



Dr. Bbosa Science

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545/2

S4 CHEMISTRY

Exam 3 Marking guide

PAPER 2

DURATION: 2 HOUR

INSTRUCTIONS TO CANDIDATES:

SECTION A: Consists of 10 structured questions.

Answer all questions in this section.

Answers to questions in section A should be written in the spaces provided on this question paper.

SECTION B: Consists of Semi – structured questions.

Attempt any TWO questions from this section.

Answers to the question must be written in the answer sheet provided.

In both sections, all working must be clearly shown.

1 mole of a gas occupies 22,400 cm³ at s.t.p

1 mole of a gas occupies 24,000 cm³ at room temperature.

Use the following where necessary

H=1, C=12, O=16, Mg=24, Fe=56

For Examiner's use only														
1	2	3	4	5	6	7	8	9	10	11	12	13	14	TOTAL

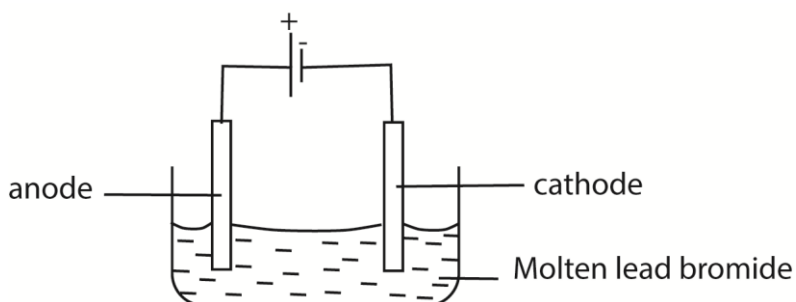
SECTION A

Attempt ALL questions in this section.

1. Some methods of separation of mixtures are given in the table below. Complete the table by naming a pair of substance which can be separated by the method given and the principle behind the methods. (5 marks)

	Method	Mixture	Principle
Eg	Separating funnel	Water and paraffin	Immiscible liquids
(a)	Fractional distillation	<i>Ethanol and water</i>	<i>Difference in boiling points</i>
(b)	A magnet	<i>Iron and sulphur</i>	<i>Iron is magnetic while sulphur is not</i>
(c)	Filtration	<i>Sodium chloride and sand</i>	<i>Sodium chloride is soluble while sand is not</i>
(d)	Sublimation	<i>Sodium chloride and ammonium chloride</i>	<i>Ammonium chloride sublimes while sodium chloride does not</i>
(e)	Fractional crystallization	<i>Potassium nitrate and potassium chloride</i>	<i>Potassium nitrate is more soluble than potassium chloride</i>

2. (a) Graphite and lead(II) bromide are conductors of electricity.
Name the particles which are responsible for conducting electricity in. (1 mark)
- (i) Graphite: *electrons*
- (ii) Lead(II) bromide: *ions*
- (b)(i) Draw a labeled diagram of the setup of apparatus that can be used to electrolyze molten Lead (II) bromide. (2 marks)



- (ii) State what is observed at the anode. (½ mark)
orange gas
- (iii) Write the equation for the observation in (ii) above. (1 ½ marks)
 $2Br^- - 2e \rightarrow Br_2(g)$

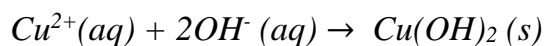
3. (a) Excess Sodium hydroxide solution is added to a solution of a mixture of copper(II) nitrate and Zinc Sulphate and the mixture filtrated.
State the color of the (1 mark)

(i) Filtrate: *colorless*

(ii) Residue *blue*

- (b) Write the ionic equation leading to the formation of the residue.

(1 ½ marks)



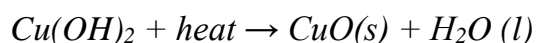
- (c) The residue was dried, transferred to a test tube and heated strongly

(i) State what is observed (1 mark)

A blue ppt. turns black

- (ii) Write the equation for the reaction when the residue was heated.

