

**WKGS AS Chemistry**

**Summer Work**

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| **NAME** |  |
| **PREVIOUS SCHOOL** |  |
| **GCSE SCIENCE AND MATHS GRADES** |  |
| **CURRENT CAREER ASPIRATIONS (if any)** |  |
| **MARK**  | **/ 50** |
| **PERCENTAGE** | **%** |
| **AREAS OF SUCCESS** |  |
| **AREAS FOR IMPROVEMENT** |  |

**WRITING CHEMICAL FORMULA**

For ionic compounds, the chemical formula must be worked out. You will no longer have the list of ions in the exam (like at GCSE). Instead you must learn some and work out others.

***Working out charges on ions***

* Ionic compounds contain metals and non-metals.
* Metal atoms (under staircase) lose electrons during a reaction and will ALWAYS form positive ions.
* Non-metal atoms (above the stair case) gain electrons during a reaction and will ALWAYS form negative ions.
* Group number in the periodic table can therefore be used to determine the charge on single ions:

Group 1 elements (1st column) = 1+ ions

**Metals**

Group 2 elements (2nd column) = 2+ ions

Group 6 elements (6th column) = 1- ions

**Non-metals**

Group 7 elements (7th column) = 2- ions

***Ions to LEARN***

Some ions exist as covalent or polyatomic ions (bonding between atoms within these ions is covalent and the charge is overall) and these just have to be learnt! Below is a list of some of the most common polyatomic ions:

hydroxide - OH- manganate - MnO4- nitrate - NO3 - phosphate - PO4 3- nitrite - NO2 - cyanide - CN-
carbonate - CO3 2- chlorate - ClO3-
sulfate - SO4 2- peroxide - O2 2-

sulfite - SO3 2-  dichromate - Cr2O7 2-

thiosulfate - S2O3 2-  chromate - CrO4 2-

ammonium - NH4 + (common exception to positive metal ions)

Charges must cancel out when ***working out*** the overall formula. For example:

***1. Sodium Chloride:***

Sodium = group 1 metal = Na+

Chloride = group 7 non-metal = Cl -

**Formula:** Na+ + Cl - = NaCl

Charges are equal and opposite so cancel out (ratio = 1 Na+ : 1 Cl-)

***2. Magnesium Bromide:***

Magnesium = group 2 metal = Mg2+

Bromide = group 7 non-metal = Br -

**Formula:** Mg2+ + 2Br -  = MgCl2

Charges DO NOT cancel out with one of each – need 2 x Br – to cancel out Mg2+ (ratio = 1 Mg2+ : 2Br -)

***3. Calcium Carbonate:***

Calcium = group 2 metal = Ca2+

Carbonate = polyatomic ion (from list) = CO3 2-

**Formula:** Ca2+ + CO3 2- = CaCO3

Charges are equal and opposite so cancel out (ratio = 1 Ca2+ : 1 CO3 2-)

***4. Ammonium sulphate:***

Ammonium = polyatomic ion (from list) = NH4 +, Sulphate = polyatomic ion (from list) = SO4 2-

**Formula:** 2NH4 +  + SO4 2- = (NH4)2SO4

Charges DO NOT cancel out with one of each – need 2 x NH4 + to cancel out SO4 2- (ratio = 2 NH4 +: 1 SO4 2-)

**NOTE:** when you need more than one polyatomic ion you need to use brackets.

**There are some reactions from GCSE that you use at A-level. Some of these include:**

1. Metal + oxygen → Metal oxide
2. Hydrocarbon + oxygen → carbon dioxide + water
3. Metal + acid → salt + hydrogen
4. Base + acid **→** salt + water
5. Alkali + acid **→** salt + water
6. Metal carbonate + acid → salt + water + carbon dioxide

