

Name: .....Index Number:.....

Candidate's Signature .....

Date.....

**END OF TERM 1, 2021 EXAMS,**

**233/1**

**CHEMISTRY (THEORY)**

**PAPER 1**

**2 HOURS**

**INSTRUCTIONS TO CANDIDATES**

1. Answer all the questions in the spaces provided.
2. Mathematical tables and electronic calculators may be used.
3. All working must be clearly shown where necessary.

**For Examiner's Use Only**

Question	Maximum Score	Candidate's Score
1 – 31	80	

*This paper consists of 12 printed pages. Candidates should check the question paper to ensure that all pages are printed as indicated and no questions are missing.*

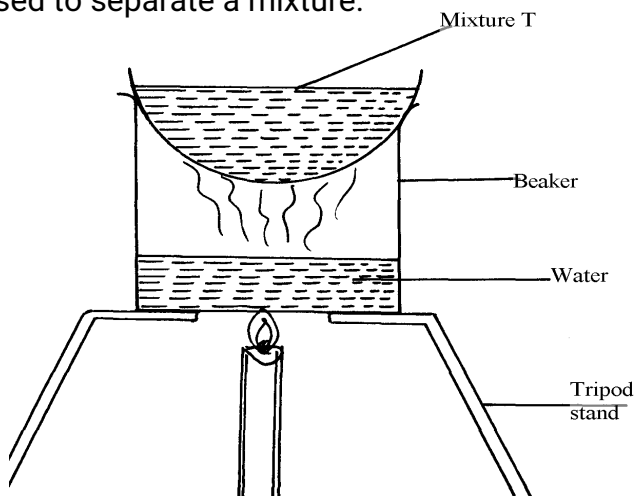
1. An oxide of element **G** has the formula as  $G_2O_3$ .  
(a) State the valency of element **G**. (1 mark)

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(b) In which group of the periodic table is element **G**? (1 mark)

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2. The set-up below was used to separate a mixture.



(a) Name the apparatus missing in the set-up. (1 mark)

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(b) Give **one** example of mixture T. (1 mark)

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(c) What is the name of this method of separation? (1 mark)

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3. Name the process which takes place when:

(a) Solid Carbon (IV) oxide (dry ice) changes directly into gas. (1 mark)

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(b) A red litmus paper turns white when dropped into chlorine water. (1 mark)

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(c) Propene gas molecules are converted into a giant molecule. (1 mark)

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4. The information below gives pH values of solutions V, W, X, Y Z.

Solution	pH values
V	2
W	6.5
X	11
Y	14
Z	4.5

(a) Which solution is likely to be?  
(i) Calcium hydroxide? (1 mark)

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(ii) Rain water? (1 mark)

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(b) Which solution would react most vigorously with Zinc carbonate? (1 mark)

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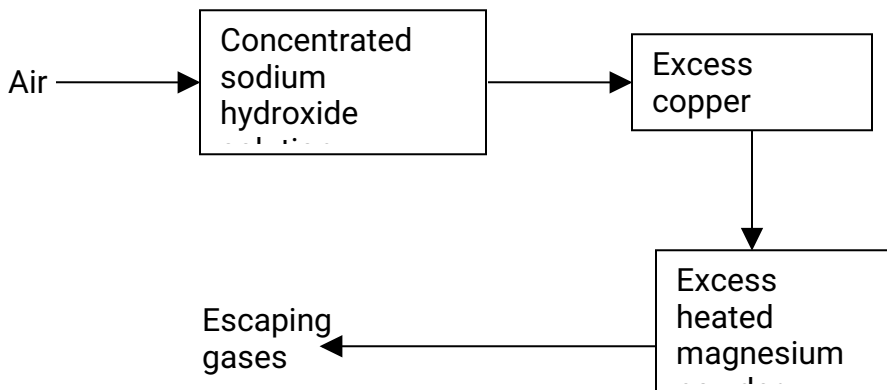
5. Explain why very little Carbon (IV) oxide gas is evolved when dilute sulphuric (VI) acid is added to lead (II) carbonate. (1 mark)

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6. Air was passed through several reagents as shown below:



(a) Write an equation for the reaction which takes place in the chamber containing magnesium powder. (1 mark)