(1 ½ marks)



4. Ethene can be prepared in the laboratory using the set of apparatus shown in figure 1

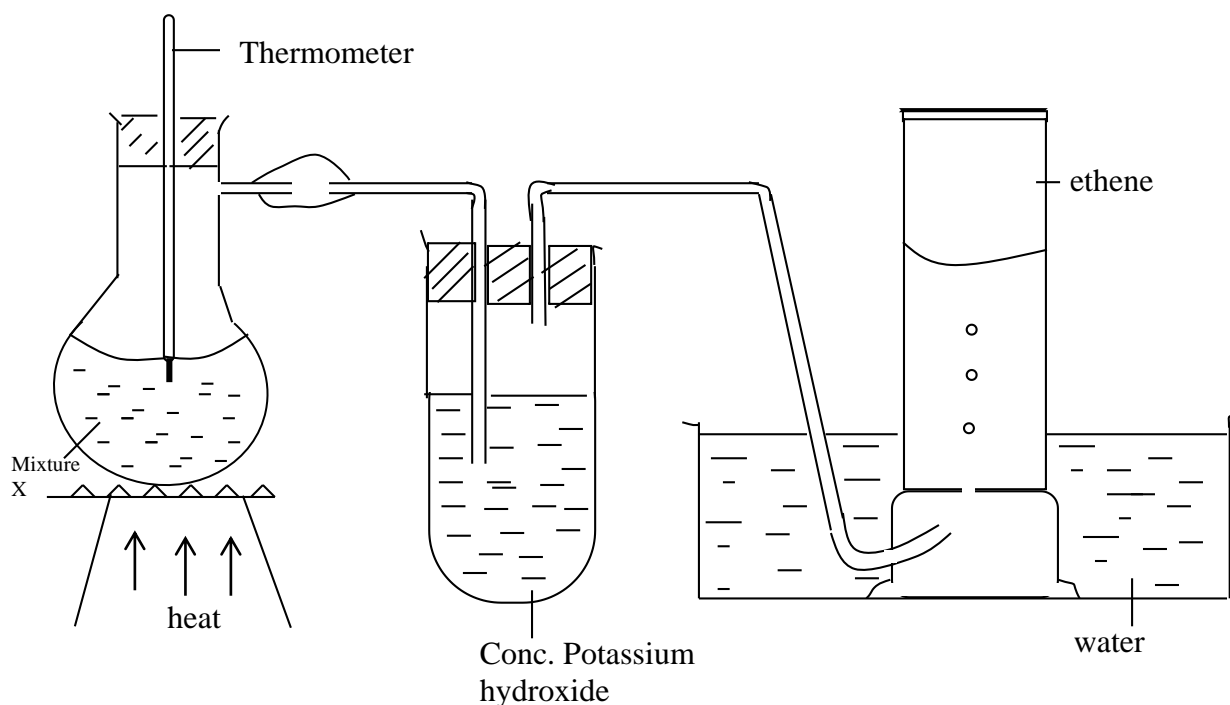


Fig. 1

- (a) Name the mixture being heated (1 mark)

Ethanol and concentrated sulphuric acid

- (b) Write the equation of reaction (1 mark)



