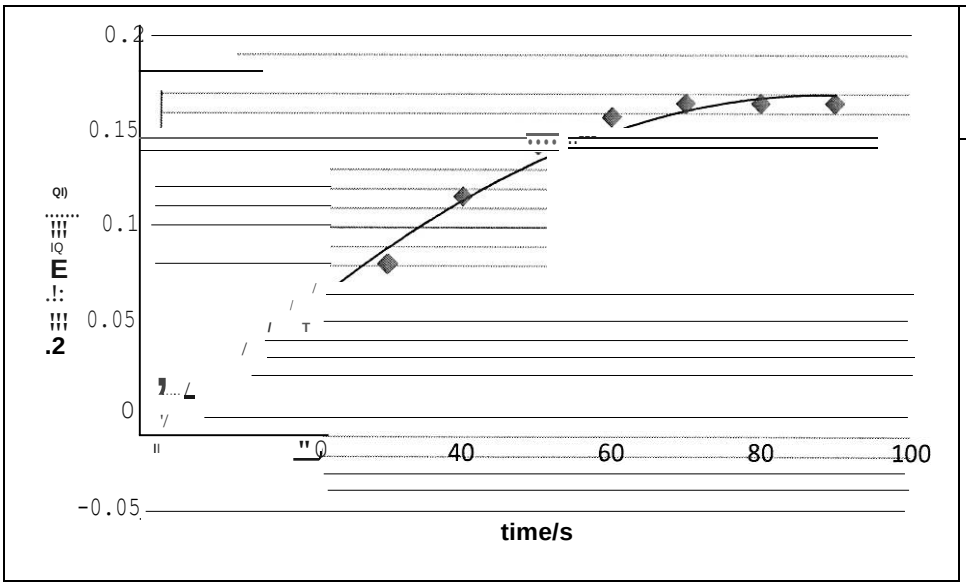
	in grams		in cm^3
13.5 tonnes	1.35×10^{7}	$0.025 dm^3$	2.5×10^{1}

0.000235kg	2.35 x 10-1	14.3m 3	1.43 x 10^7
315mg	3.15 x 10-1	0.000412m3	4.1 2 x 102
0.567t	6.67 x 10^5	256dm3	2.56 x 10^5

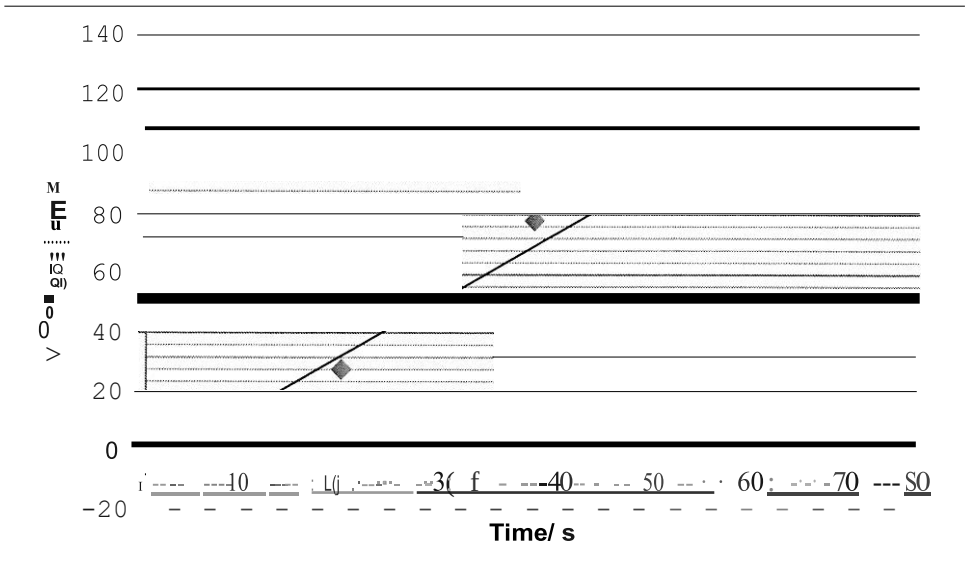
EXERCISE 13

$\frac{a^z}{a3}$	a - 1	$\frac{a-6}{a^7 \times a^2}$	a - 1 s
$\frac{a^2 \times a^3}{a2}$	a3	a b- 3c- 1 (a b - 3) 3 -	$a-2b6c-1$

EXERCISE 14



2) 55s
3) 3.17 X 10-3 g-s
4) 0.00 g-s



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

Ex 15 Reading Scales

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

WHERE AM I? ANSWERS

a) $Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$

b) Magnesium nitrate is an ionic compound, hydrogen is a simple molecular substance.

c) $\therefore \frac{0.0}{50} = 8.24g$ of magnesium nitrate is the theoretical yield

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

Mass of magnesium = 0.0555 x 24.3 = **1 . 35g** *to 3sf* **MUST BE TO 3 SF**

d) $\frac{1300}{420} = 3.10\ cm^3 s^{-1}$ **MUST BE TO 3 SF**

e) Magnesium oxide or Magnesium hydroxide

f) $MgO + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$

or $Mg(OH)_2 + 2HNO_3 \rightarrow Mg(NO_3)_2 + 2H_2O$

or $MgCO_3 + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2O + CO_2$

g) 416g **MUST BE TO 3 SF**