THE KENYA NATIONAL EXAMINATIONS COUNCIL
Kenya Certificate of Secondary Education

233/1 Paper 1

CHEMISTRY – (Theory)

Mar. 2022 – 2 hours

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

Candidate's Signature ..... Date .....

Instructions to candidates

(a) Write your name and index number in the spaces provided above.
(b) Sign and write the date of examination in the spaces provided above.
(c) Answer **all** the questions in the spaces provided in the question paper.
(d) **Non-programmable** silent electronic calculators and KNEC mathematical tables may be used.
(e) All working **must** be clearly shown where necessary.
(f) **This paper consists of 20 printed pages.**
(g) **Candidates should check the question paper to ascertain that all the pages are printed as indicated and that no questions are missing.**
(h) **Candidates should answer the questions in English.**

For Examiner's Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16

17	18	19	20	21	22	23	24	25	26	27	Grand Total	

© 2021 The Kenya National Examinations Council

1. (a) Draw a labelled diagram showing the atomic structure of $^{24}_{12}Mg$ (2 marks)

(b) The atomic number of phosphorus is 15. Draw a dot (•) and cross (x) diagram for the compound formed when phosphorus reacts with chlorine, atomic number 17. (1 mark)

2. (a) State the condition under which a Bunsen burner produces a luminous flame. (1 mark)

.....

.....

.....

(b) Write an equation for the reaction that takes place in a luminous flame assuming the laboratory gas is butane. (1 mark)

.....

.....

(c) One of the regions in the non-luminous flame is the unburnt gas region. Describe how the presence of this region can be shown using a wooden splint. (1 mark)

.....

.....

.....

.....

Scanned with CamScanner

3. (a) The elements sodium, magnesium and aluminium belong to group I, II and III respectively. Select the element with the highest electrical conductivity and give a reason. (1 mark)

.....

.....

.....

.....

(b) Complete **Table 1** to show the products of electrolysis for concentrated sodium chloride and molten sodium chloride.

Table 1

Compound	Anode	Cathode
Concentrated sodium chloride		
Molten sodium chloride		

(2 marks)

4. A small piece of sodium metal was placed in a beaker containing pure water.

(a) State **two** observations made during the reaction. (1 mark)

.....

.....

.....

(b) State and explain another observation made when a drop of phenolphthalein is added to the mixture in the beaker. (1 mark)

.....

.....

(c) Explain why it is **not** advisable to carry out this experiment using potassium metal. (1 mark)

.....

.....

.....

Scanned with CamScanner

5. Describe how a pure sample of copper(II) nitrate crystals can be prepared using recycled copper wire. (3 marks)

1

.....

.....

.....

.....

.....

6. The following apparatus and chemicals are used to investigate the percentage of air used when iron rusts: iron filings, 100 ml measuring cylinder, trough and water.

(a) Draw a setup of the experiment. (2 marks)

2

(b) Write an expression to show how the percentage of air used is calculated at the end of the experiment. (1 mark)

.....

.....

Scanned with CamScanner

7. **Figure 1** shows a graph of atomic radius of some group I and group II elements.

