Saint Benedict
Catholic Voluntary Academy

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BE PREPARED

Chemistry

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Catholic Multi Academy Trust

What do you need to know?

- OCR A GCE Chemistry https://ocr.org.uk/qualifications/as-and-a-level/chemistry-a-h032-h432-from-2015/
- The textbook – you will be lent a textbook for both years

Useful websites to consolidate your study:

http://www.docbrown.info/page13/page13.htm

https://www.chemguide.co.uk/

http://www.knockhardy.org.uk/sci.htm

https://mathsmadeeasy.co.uk/a-level-chemistry-revision/

http://www.physicsandmathstutor.com/chemistry-revision/a-level-ocr-a/

YouTube: MaChemGuy: Excellent source of walked through exam questions specific to OCR

https://cramnow.com/: Excellent website to practice multiple choice questions which make up the first section of Paper 1 and Paper 2

Equipment that you will need for every lesson

A4 ring binder
A4 lined pad of paper
30 cm ruler
Basic stationary
Calculator
Post-It notes
Subject dividers
Access to a hole punch and stapler

Completing the Be Prepared Booklet

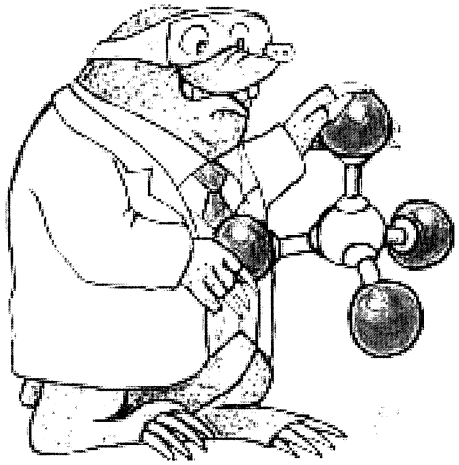
You are expected to know, recall and apply the content that you have learnt at GCSE.

There is a data sheet and periodic table at the back of this booklet.

Completing the tasks.

- Complete tasks in the booklet where the spaces have been provided
- For all maths calculations, these need to be completed on A4 lined paper.

AMOUNT OF SUBSTANCE



CHEMSHEETS.co.uk

1 - FORMULAE

If you are serious about doing A level Chemistry, you **MUST** be able to write a formula without a second thought. It is the single most essential skill for an A level chemist.

You have to know and be able to use the information on this page – you should not be looking it up. There is no data sheet with ion charges at A level.

If you can't write a formula in an instant, **DROP CHEMISTRY NOW** and choose something else.

Elements

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
He helium	H_2 hydrogen	There are no ionic elements!!	The formula is just the symbol, e.g.	The formula is just the symbol
Ne neon	N_2 nitrogen		Mg magnesium	C diamond
Ar argon	O_2 oxygen		Fe iron	C graphite
Kr krypton	F_2 fluorine		Na sodium	C graphine
Xe xenon	Cl_2 chlorine		Ni nickel	Si silicon
Rn radon	Br_2 bromine			
	I_2 iodine			
	P_4 phosphorus			
	S_8 sulfur			

Compounds

Monatomic	Simple molecular	Ionic	Metallic	Giant covalent
There are no monatomic compounds!!	Some common molecular compounds: CO_2 carbon dioxide CO carbon monoxide NO nitrogen monoxide NO_2 nitrogen dioxide SO_2 sulfur dioxide SO_3 sulfur trioxide NH_3 ammonia CH_4 methane H_2S hydrogen sulfide	These have to be worked out using ion charges – you have to know these at AS/A level! LEARN them ASAP. Note these acids: HCl hydrochloric acid H_2SO_4 sulfuric acid HNO_3 nitric acid H_3PO_4 phosphoric acid	There are no metallic compounds!!	SiO_2 silicon dioxide