- (c) What is the function of the
- (i) Concentrated Potassium hydroxide solution?
Neutralizes the acid that may escape with vapour (½ mark)
- (ii) Thermometer
Indicates temperature (½ mark)
- (d) Ethene was bubbled through a solution of acidified potassium permanganate
- (i) State what is observed. (1 mark)
Acidified potassium permanganate decolorizes
- (ii) Name one other gas which shows similar behavior like ethene with potassium permanganate. (½ mark)
Sulphur dioxide
5. 20cm³ of dilute hydrochloric acid reacted completely with Zinc metal and 480cm³ of Hydrogen gas evolved at room temperature.
- (a) Write the equation of reaction (1 ½ marks)
$$\text{Zn (s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2 \text{ (aq)} + \text{H}_2 \text{ (g)}$$
- (b) Calculate:
- (i) The mass of zinc the reacted (2 marks)
22400 cm³ of hydrogen require 65g of Zn
480cm³ of hydrogen require $\frac{65 \times 480}{22400} = 1.39\text{g}$ of Zn
- (ii) The concentration of the acid in moles per litre. (1 ½ marks)
Moles of H⁺ reacted
22400cm³ of hydrogen requires 2moles of H⁺
480cm³ of hydrogen require $\frac{2 \times 480}{22400} = 0.042\text{moles}$
20cm³ of hydrogen chloride solution contain 0.042moles
1000cm³ of hydrogen chloride solution contain $\frac{0.042 \times 1000}{20} = 2.1\text{M}$
6. The atomic numbers of elements P, Q and R are 2, 9 and 20 respectively.
- (a) State the
- (i) Group number of P and Q (1 mark)
P = *group 0 or 8*
Q = *2: 7: group 7*
- (ii) The period of element R (½ mark)
R- *2:8:8:2* it is in period 4
- (b) Element P is generally unreactive
- (i) Give a reason (½ mark)
has full outmost shell
- (ii) Name one other element in the periodic table which shows similar behavior like P (½ mark)

Neon or argon

- (c) The compound formed when Q combines with R conducts electricity.
 (i) State the condition under which the compound conducts electricity.

(½ mark)

In molten or solution form

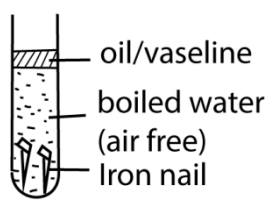
- (ii) Explain your answer in C(i) (2 marks)

In molten or solution form it has free mobile ions while in solid form these ions are locked up by electrostatic forces

7. (a) Define the term rusting (1 mark)

Is the development of a brown coat on the surface of iron left exposed in moist air

- (b) Draw a well labeled diagram to show that rusting cannot take place in the absence of oxygen (1 mark)



- (c) Two Iron rods X and Y were connected with a wire to magnesium and Lead metal respectively as shown in figure 2.

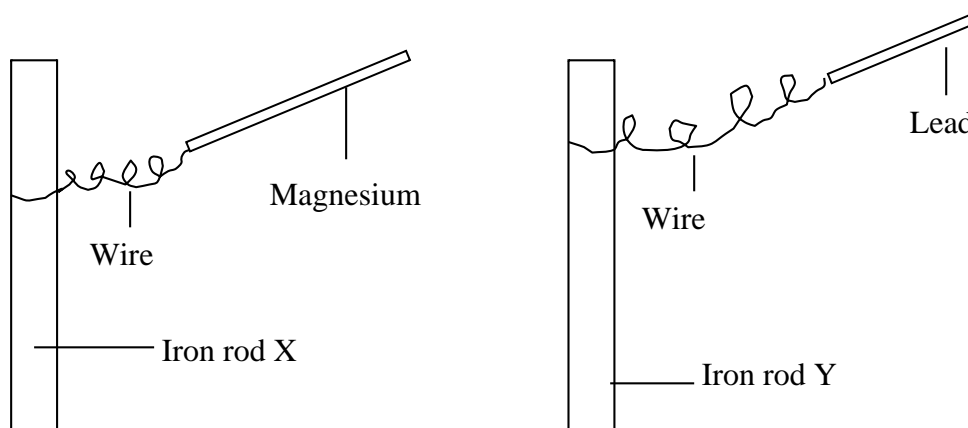


Figure 2

The Iron were left in the open for several months

State what would be observed on

- (i) Iron rod X

(1 ½ marks)

Rusting does not occur

Explain your answer

Magnesium reduces rust to iron because it is higher in electrochemical series

- (ii) Iron rod Y (1 ½ marks)
 Explain your answer
Iron rusts because it higher than lead in electrochemical series