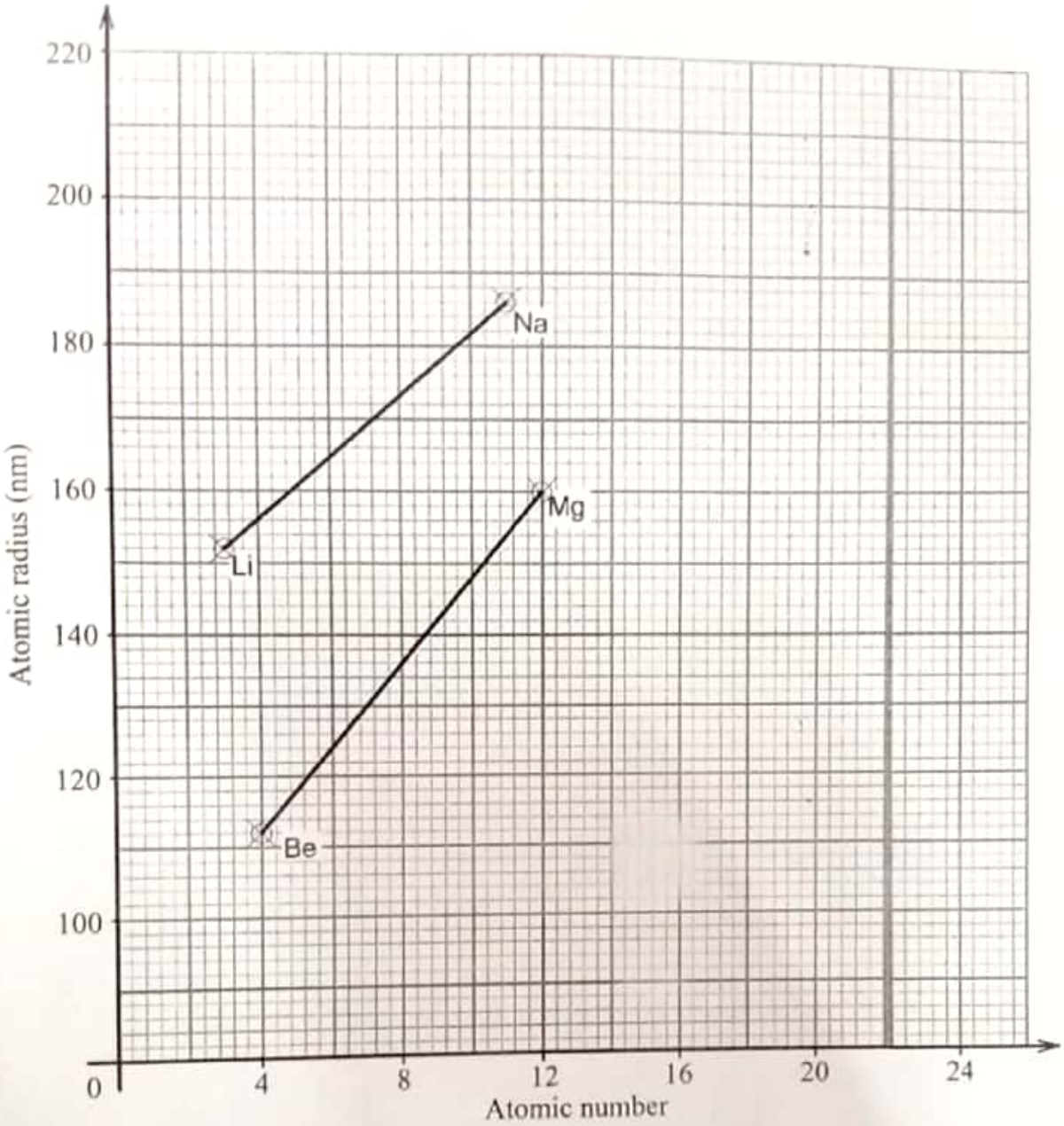


Figure 1

(a) Explain why the atomic radius of sodium is higher than that of:

(i) lithium. (1 mark)

.....

.....

.....

Scanned with CamScanner

(ii) magnesium. (1 mark)

.....

.....

.....

(b) Predict the atomic radius of calcium. (1 mark)

.....

8. Compound **D** with formula, C_3H_4, was reacted with excess hydrogen chloride gas.

(a) Give the name of compound **D**. (1 mark)

.....

(b) Draw **two** possible structures of the products formed. (2 marks)

.....

.....

.....

.....

