



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

PURE CHEMISTRY
PAPER 2

6092/02
September 2021
1 hour 45 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.

You are advised to spend no longer than one hour on Section A and no longer than 45 minutes on Section B.

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. 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]

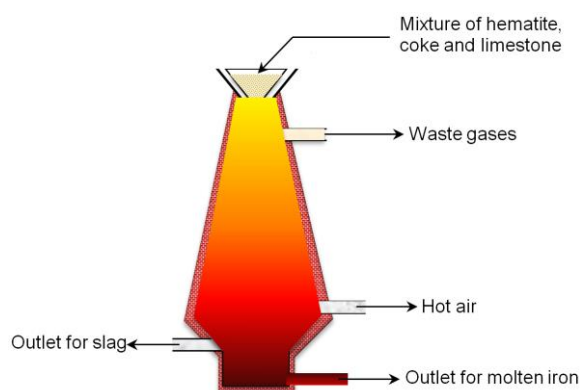
- c) Gives a white precipitate when added to acidified silver nitrate [1]

- 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]

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



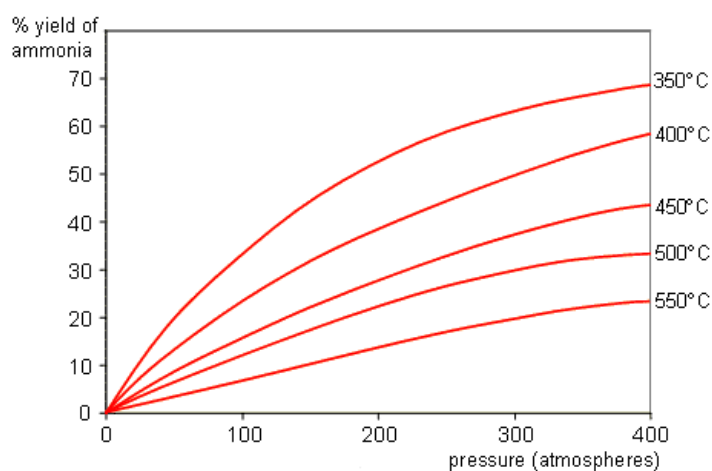
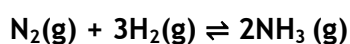
a) Give the **chemical formula of haematite**. [1]

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

c) Identify the **reducing agent** in the reaction which reduced the product to become molten iron and **explain why**. [2]

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

3. The Haber process chemical equation is as such:



The Haber process is carried out at a **temperature of 450 °C**, **pressure of 200 atm** and in the presence an iron catalyst.

a) **Explain** in terms of **collision theory**, why using a **higher pressure** will **increase the rate of reaction**. [2]

b) **Explain** why **450 °C** is used even though it **lowers the yield of the reaction**. [2]

c) Draw the **energy profile diagram** for Haber process. [3]

d) Draw an **additional line** to show the effects of **having iron as a catalyst**. [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**. [2]

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]

f) One way to reduce the effects of pollutant gas is to use a catalytic converter. Using **chemical equations**, show how **carbon monoxides** and **oxides of nitrogen are removed** via the catalytic converter. [2]

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

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

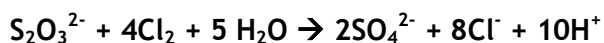
a) Arrange the substances **increasing order of oxidation state** of Mn. [2]

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



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:

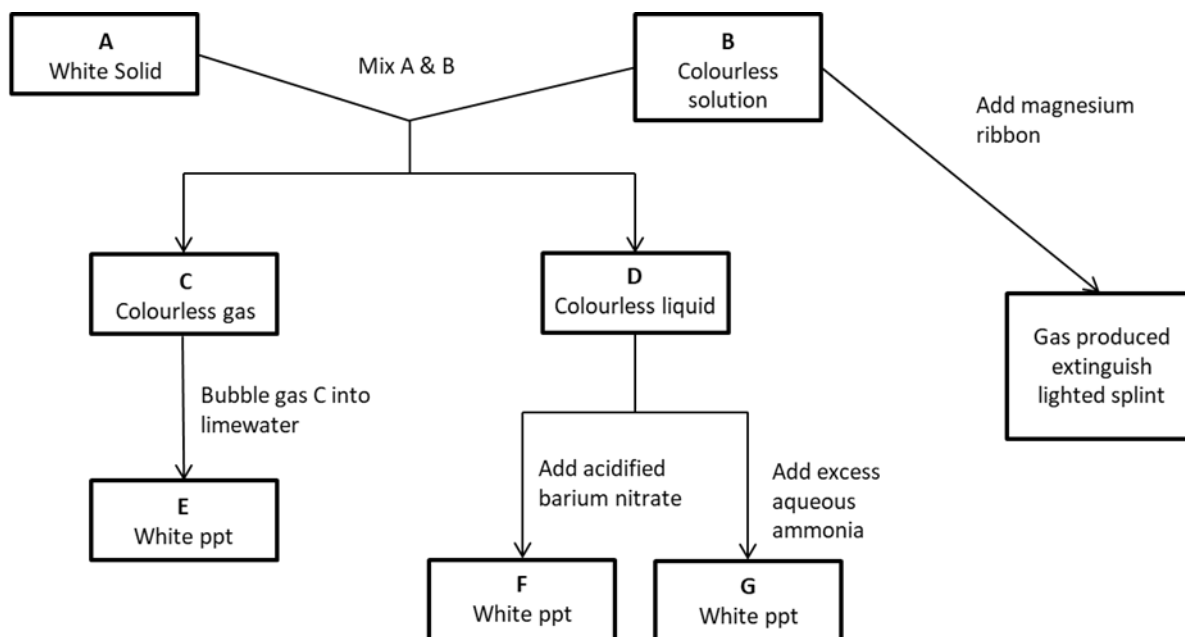


i) Deduce the **oxidation states** of sulfur in each substance. [2]