8. To aqueous magnesium hydrogen carbonate was added the following:-

- (a) Sodium carbonate solution
- (i) State what was observed (½ mark)
A white ppt. is formed
- (ii) Write the equation for the reaction that took place (1 ½ marks)
 $Mg^{2+}(aq) + CO_3^{2-}(aq) \rightarrow MgCO_3(s)$
- (b) Soap solution.
 State what was observed (½ mark)
Scum is formed
- (c) Aqueous magnesium hydrogen carbonate was heated.
- (i) Write the equation for the reaction that took place (1 ½ marks)
 $Mg(HCO_3)_2 + Heat \rightarrow MgCO_3(s) + CO_2(g) + H_2O(l)$
- (ii) Soap solution was added to resultant mixture in (c)
 State what was observed (½ mark)
Scum not formed but lather forms

9. (a) What is a hydrocarbon? (1 mark)

Hydrocarbon is a compound that contains carbon and hydrogen only

- (b) A gaseous hydrocarbon, W contains 82.8% carbon. Calculate the empirical formula of the hydrocarbon W (2 marks)
 Percentage of hydrogen = $100 - 82.8 = 17.2\%$

Element	C	H
Percentage	82.8	17.2
Atomic number	12	1
moles	6.9	17.2
Mole ratio	1	2.49
Empirical formula	C ₂ H ₅	

- (c) If 1.16gm of the hydrocarbon W occupied 0.448dm³ at s.t.p
- (i) Calculate the molecular mass of hydrocarbon W. (1 ½ marks)
 0.448dm³ weigh 1.16g
 22.4dm³ weigh $\frac{1.16 \times 22.4}{0.448} = 58g$

- (ii) Determine the molecular formula of W (1 mark)
 $(C_2H_5)_n = 58$
 $n = 2$
 Molecular formula of W = C_4H_{10}
10. (a)(i) Define the term “alloy” (1 mark)
An alloy is a mixture of metal
- (ii) Give a reason why alloys are more useful than pure substances. (1 marks)
 - *durable*
 - *do not rust*
 - *have high tensile strength*
 - *are beautiful*
- (b) State the composition of the following alloys
- (i) Bronze (1 mark)
tin and copper
- (ii) Solder (1 mark)
Lead and tin
- (c) State one use of
- (i) Bronze (½ mark)
Bronze is used in the construction of sculptures, musical instruments and medals, and in industrial applications such as bushings and bearings, the manufacture of coins, hardware mounts, furniture trim, ceiling or wall panels, ship hardware, and all sorts of automobile parts.
- (ii) Solder (½ mark)
Welding

SECTION B(30 MARKS)

Attempt only two questions

11. (a) When Sulphur is extracted from the Sulphur beds, Super-heated water is pumped down a shaft into the beds containing sulphur
- (i) Name the process by which Sulphur is extracted. (½ mark)
Frasch process
- (ii) What is meant by Super-heated water? (1 mark)
Water heat to 170°C
- (iii) Why does the water have to be super-heated? (1 mark)
To melt sulphur
- (b) When the molten Sulphur is pumped to the surface, it solidifies
- (i) Name the allotrope of Sulphur which forms first (½ mark)
Monoclinic sulphur

- (ii) Give a reason for your answer in b(i) (1 mark)
It is stable above 96°C
- (c) Write equations only to show how Sulphuric acid is obtained from Sulphur. (6 marks)

$$S(s) + O_2(g) \rightarrow SO_2(g)$$

$$2SO_2(g) + O_2(g) \leftrightarrow 2SO_3$$

$$H_2SO_4(aq) + SO_3(g) \leftrightarrow H_2S_2O_7(l)$$

$$H_2S_2O_7(l) + H_2O(l) \rightarrow 2H_2SO_4(aq)$$
- (d) Name the gas produced when each of the following substances is heated with concentrated sulphuric acid
- (i) Sodium Chloride (½ mark)
Hydrogen chloride
- (ii) Sodium Chloride and Manganese (IV) oxide (½ mark)
Chlorine
- (iii) Copper (½ mark)
Sulphur dioxide
- (e) Explain what is observed when burning magnesium is lowered into a gas jar Sulphur dioxide. (3 ½ marks)
A yellow deposit of sulphur is observed and a white powder of MgO formed.