9. Study the setup in **Figure 2** and answer the questions that follow.

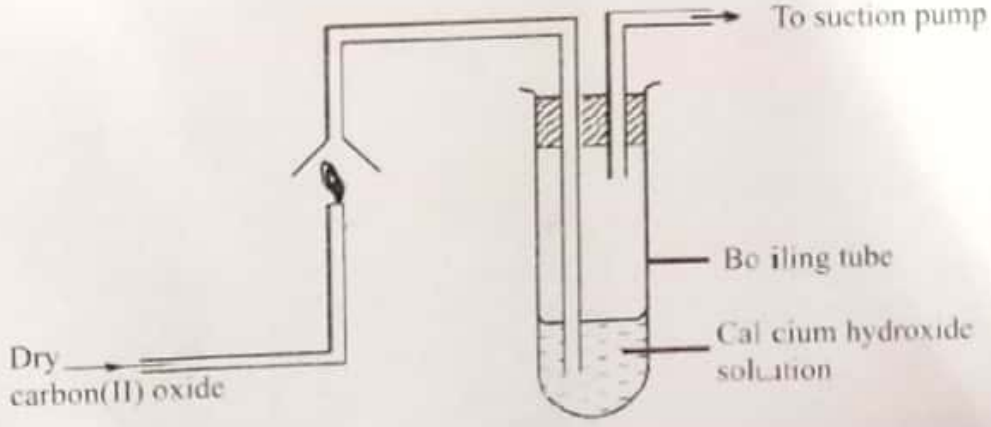


Figure 2

Scanned with CamScanner

(a) State the precaution that should be taken in carrying out the experiment. Give a reason. (1 mark)

.....

.....

.....

.....

(b) State the observations made in the boiling tube. (2 marks)

.....

.....

.....

.....

10. Consider the following reaction:

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The enthalpy change is **–92.4 kJ** per mole of nitrogen.

(a) Give the enthalpy change per mole of ammonia. (1 mark)

.....

(b) State and explain how each of the following affects the yield of ammonia:

(i) Increase in temperature. (1 mark)

.....

.....

(ii) Finely divided iron. (1 mark)

.....

.....

.....

.....

Scanned with CamScanner

11. Study the flow chart in **Figure 3** and answer the questions that follow.

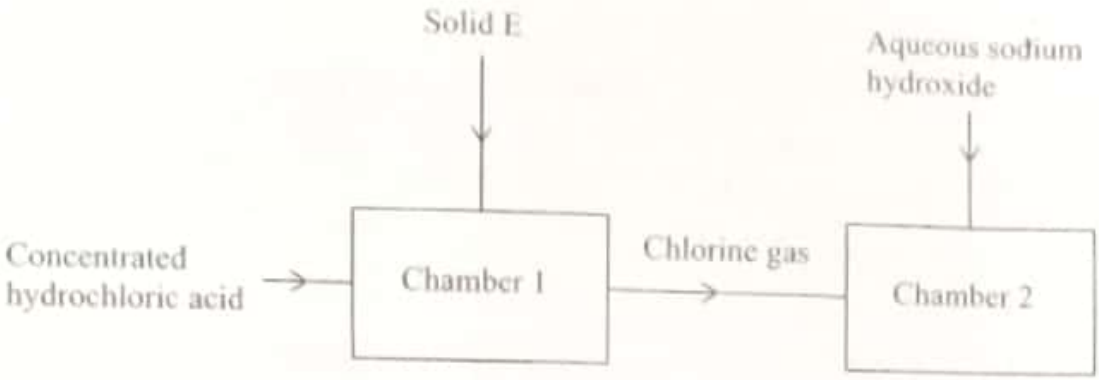


Figure 3

(a) Identify solid **E**. (1 mark)

.....

(b) Name the type of reaction that takes place in chamber **1**. (1 mark)

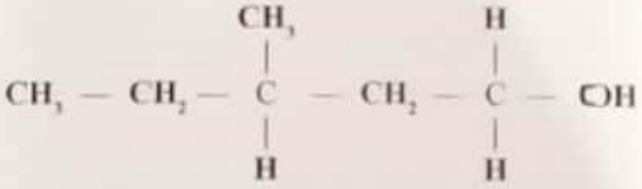
.....

(c) Write an equation for the reaction that takes place in chamber **2**. (1 mark)

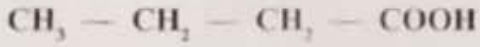
.....