Positive ions		Negative ions	
Group 1 ions: Li^+ lithium Na^+ sodium K^+ potassium Group 2 ions: Mg^{2+} magnesium Ca^{2+} calcium Ba^{2+} barium	Group 3 ions: Al^{3+} aluminium Other common ions Mg^{2+} silver(I) Zn^{2+} zinc(II) NH_4^+ ammonium H^+ hydrogen	Group 7 ions: F^- fluoride Cl^- chloride Br^- bromide I^- iodide Group 6 ions: O^{2-} oxide S^{2-} sulfide	Other common ions NO_3^- nitrate SO_4^{2-} sulfate CO_3^{2-} carbonate HCO_3^- hydrogencarbonate OH^- hydroxide H^- hydride PO_4^{3-} phosphate

TASK 1 – WRITING FORMULAS OF IONIC COMPOUNDS

1) silver(I) bromide .....
2) sodium carbonate .....
3) potassium oxide .....
4) iron(III) oxide .....
5) chromium(III) chloride .....
6) calcium hydroxide .....
7) aluminium nitrate .....
8) sodium sulfate .....
9) lead(II) oxide .....
10) sodium phosphate .....
11) zinc hydrogencarbonate .....
12) ammonium sulfate .....
13) gallium hydroxide .....
14) strontium selenide .....
15) radium sulfate .....
16) sodium nitride .....

TASK 2 – WRITING FORMULAS 1

1) lead(IV) oxide .....
2) copper .....
3) sodium .....
4) ammonium chloride .....
5) ammonia .....
6) sulfur .....
7) sulfuric acid .....
8) neon .....
9) silica .....
10) silicon .....
11) barium hydroxide .....
12) tin(IV) chloride .....
13) silver(I) nitrate .....
14) iodine .....
15) nickel .....
16) hydrogen sulfide .....
17) titanium(IV) oxide .....
18) lead .....
19) strontium sulfate .....
20) lithium .....

TASK 3 – WRITING FORMULAS 2

1) silver(I) carbonate .....
2) gold .....
3) platinum(II) fluoride .....
4) nitric acid .....
5) ammonia .....
6) silicon(IV) hydride .....
7) phosphorus .....
8) diamond .....
9) vanadium(V) oxide .....
10) cobalt(II) hydroxide .....
11) barium hydroxide .....
12) ammonia .....
13) hydrochloric acid .....
14) fluorine .....
15) silicon .....
16) calcium phosphate .....
17) rubidium .....
18) germanium(IV) oxide .....
19) magnesium astatide .....
20) nitrogen monoxide .....

2 - EQUATIONS

From an early age you should have been able to balance chemical equations. However, at A level, you will often need to:

- work out the formulas yourselves
- work out what is made (so you need to know some basic general equations)
- for reactions involving ions in solution, write ionic equations

Some general reactions you should know:

General Reaction	Examples
substance + oxygen → oxides	$2\ Mg + O_2 \rightarrow 2\ MgO$ $2\ H_2S + 3\ O_2 \rightarrow 2\ H_2O + 2\ SO_2$ $C_3H_8 + 5\ O_2 \rightarrow 3\ CO_2 + 4\ H_2O$
metal + water → metal hydroxide + hydrogen	$2\ Na + 2\ H_2O \rightarrow 2\ NaOH + H_2$
metal + acid → salt + hydrogen	$Mg + 2\ HCl \rightarrow MgCl_2 + H_2$
oxide + acid → salt + water	$MgO + 2\ HNO_3 \rightarrow Mg(NO_3)_2 + H_2O$
hydroxide + acid → salt + water	$2\ NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
carbonate + acid → salt + water + carbon dioxide	$CuCO_3 + 2\ HCl \rightarrow CuCl_2 + H_2O + CO_2$
hydrogencarbonate + acid → salt + water + carbon dioxide	$KHCO_3 + HCl \rightarrow KCl + H_2O + CO_2$
ammonia + acid → ammonium salt	$NH_3 + HCl \rightarrow NH_4Cl$
metal carbonate → metal oxide + carbon dioxide (on heating)	$CaCO_3 \rightarrow CaO + CO_2$

TASK 4 – WRITING BALANCED EQUATIONS

1) Balance the following equations.