Substance	Oxidation state of sulfur
$\text{S}_2\text{O}_3^{2-}$	
SO_4^{2-}	

ii) Identify the **oxidising agent** in this reaction. **Explain** your answer. [2]

6. Refer to the flowchart below.



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

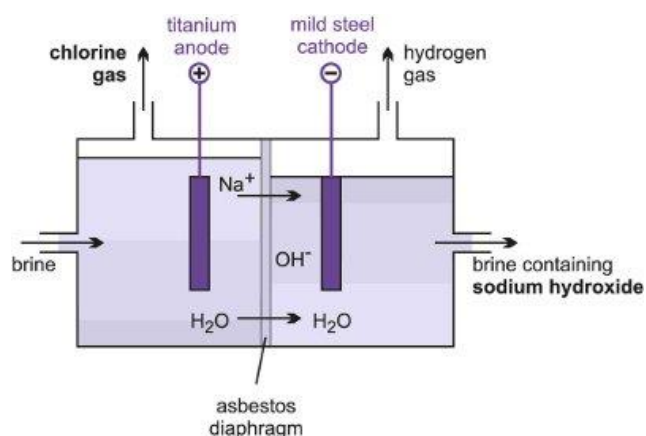
A	
B	
C	
D	
E	
F	
G	

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. The electrolysis of brine in a diaphragm cell is as shown below.



Brine is made with **concentrated sodium chloride solution**. The diaphragm allows for particles like Na^+ and H_2O molecules to pass through but does not allow negatively charged ions like OH^- and Cl^- to pass through.

This allows for **sodium hydroxide and chlorine gas** to be produced in the same set-up.

a) Identify the respective ions present in each side of the cell. [2]

Titanium anode:

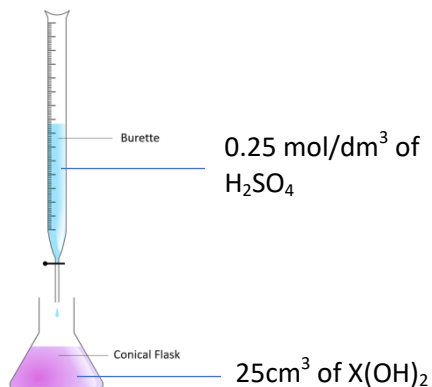
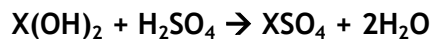
Mild steel cathode:

b) State and explain the reaction occurring at each electrode, with the aid of ionic-half equations. [4]

c) Explain why it is important that the negatively charged ions like OH^- and Cl^- are not allowed to pass through the membrane. [2]

d) Construct the **balanced ionic equation & chemical equation** for the whole process. [2]

8. 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:



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]

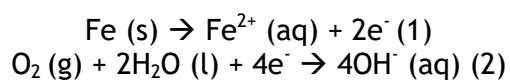
d) The concentration of $X(OH)_2$ is $13.26g/dm^3$. Identify X. [2]

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

9 EITHER)

A compound contains **38.6% potassium, 13.9% nitrogen and the rest is made of oxygen**. Determine the **empirical formula** of this compound. [3]

When iron metal is exposed to air and moisture, it will undergo oxidation. The oxidation process is represented using **two ionic half-equations** below.



b) Combine the **two half-equations** to form the **chemical equation** for the reaction. [2]

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



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

d) In terms of **gain or loss of oxygen**, **identify** and **explain** which compound has been reduced. [2]

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]

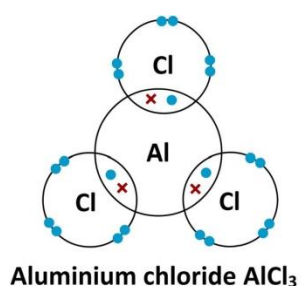
9 OR)

Phosphorus trichloride is a colorless, clear, fuming liquid with a strong odor. It is used in gasoline additives, textile finishing and to make other chemicals like pesticides.

a) Draw a 'dot-and-cross' diagram to show the bonding in Phosphorus trichloride. Show only the valence electrons only. [2]

b) State whether the melting and boiling point of phosphorus trichloride is high or low and explain why. [2]

The diagram below shows the bonding for aluminium chloride.



c) Explain why this bond is unconventional. [2]

d) Draw the bonding that should exist for aluminium chloride in normal conditions. [1]

e) State, with clearly outline steps, the steps to prepare a **sample of aluminium chloride salt**. [3]