.....

12. Compounds **H** and **J** have the following structures.



Compound **H**



Compound **J**

(a) Give the names of:

(i) Compound **H**. (1 mark)

.....

Scanned with CamScanner

(ii) Compound **J**

(1 mark)

.....

(b) State the conditions necessary for **H** and **J** to react. (1 mark)

.....

.....

13. Rhombic sulphur is **one** of the allotropes of sulphur.

(a) Draw the structure of rhombic sulphur. (1 mark)

(b) Describe the observations made when rhombic sulphur is heated from room temperature until it boils. (1 mark)

.....

.....

.....

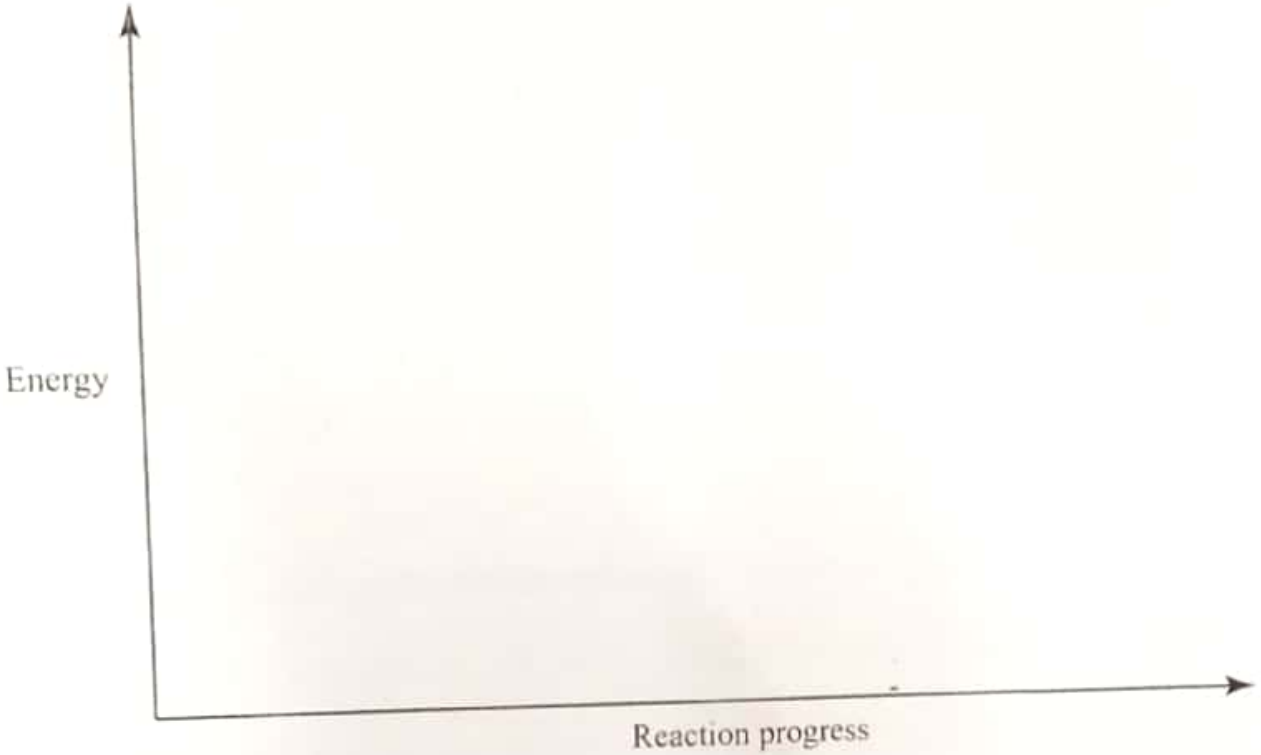
.....

.....