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

b) $CuCl_2 + NaOH \rightarrow Cu(OH)_2 + NaCl$

c) $SO_2 + O_2 \rightarrow SO_3$

d) $C_4H_{10} + O_2 \rightarrow CO_2 + H_2O$

2) Give balanced equations for the following reactions.

a) sodium + oxygen → sodium oxide

b) aluminium + chlorine → aluminium chloride

c) calcium + hydrochloric acid → calcium chloride + hydrogen

d) ammonia + sulfuric acid → ammonium sulfate

TASK 5 – WRITING BALANCED EQUATIONS 2

Write balance equations for the following reactions:

1) burning aluminium

2) burning hexane (C_6H_{14})

3) burning ethanethiol (CH_3CH_2SH)

4) reaction of lithium with water

5) reaction of calcium carbonate with nitric acid

6) thermal decomposition of lithium carbonate

7) reaction of ammonia with nitric acid

8) reaction of potassium oxide with sulfuric acid

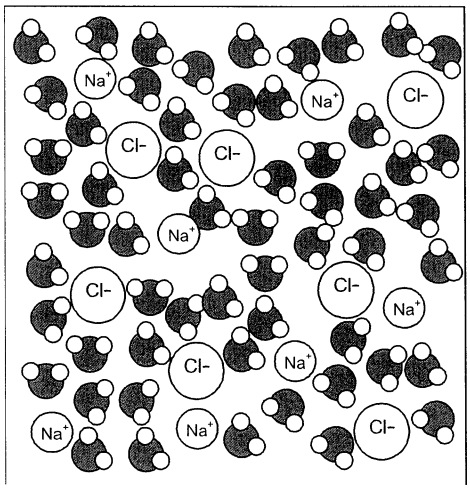
9) reaction of calcium hydroxide with hydrochloric acid

10) reaction of zinc with phosphoric acid

11) reaction of sodium hydrogencarbonate with sulfuric acid

12) reaction of potassium hydroxide with sulfuric acid

Ionic equations



When an ionic substance dissolves in water, the positive and negative ions separate and become hydrated (they interact with water molecules rather than each other). For example, a solution of sodium chloride could also be described as a mixture of hydrated sodium ions and hydrated chloride ions in water.

In reactions involving ionic compounds dissolved in water, some of the ions may not be involved in the reaction. These are called ***spectator ions***. For such reactions, we can write an ***ionic equation*** that only shows the species that are involved in the reaction.

Simple examples are equations for which ionic equations can be written include:

Reactions of acids:

Common ionic equations are:	acid + hydroxide	$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$
	acid + carbonate	$2\ H^+(aq) + CO_3^{2-}(aq) \rightarrow H_2O(l) + CO_2(g)$
	acid + hydrogencarbonate	$H^+(aq) + HCO_3^-(aq) \rightarrow H_2O(l) + CO_2(g)$
	acid + ammonia	$H^+(aq) + NH_3(aq) \rightarrow NH_4^+(aq)$

We can even use these ionic equations to work out the ratio in which acids react without writing any equation.

For example, in the reaction of $H_2SO_4(aq)$ with NaOH(aq) we know that one lot of H_2SO_4 contains two lots of H^+ ions. As H^+ ions react with OH^- ions in the ratio 1:1 [$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$] we know that we need two lots of NaOH to provide two lots of OH^- ions to react with the two lots of H^+ ions. Therefore, one lot of H_2SO_4 reacts with two lots of NaOH, i.e. the reacting ratio of H_2SO_4 : NaOH = 1:2

TASK 7 – SIGNIFICANT FIGURES & STANDARD FORM

1) Write the following numbers to the quoted number of significant figures.

a) 345789 4 sig figs .....
b) 297300 3 sig figs .....
c) 0.07896 3 sig figs .....
d) 6.0961 3 sig figs .....
e) 0.001563 3 sig figs .....
f) 0.010398 4 sig figs .....

2) Complete the following sums and give the answers to the appropriate number of significant figures.

a) 6125 x 384 .....
b) 25.00 x 0.010 .....
c) 13.5 + 0.18 .....
d) 7550 ÷ 25 .....
e) 0.000152 x 13.00 .....
f) 0.0125 x 0.025 .....

3) Write the following numbers in non standard form.

a) 1.5×10^{-3} .....
b) 4.6×10^{-4} .....
c) 3.575×10^{5} .....
d) 5.34×10^{2} .....
e) 1.03×10^{6} .....
f) 8.35×10^{-3} .....