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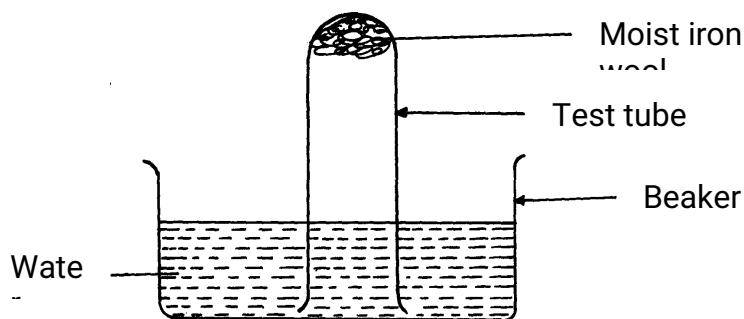
(b) Name **one** gas which escapes from the chamber containing magnesium powder. Give a reason for your answer. (2 marks)

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7. The set-up below was used to study some properties of air.



State and explain **two** observations that would be made at the end of the experiment. (2 marks)

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8. Below is a list of oxides.  
MgO, N<sub>2</sub>O, K<sub>2</sub>O, CaO and Al<sub>2</sub>O<sub>3</sub>  
Select:-  
(a) A neutral oxide. (1 mark)

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(b) A highly water soluble basic oxide. (1 mark)

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(c) An oxide which can react with both sodium hydroxide solution and dilute hydrochloric acid. (1 mark)

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9. (a) Hydrogen can reduce copper (II) Oxide but not aluminium oxide. Explain. (1 mark)

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(b) When water reacts with potassium metal, the hydrogen produced ignites explosively on the surface of water.

(i) What causes this ignition? (1 mark)

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(ii) Write an equation to show how this ignition occurs. (1 mark)

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10. In an experiment an unknown mass of anhydrous sodium carbonate was dissolved in water and the solution made up to  $250 \text{ cm}^3$ .  $25 \text{ cm}^3$  of this solution neutralized  $20 \text{ cm}^3$  of  $0.25 \text{ M}$  nitric acid. Calculate the mass of unknown sodium carbonate used. (3 marks)  
(Na = 23.0, C = 12.0, O = 16.0)

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11. An element **M** has two naturally occurring isotopes,  $^{63}\text{M}$  and  $^{65}\text{M}$ . Calculate the percentage of each isotope if the relative atomic mass of **M** is 63.55. (2 marks)

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12. Carbon and silicon belong to the same group of the periodic table, yet Carbon (IV) oxide is a gas while silicon (IV) oxide is a solid with a high melting point. Explain this difference

(2 marks)

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13. The table below gives information about the ions  $\text{T}^+$  and  $\text{Z}^{2-}$ .

Ion	$\text{T}^+$	$\text{Z}^{2-}$
Electron arrangement	2.8	2.8.8
Number of neutrons	12	16

(a) Determine the relative formula mass of the compound formed between T and Z. (2 marks)

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(b) State **two** conditions under which the compound in (a) above would conduct electricity.

(1 mark)

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14. An ion of oxygen is larger than oxygen atom. Explain. (2 marks)

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15. A solution of hydrogen chloride gas in methylbenzene has no effect on calcium carbonate while a solution of hydrogen chloride gas in water reacts with calcium carbonate to produce a gas. Explain. (2 marks)

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16. Starting with Lead (II) carbonate explain how you would prepare a pure sample of Lead (II) sulphate. (3 marks)

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17. Draw a dot (•) and cross (x) diagram to show bonding in:- (1 mark)  
(a) Ammonium ion,  $\text{NH}_4^+$  (N = 7.0, H = 1.0)

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(b) Silane, SiH<sub>4</sub> (Si = 14.0, H = 1.0) (1 mark)

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18. Sodium carbonate decahydrate crystals, Na<sub>2</sub>CO<sub>3</sub>.10H<sub>2</sub>O, were left exposed in the atmosphere on a watch glass for two days.

(a) State the observation made on the crystals after two days. (1 mark)

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(b) Name the property of salts investigated in the above experiment. (1 mark)

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19. (a) What is meant by the term solubility of salts? (1 mark)

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(b) Calculate the solubility of a salt given that 15 g of the salt can saturate 25 cm<sup>3</sup> of water. (1 mark)

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20. (a) State the Graham's law. (1 mark)

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(b) A 100 cm<sup>3</sup> of Carbon (IV) oxide gas diffused through a porous partition in 30



seconds.