Scanned with CamScanner

14. The molar enthalpy of solution for potassium sulphate (K_2SO_4) is +23.8 kJ.

(a) On the axes provided, draw a labelled energy level diagram for the dissolution process of potassium sulphate in water. (2 marks)



(b) Calculate the enthalpy change when 5.22 g of potassium sulphate is completely dissolved in water (K = 39.0; S = 32.0; O = 16.0) (1 mark)

.....

.....

.....

.....

Scanned with CamScanner

15. (a) State Gay–Lussac's law. (1 mark)

.....

.....

.....

.....

(b) 180 cm^3 of nitrogen(II) oxide gas was reacted with 400 cm^3 of oxygen gas.

(i) Write an equation for the reaction. (1 mark)

.....

.....

(ii) Calculate the total volume of the gases at the end of the reaction. (3 marks)

.....

.....

.....

.....

.....

.....

.....

.....

Scanned with CamScanner

16. Describe how the setup in **Figure 4** can be used to distinguish between 50.0cm^3 of 0.2M hydrochloric acid and 50.0cm^3 of 0.2M ethanoic acid using pieces of 6m length of magnesium ribbon and a stop watch. (3 marks)

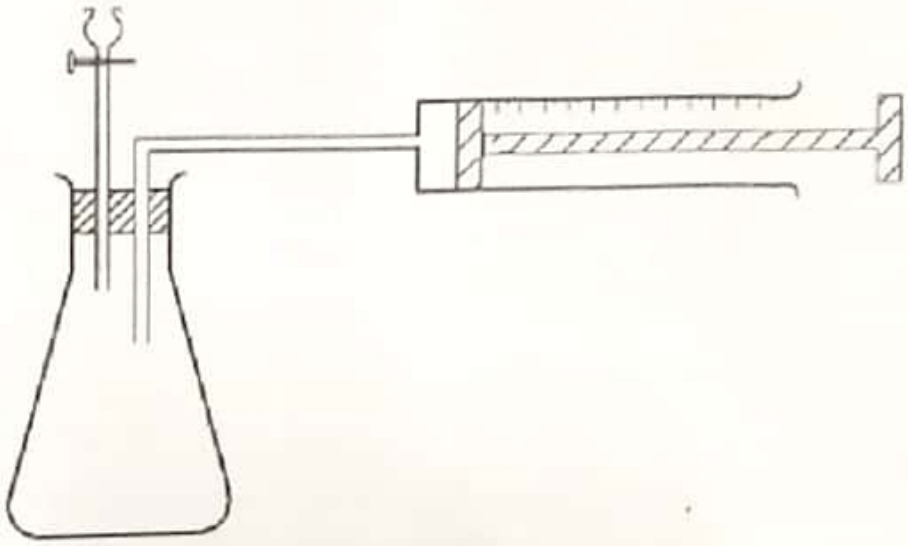


Figure 4

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

2689

Scanned with CamScanner

17. Describe how dilute nitric(V) acid and blue litmus papers can be used to distinguish between solid samples of sodium carbonate and sodium sulphite. (3 marks)

.....

.....

.....

.....

.....

.....

18. (a) Describe how propanone can be used to extract a pure sample of sunflower oil. (2 marks)

.....

.....

.....

.....

.....

(b) State why sodium hydroxide solution is **not** suitable for the extraction of sunflower oil. (1 mark)

.....

.....

Scanned with CamScanner

19. $31.5\,cm^3$ of concentrated nitric(V) acid was diluted to $500\,cm^3$. $10.0\,cm^3$ of the dilute acid required $25.0\,cm^3$ of 0.4 M sodium hydroxide for neutralisation.

(a) Calculate concentration of the:

(i) dilute acid. (1 mark)

.....

.....

.....

.....

.....

(ii) concentrated acid. (1 mark)

.....

.....

.....

.....

(b) State the correct method for diluting the concentrated nitric(V) acid. (1 mark)

.....

.....

.....

Scanned with CamScanner

20. **Figure 5** shows part of a radioactive decay series.