4) Write the following numbers in standard form.

a) 0.000167 .....
b) 0.0524 .....
c) 0.000000015 .....
d) 34500 .....
e) 0.62 .....
f) 87000000 .....

5) Complete the following calculations and give the answers to the appropriate number of significant figures.

a) $6.125 \times 10^{-3} \times 3.5$ .....
b) $4.3 \times 10^{-4} \div 7.00$ .....
c) $4.0 \times 10^{8} + 35000$ .....
d) $0.00156 + 2.4 \times 10^{3}$ .....
e) $6.10 \times 10^{-2} - 3.4 \times 10^{-5}$ .....
f) $8.00 \times 10^{-3} \times 0.100 \times 10^{-3}$ .....

4 – RELATIVE MASS

- Most elements are made of up atoms of different isotopes (e.g. chlorine contains both ^{35}Cl and ^{37}Cl atoms)
- The relative atomic mass (A_r) of an element is an average of the mass of the isotopes taking into account the relative abundance of each isotope.

Relative atomic mass, A_r	Average mass of an atom of an element relative to $\frac{1}{12}$th the mass of ^{12}C atom
Relative formula mass, M_r	*If referring specifically to a molecule (relative molecular mass)* Average mass of a molecule of a substance relative to $\frac{1}{12}$th the mass of ^{12}C atom
	More generally for any substance Sum of the relative atomic masses of all the atoms in the formula of a substance

TASK 8 – RELATIVE FORMULA MASS

Calculate the M_r of each of these substances.

1 F_2 .....

2 Fe .....

3 H_2SO_4 .....

4 Al_2O_3 .....

5 $Mg(OH)_2$ .....

6 $Al(NO_3)_3$ .....

7 $(NH_4)_2SO_4$ .....

8 $CuCO_3$ .....

9 $AgNO_3$ .....

10 NH_4NO_3 .....

11 $CuSO_4.5H_2O$ .....

12 magnesium .....

13 oxygen .....

14 sodium bromide .....

15 calcium fluoride .....

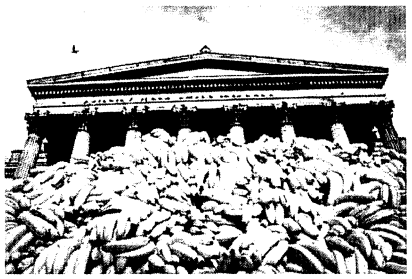
16 potassium sulfate .....

17 chlorine .....

18 iron(III) sulfate .....

5 – THE MOLE & AVOGADRO CONSTANT

- One mole of anything contains 6.022×10^{23} of those things. One mole of bananas is 6.022×10^{23} bananas. One mole of water molecules is 6.022×10^{23} water molecules
- This number is known as the Avogadro constant (= 6.022×10^{23} mol^{-1}).
- The Avogadro number was chosen so that the mass of one mole of particles of a substance equals the M_r in grams. For example, the M_r of water is 18.0, and the mass of one mole of water molecules in 18.0 grams.



$$\text{Moles} = \frac{\text{mass (g)}}{M_r}$$

1 ton = 1,000,000 g

1 kg = 1,000 g

1 mg = 0.001 g

Remember *Mr Moles!*

TASK 9 – MOLES

1) How many moles are there in each of the following?

a) 72.0 g of Mg b) 4.00 kg of CuO c) 39.0 g of $Al(OH)_3$

d) 1.00 tonne of NaCl e) 20.0 mg of $Cu(NO_3)_2$

2) What is the mass of each of the following?

a) 5.00 moles of Cl_2 b) 0.200 moles of Al_2O_3 c) 0.0100 moles of Ag

d) 0.00200 moles of $(NH_4)_2SO_4$ e) 0.300 moles of $Na_2CO_3.10H_2O$

3) a) Calculate the number of moles of CO_2 molecules in 11.0 g of carbon dioxide.

b) Calculate the number of moles of C atoms in 11.0 g of carbon dioxide.

a) Calculate the number of moles of O atoms in 11.0 g of carbon dioxide.