How long would it take  $150 \text{ cm}^3$  of Nitrogen (IV) oxide to diffuse through the same partition under the same conditions? (C = 12.0, N = 14.0, O = 16.0) (2 marks)

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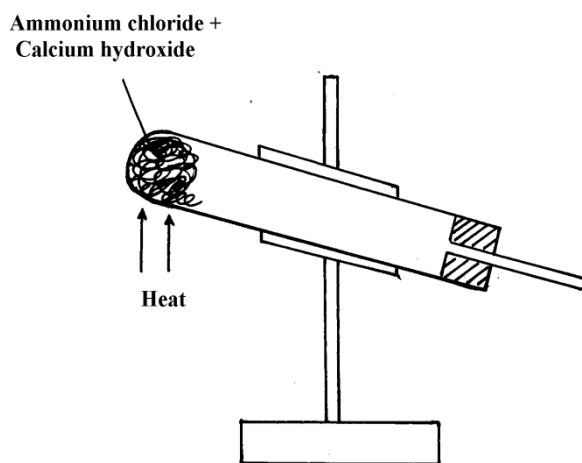
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21. The diagram below represents an incomplete set-up for preparation of a dry sample of gas R.



- (a) Complete the set-up to show how a dry sample of gas R is collected. (2 marks)
- (b) Write a chemical equation for the reaction that produces gas R. (1 mark)

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22. When sulphur powder is heated to over  $400^\circ\text{C}$  the following changes are observed:-  
At  $113^\circ\text{C}$  it melts into light brown liquid. The liquid then darkens to become red-brown  
and very viscous at  $160^\circ\text{C}$ . Above  $160^\circ\text{C}$  the liquid becomes almost black. Near the boiling point ( $444^\circ\text{C}$ ) the liquid becomes mobile. Explain these observations. (3 marks)

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23. A gas cylinder contains about 1.12dm<sup>3</sup> of butane measured at 0° and 1atm. Given that 25% of heat is lost, what is the maximum volume of water at room temperature which can be boiled

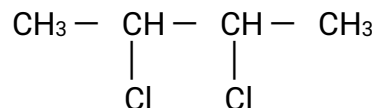
to 100°C in order to make some coffee?

$C_4H_{10(g)} + 6 \frac{1}{2} O_{2(g)} \rightarrow 4CO_{2(g)} + 5H_2O_{(l)}$ ;  $\Delta H^\theta = -3,000 \text{ kJmol}^{-1}$  (3 marks)  
(Specific heat capacity of water = 4.2J g<sup>-1</sup>°C<sup>-1</sup>, density of water 1gcm<sup>-3</sup> Molar gas volume 22.4 at s.t.p)

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24. Compound **W** reacted with chlorine to form compound **X** only. The structural formula of

**X** is shown below:



(a) Give the structural formula and name of compound **W**. (1 mark)

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(b) Draw the structure of 1-chloro-2, 2-dimethylpropane. (1 mark)

25. A weighed sample of crystalline sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>.nH<sub>2</sub>O) was heated in a crucible until there was no further change. The mass of the sample reduced by 14.5%. Calculate the number of moles, **n**, of water of crystallization. (Na = 23, O = 16.0, C = 12,

H = 1). (3 marks)

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26. In an experiment, soap solution was added to three samples of water. The results below

show the volume of soap solution required to lather with 500 cm<sup>3</sup> of each water sample before and after boiling.

	Sample 1	Sample 2	Sample 3
Volume of soap used before water boiled	26.0	14.0	4.0
Volume of soap after water boiled	26.0	4.0	4.0

(a)  
Which

water samples are likely to be soft?

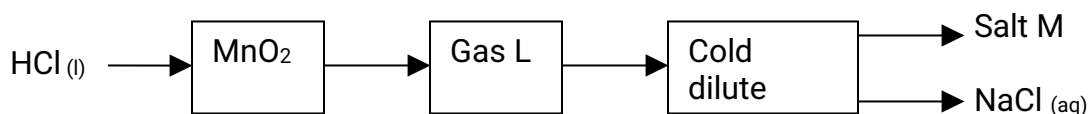
(1 mark)

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(b) Explain the change in volume of soap solution used in sample 2. (1 mark)

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27. Study the flow diagram below and answer the questions that follow:



(a) Name salt M.