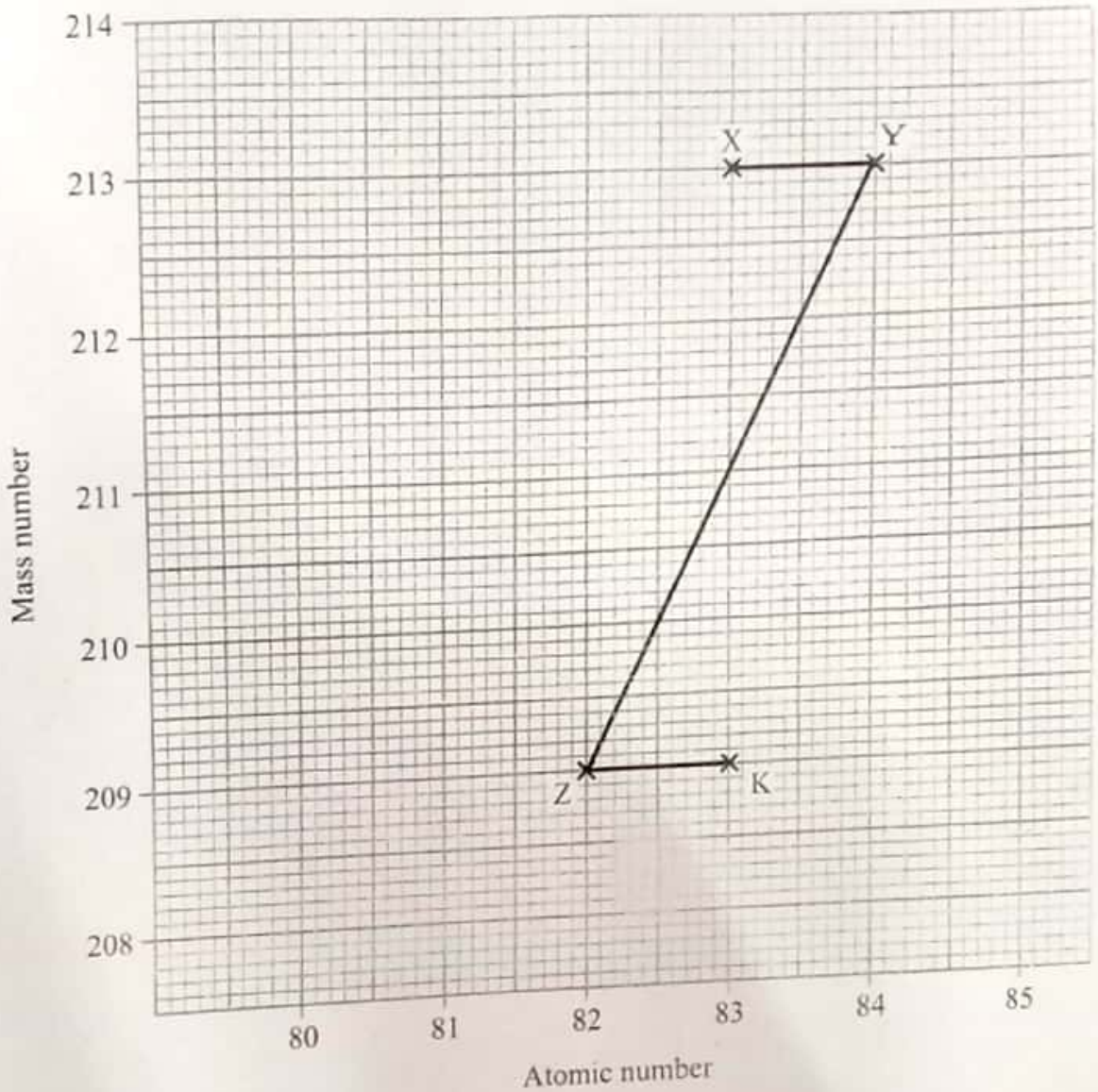


Figure 5

(a) Write a nuclear equation for the formation of nuclide **K** from nuc lide **X**. (1 mark)

.....

.....

.....