**TASKS 1:** Give the formula of the following substances, showing working out:

 a) aluminium nitrate d) Potassium manganate

 b) vanadium(V) oxide e) Magnesium bromide

 c) copper(II) hydroxide f) potassium dichromate

**(Total 6 marks)**

**TASK 2:** Complete the following word equations and write balanced equations for each reaction.

a) Aluminium + oxygen →

b) Ethane + oxygen →

c) Nitric acid + potassium carbonate →

d) Hydrochloric acid + magnesium →

e) Copper oxide + sulphuric acid →

f) Potassium hydroxide + hydrochloric acid →

**(Total 12 marks)**

EXTENSION: write ionic equations for the following reactions

Remember – You will need to construct a balanced symbol equation first. Double check all of your chemical formulae are correct, or you will not get the correct answer!

a) reaction of nitric acid (aq) with lithium hydroxide (aq)
b) precipitation of silver chloride from reaction between silver nitrate (aq) and potassium chloride (aq)
c) reaction of potassium carbonate (aq) with hydrochloric acid (aq)
g) precipitation of barium sulfate from reaction between barium chloride (aq) and sulfuric acid (aq)

**(Total 4 marks)**

**EXAM STYLE QUESTIONS:**

**1a.** An unknown metal carbonate reacts with hydrochloric acid according to the following equation:

M2CO3(aq) + 2HCl(aq) → 2MCl(aq) + CO2(g) + H2O(l)

A 3.44 g sample of M2CO3 was dissolved in distilled water to make 250 cm3 of solution. A 25.0 cm3 portion of this solution required 33.2 cm3 of 0.150 mol dm–3 hydrochloric acid for complete reaction.

(i)      Calculate the amount, in moles, of HCl in 33.2 cm3 of 0.150 mol dm–3 hydrochloric acid. Give your answer to 3 significant figures.

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**(1)**

(ii)     Calculate the amount, in moles, of M2CO3 that reacted with this amount of HCl.
Give your answer to 3 significant figures.

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**(1)**

(iii)     Calculate the amount, in moles, of M2CO3 in the 3.44 g sample. Give your answer to 3 significant figures.

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**(1)**

(iv)    Calculate the relative formula mass, *M*r, of M2CO3 Give your answer to 1 decimal place.

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**(1)**

**b.** In a different experiment, 6.27 g of magnesium carbonate were added to an excess of sulfuric acid. The following reaction occurred.

MgCO3 + H2SO4 →  MgSO4 + CO2 + H2O

(i)      Calculate the amount, in moles, of MgCO3 in 6.27 g of magnesium carbonate.

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**(2)**

(ii)     Calculate the mass of MgSO4 produced in this reaction assuming a 95% yield.

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**(3)**

**(Total 9 marks)**

**4.**     Zinc chloride can be prepared in the laboratory by the reaction between zinc oxide and hydrochloric acid.
The equation for the reaction is

ZnO + 2HCl   ZnCl2 + H2O

A 0.0830 mol sample of pure zinc oxide was added to 100 cm3 of 1.20 mol dm−3 hydrochloric acid.

Calculate the maximum mass of anhydrous zinc chloride that could be obtained from the products of this reaction.

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**(Total 4 marks)**

**5.** When TiCI4 is reduced with hydrogen under certain conditions, a new compound is produced which contains 68.9% chlorine by mass. Which one of the following could be the formula of the new compound?

**A**       TiH2Cl2

**B**       TiCl

**C**       TiCl2

**D**       TiCl3

**(Total 1 mark)**

**6.** Which one of the following compounds contains the smallest percentage, by mass, of oxygen?

**A**       CH3OCH2CH3

**B**       CH3OCH2NH2

**C**       COS

**D**       C4H9Al(OH)2

**(Total 1 mark)**

**EXTENSION QUESTION:**

**1a.** Zinc forms many different salts including zinc sulfate, zinc chloride and zinc fluoride.

People who have a zinc deficiency can take hydrated zinc sulfate (ZnSO4.*x*H2O) as a dietary supplement.

A student heated 4.38 g of hydrated zinc sulfate and obtained 2.46 g of anhydrous zinc sulfate.

Use these data to calculate the value of the integer *x* in ZnSO4.*x*H2O
Show your working.

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**(Total 4 marks)**