(1 mark)

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(b) Write a balanced chemical equation for the reaction between hydrochloric acid and manganese (IV) oxide. (1 mark)

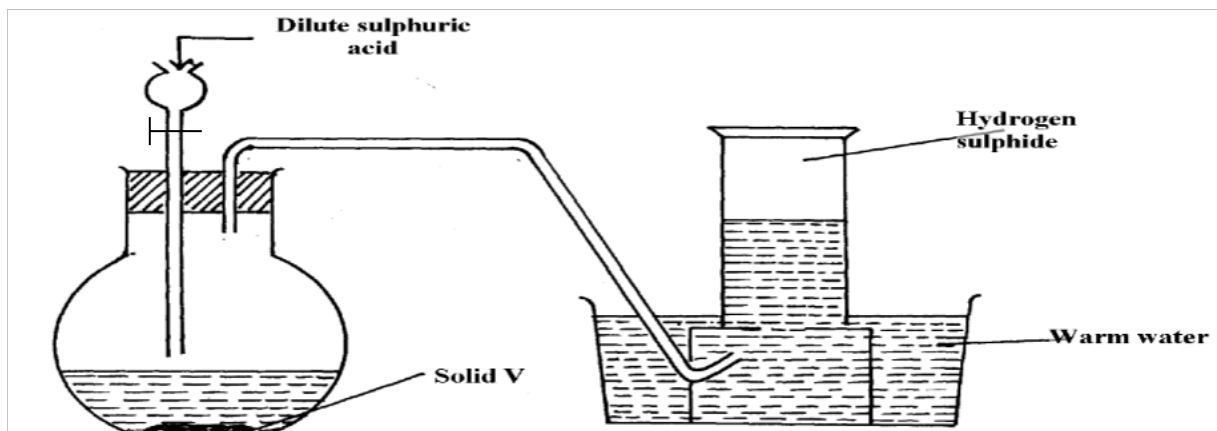
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(c) Identify another reagent that can be reacted with concentrated hydrochloric acid

to produce gas L.  
(1 mark)

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28. The set-up below was used to prepare and collect hydrogen sulphide gas. Study it and answer the questions that follow.



(a) Name solid V.

(1 mark)

(b) Write chemical equation of the reaction taking place in the flask.  
(1 mark)

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(c) Give a reason why warm water is used in the set-up.  
(1 mark)

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29. The table below gives information on four elements represented by letters K, L, M and N. Study it and answer the questions that follow:

Element	Electron arrangement	Atomic radius (nm)	Ionic radius (nm)
K	2.8.2	0.136	0.065
L	2.8.7	0.099	0.181
M	2.8.8.1	0.203	0.133
N	2.8.8.2	0.174	0.099

(a) Select the elements with similar chemical properties. (1 mark)

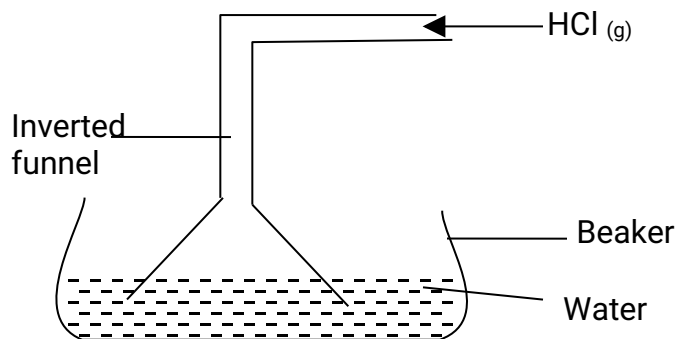
(b) Explain why the ionic radius of L is greater than its atomic radius. (1 mark)

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(c) Identify the most reactive metal. (1 mark)

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30. The set up below was used to prepare a solution of hydrogen chloride.



(a) Explain why an inverted funnel is used. (2 marks)

(b) Name another gas whose aqueous solution can be prepared in the same way. (1 mark)

31. Heated iron can react with both chlorine gas and hydrogen chloride gas.

(a) Write equations for the two reactions. (2 marks)

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(b) Chlorine gas has no effect on dry blue litmus paper. Explain. (1 mark)

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