Scanned with CamScanner

(b) The half-life of nuclide **X** is 47 minutes. Determine the percentage of nuclide **X** that remains after 188 minutes. (2 marks)

.....

.....

.....

.....

.....

21. Aluminium is extracted from aluminium oxide by electrolysis.

(a) Other than the cost of electricity, give another reason why this method is expensive. (1 mark)

.....

.....

(b) Calculate the mass of aluminium obtained when a current of 2·0A is used for 5 hours. (2 marks)
(1 Faraday = 96500 C; Al = 27.0)

.....

.....

.....

.....

.....

.....

.....

22. Explain each of the following observations:

(a) Articles made of copper turn green when left exposed in air over a long period of time. (1 mark)

.....

.....

.....

.....

Scanned with CamScanner

(b) Addition of aqueous ammonia to a solution containing copper(II) ions produces a deep blue solution. (1 mark)

.....

.....

23. (a) State what is meant by relative atomic mass of an element. (1 mark)

.....

.....

.....

.....

(b) A compound of carbon and element **X** with formula, CX_4 contains 3.6% carbon by mass. Calculate the relative atomic mass of **X**. (2 marks)

.....

.....

.....

.....

.....

.....

24. Carbon(II) oxide can be prepared by dehydration of ethanedioic acid.

(a) Complete the following equation to show the reaction that takes place. (1 mark)

$H_2C_2O_4 \rightarrow$

.....

.....

(b) Name another reagent that can be used to prepare carbon(II) oxide by dehydration. (1 mark)

.....

Scanned with CamScanner

25. **Figure 6** shows an incomplete diagram of a setup for laboratory preparation of nitrogen gas.

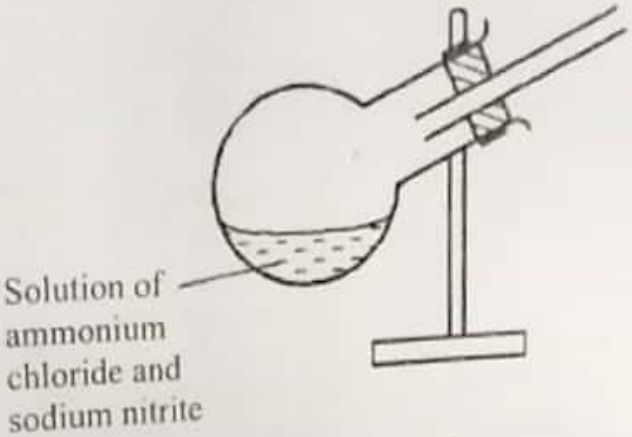


Figure 6

(a) Complete the setup in **Figure 6** to show how nitrogen gas can be collected. (2 marks)

(b) The nitrogen prepared using this setup is purer than that obtained from air. Give a reason. (1 mark)

.....

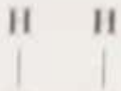
.....

.....

.....

.....

Scanned with CamScanner

26. Hydrazine,  is used as a fuel in rockets. Using the bond energies in **Table 2**, calculate the enthalpy change for combustion of hydrazine.

$N_2H_4(l) + O_2(g) \rightarrow N_2(g) + 2H_2O(g)$

Table 2

Bond	Bond Energy kJ/mol
N — H	388
N — N	163
O = O	496
N ≡ N	944
O — H	463

(3 marks)

Scanned with CamScanner

27. (a) **Table 3** gives the standard reduction potentials of some group VII elements.

Table 3

Reduction equations	$E^{\ominus}$/V
$Cl_2 + 2e \rightarrow 2Cl^-$	+1.36
$Br_2 + 2e \rightarrow 2Br^-$	+1.07
$I_2 + 2e \rightarrow 2I^-$	+0.54

State and explain the reactions that take place when aqueous bromine is added to a sample of sea water containing both chloride and iodide ions. (2 marks)

.....

.....

.....

.....

(b) Give a reason why potassium iodide is added to table salt. (1 mark)

.....

.....

541

2689

THIS IS THE LAST PRINTED PAGE.

Scanned with CamScanner