4) a) Calculate the number of moles of Al_2O_3 in 5.10 g of Al_2O_3

b) Calculate the number of moles of Al^{3+} ions in 5.10 g of Al_2O_3

a) Calculate the number of moles of O^{2-} ions in 5.10 g of Al_2O_3

5) An experiment was carried out to find the M_r of vitamin C (ascorbic acid). It was found that 1.00 g contains 0.00568 moles of Vitamin C molecules. Calculate the M_r of vitamin C.

6) Use the following data to calculate the mass of the particles shown.

Mass of proton = 1.6726×10^{-24} g Mass of electron = 9.1094×10^{-28} g

Mass of neutron = 1.6749×10^{-24} g Avogadro constant = 6.022×10^{23} mol^{-1}

a) Calculate the mass of a ^1H atom.

b) Calculate the mass of an $^1H^+$ ion.

c) Calculate the mass of one mole of ^3H atoms.

TASK 11 – REACTING MASS CALCULATIONS 1

1) What mass of hydrogen is needed to react with 40.0 g of copper(II) oxide?

$CuO + H_2 \rightarrow Cu + H_2O$

2) What mass of oxygen reacts with 192 g of magnesium?

$2\ Mg + O_2 \rightarrow 2\ MgO$

3) What mass of sulfur trioxide is formed from 96.0 g of sulfur dioxide?

$2\ SO_2 + O_2 \rightarrow 2\ SO_3$

4) What mass of carbon monoxide is needed to react with 480 kg of iron(III) oxide?

$Fe_2O_3 + 3\ CO \rightarrow 2\ Fe + 3\ CO_2$

5) What mass of carbon dioxide is produced when 5.60 g of butene is burnt.

$C_4H_8 + 6\ O_2 \rightarrow 4\ CO_2 + 4\ H_2O$

6) What mass of oxygen is needed to react with 8.50 g of hydrogen sulfide (H_2S)?

$2\ H_2S + 3\ O_2 \rightarrow 2\ SO_2 + 2\ H_2O$

7) 4.92 g of hydrated magnesium sulfate crystals ($MgSO_4.nH_2O$) gave 2.40 g of anhydrous magnesium sulfate on heating to constant mass. Work out the formula mass of the hydrated magnesium sulfate and so the value of *n*.

$MgSO_4.nH_2O \rightarrow MgSO_4 + n\ H_2O$

8) In an experiment to find the value of *x* in the compound $MgBr_2.xH_2O$, 7.30 g of the compound on heating to constant mass gave 4.60 g of the anhydrous salt $MgBr_2$. Find the value of *x*.

$MgBr_2.xH_2O \rightarrow MgBr_2 + x\ H_2O$

9) What mass of glucose must be fermented to give 5.00 kg of ethanol?

$C_6H_{12}O_6 \rightarrow 2\ C_2H_5OH + 2\ CO_2$

10) The pollutant sulfur dioxide can removed from the air by reaction with calcium carbonate in the presence of oxygen. What mass of calcium carbonate is needed to remove 1.000 tonnes of sulfur dioxide?

$2\ CaCO_3 + 2\ SO_2 + O_2 \rightarrow 2\ CaSO_4 + 2\ CO_2$

11) What mass of potassium oxide is formed when 7.80 mg of potassium is burned in oxygen?

$4\ K + O_2 \rightarrow 2\ K_2O$

12) What mass of hydrogen is produced when 10.0 g of aluminium reacts with excess hydrochloric acid?

$2\ Al + 6\ HCl \rightarrow 2\ AlCl_3 + 3\ H_2$

13) What mass of sodium just reacts with 40.0 g of oxygen?

$4\ Na + O_2 \rightarrow 2\ Na_2O$

14) What mass of nitrogen is produced when 2.00 tonnes of ammonia gas decomposes?

$2\ NH_3 \rightarrow N_2 + 3\ H_2$

15) What mass of oxygen is produced when 136 g of hydrogen peroxide molecules decompose?

$2\ H_2O_2 \rightarrow 2\ H_2O + O_2$

16) What mass of lead(II) oxide is produced when 0.400 moles of lead(II) nitrate decomposes?

$2\ Pb(NO_3)_2 \rightarrow 2\ PbO + 4\ NO_2 + O_2$