OVERMUGGED O LEVEL MOCK PAPER 2021
SECONDARY 4 EXPRESS
SECONDARY 5 NORMAL ACADEMIC

COMBINED SCIENCE (CHEMISTRY) **5076/03|5078/03**
PAPER 3 **September 2021**
1 hour 15 mins

INSTRUCTIONS TO CANDIDATES

Write in dark blue or black pen.
You may use an HB pencil for diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.

Section A
Answer **all** questions.
Write your answers in the spaces provided on the Question Paper.

Section B
Answer **all** questions, the last question is in the form either/or.
Write your answers in the spaces provided on the Question Paper.

Electronic calculators may be used.

The number of mark is given in brackets [ ] at the end of each question or part question.

**Questions in this mock paper may contain adapted questions from the Ten Year Series and Prelim Papers from various schools in Singapore.*

Section A

1. James did a series of experiments using varying amount of zinc metal and $100cm^3$ of different concentration of sulfuric acid.

Experiment	**Amount of Zn metal**	**Concentration of H_2SO_4**	**Temperature**	**Time taken to produce $100cm^3$ of H_2 gas**
A	5g (solid form)	2.0 mol/dm^{-3}	25 °C	200s
B	5g (powder form)	2.0 mol/dm^{-3}	25 °C	133s
C	5g (powder form)	4.0 mol/dm^{-3}	25 °C	X
D	5g (powder form)	4.0 mol/dm^{-3}	45 °C	Y

a) **Predict an estimate value of X** and **explain** your answer. [2]

b) **Explain the difference in time taken between Experiment A and B. [2]**

c) Would the value of X be greater than or smaller than Y. **Explain** your answer. [2]

2. Choose from the following compounds to answer the questions below.

Carbon dioxide
Calcium oxide
Sodium nitrate
Sodium hydroxide
Copper (II) sulphate
Nitrogen dioxide
Aqueous ammonia
Zinc oxide
Hydrochloric acid

Each compound can be used once, more than once or not at all.

a) Formed due to high temperature in car engines [1]

b) Reacts with both acid and base to form salt and water [1]

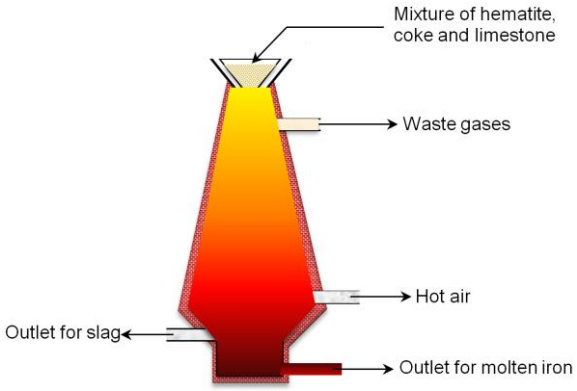
c) Gives a white precipitate when added to acidified silver nitrate [1]

d) A salt that should be prepared via titration. [1]

e) Reacts with calcium carbonate to form carbon dioxide gas [1]

f) Turn moist red litmus paper blue when added to ammonium nitrate. [1]

3. Haematite and coke are used in the extraction of iron in the blast furnace.



a) Give the **chemical formula of haematite**. [1]

b) With the **aid of chemical equations, explain** the importance of adding **coke** for the extraction of iron. [3]

c) Using oxidation states, s**tate and explain whether haematite that got oxidised or reduced** in the blast furnace reaction. [2]

d) Write out the **full balanced equation** which shows a reaction between an acidic oxide and a base. [1]

4. Acid rain is formed when atmospheric **acidic oxides** such as **sulfur dioxide and nitrogen dioxide** react with oxygen and water in the atmosphere.

a) Using **balanced chemical equations** show how **acid rain is formed**. [2]

b) **State 2 negative effect of acid rain** on the **environment.** [1]

c) **Suggest** how farmers can **reduce the acidity of the soil** such that their crops can grow better. Name **2 methods**. [2]

d) Assuming that the crops **grow best at pH 7**, **state** and **explain which method** mentioned in part c) will be a **better choice**. [2]

e) Some fertilisers contain **ammonium chloride NH_4Cl** which are help crops grow better. Some crops also grow better in a more alkaline soil at higher pH.

Using a **balanced chemical equation, explain why the fertilisers** and the **alkaline solution should not be added together**. [2]

5. The table below shows the various ionic versions of manganese.

Substance
MnO_4^-
MnO_4^{2-}
Mn^{2+}
MnO_2

a) Arrange the substances **increasing order of oxidation state** of Mn. [2]

_____

b) When solid manganese (II) nitrate is heated, solid manganese (IV) oxide and nitrogen dioxide will be produced. The chemical equation is listed below.

$$Mn(NO_3)_2\ (s) \rightarrow MnO_2\ (s) + 2\ NO_2\ (g)$$

Based on the change in oxidation state of manganese, explain whether manganese (II) nitrate has undergone **oxidation or reduction**. [2]

c) Chlorine is often used as a disinfectant in swimming pools. The chemical equation is as follows:

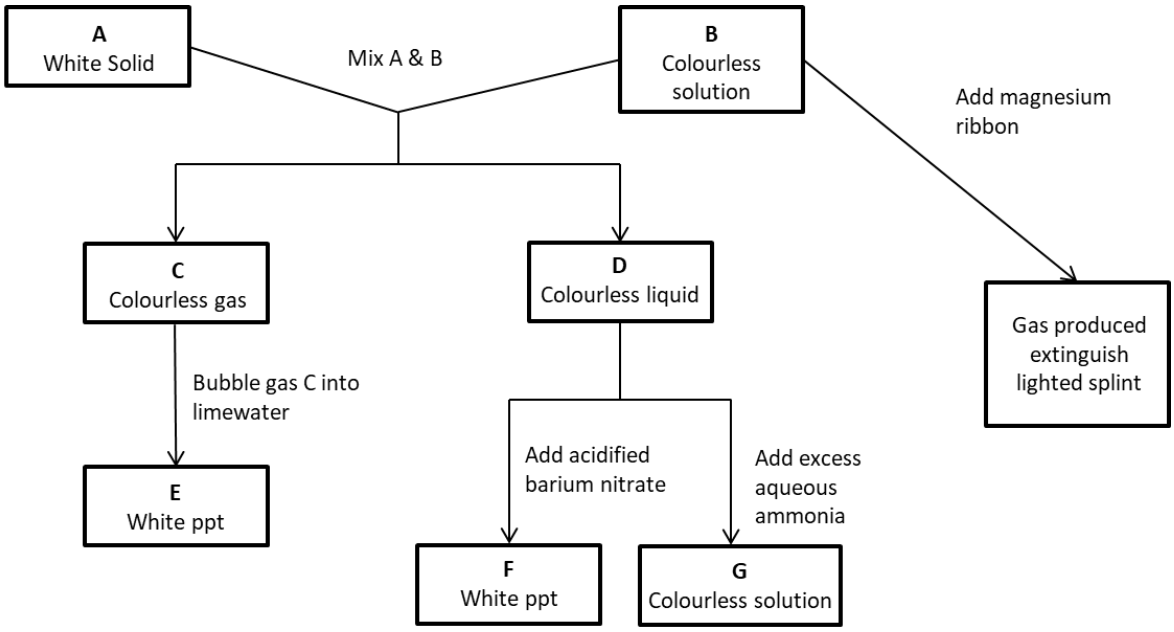
$$\mathbf{S_2O_3^{2-} + 4Cl_2 + 5\ H_2O \rightarrow 2SO_4^{2-} + 8Cl^- + 10H^+}$$

i) Deduce **the oxidation states** of sulfur in each substance. [2]

Substance	Oxidation state of sulfur
$S_2O_3^{2-}$	
SO_4^{2-}	

ii) Identify the **substance that got reduced** in this reaction. **Explain** your answer. [2]

6. Refer to the flowchart below.



a) Suggest the identity of substances A to G. [7]

A	
B	
C	
D	
E	
F	
G	

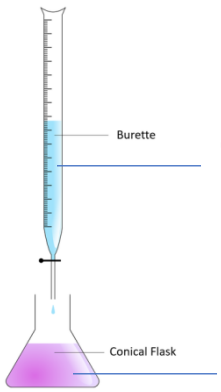
b) Write the **balanced equation** when colourless **gas C** forms **substance E** when bubbled into **limewater**. [1]

c) **Identify** the chemical reaction and write the **balanced ionic equation** when colourless liquid D reacts with acidified barium nitrate. [1]

Section B

7. Titration is a salt preparation method whereby an alkaline and an acid undergo neutralisation. The neutralisation reaction between an alkali $X(OH)_2$ and sulfuric acid can be represented by the following equation:

$$\mathbf{X(OH)_2 + H_2SO_4 \rightarrow XSO_4 + 2H_2O}$$



The results of a titration experiment are as such:

Experiment	**1**	**2**	**3**	**4**
Initial volume of H_2SO_4 / cm^3	0.0	18.1		18.3
Final volume of H_2SO_4 / cm^3	18.1	35.9	18.3	36.2
Volume of H_2SO_4 used / cm^3			17.9	

a) **Complete the table above**. [2]

b) Determine the **average volume** of H_2SO_4 used. [1]

c) Determine the **concentration of $X(OH)_2$ in mol/dm^3.** [3]

d) The concentration of $X(OH)_2$ is $13.26g/dm^3$. **Identify X**. [2]

e) Suggest **why titration is not the most ideal method** to prepare salt **XSO_4. [2]**

8. A compound contains **38.6% potassium, 13.9% nitrogen and the rest is made of oxygen**.

a) Determine the **empirical formula** of this compound. [3]

When iron metal is exposed to air and moisture, it will undergo rusting to form iron (III) oxide.

b) Construct a balanced chemical equation for rusting. [2]

c) State one method for preventing rusting and explain how it works. [2]

Aluminium and iron (III) oxide reacts in the chemical equation as shown below.

$$\mathbf{2\ Al(s) + Fe_2O_3\ (s) \rightarrow Al_2O_3\ (s) + 2\ Fe\ (l)}$$

d) **Identify** the name of this **chemical reaction**. [1]

e) Aluminium oxide can only be extracted from its ore via electrolysis while iron (III) oxide can be extracted via heating with carbon. Referencing the reactivity series, **explain**. [2]