$$2Mg(s) + SO_2(g) \rightarrow 2MgO(s) + S(s)$$

12. Explain the following observations

- (a) When Zinc powder is added to a solution of Copper (II) Sulphate, the color of the solution turns from blue to colorless and the temperature of the solution rises.
Zinc reduces copper ions to copper

$$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$$
- (b) The pH of a solution of sodium carbonate is greater than 7 whereas the pH of a solution of ammonium chloride is less than 7
 Carbonate ions hydrolyze in water to form hydroxyl ions

$$CO_3^{2-}(aq) + H_2O(l) \rightarrow HCO_3^-(aq) + OH^-(aq)$$

while ammonium ions hydrolyze to liberate H⁺

$$NH_4^+(aq) \rightarrow NH_3(aq) + H^+(aq)$$
- (c) Molten sodium chloride conduct electricity but sodium chloride crystals does not.
molten sodium chloride contains free mobile ion to conduct electricity while sodium chloride crystals do not.
- (d) Aqueous hydrogen chloride reacts with magnesium producing hydrogen gas whereas a solution of hydrogen chloride in methyl benzene has no effect on magnesium.

Aqueous hydrogen chloride liberates hydrogen ions that are reduced by magnesium while hydrogen chloride in methylbenzene is covalent and does not liberate hydrogen ions

- (e) A mixture of Zinc oxide and Aluminium reacts when heated but there is no reaction when a mixture of Aluminium oxide and Zinc is heated.
Aluminium is higher than zinc in electrochemical series and can displace zinc from its oxide
13. (a) Explain how nitric acid can be prepared in the laboratory. (No diagram needed) (7 marks)
By heating potassium nitrate with concentrated sulphuric acid to form nitric acid vapour.
$$\text{H}_2\text{SO}_4(\text{aq}) + 2\text{KNO}_3(\text{s}) \rightarrow \text{HNO}_3(\text{aq}) + \text{KHSO}_4(\text{aq})$$

The vapour is condensed by cold water to form nitric acid
- (b) Concentrated nitric acid is added to copper in a test tube.
- (i) State what is observed (1 mark)
Brown fumes and a blue solution formed.
- (ii) Write the equation for the reaction (1 ½ marks)
$$\text{Cu}(\text{s}) + 4\text{HNO}_3(\text{aq}) \rightarrow \text{Cu}(\text{NO}_3)_2 + 2\text{NO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l})$$
- (c) Write equation to show the effect of heat on
- (i) Potassium nitrate (1 ½ marks)
$$2\text{KNO}_3(\text{s}) + \text{heat} \rightarrow 2\text{KNO}_2(\text{s}) + \text{O}_2(\text{g})$$
- (ii) Silver nitrate (1 ½ marks)
$$2\text{AgNO}_3(\text{s}) + \text{heat} \rightarrow 2\text{Ag}(\text{s}) + 2\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$$
- (d) Lead(II) nitrate decomposes when heated according to the equation.
$$2\text{Pb}(\text{NO}_3)_{2(\text{s})} \longrightarrow 2\text{PbO}(\text{s}) + 4\text{NO}_2(\text{g}) + \text{O}_2(\text{g})$$

Calculate the mass of Lead(II) nitrate to be heating to form 1.5 dm³ of nitrogen dioxide gas at s.t.p (mm of Pb(NO₃)₂ = 331gm) (2 ½ marks)
4 x 22.4dm³ of nitrogen dioxide is produced by 331 x 2 g of Pb(NO₃)₂
1.5 dm³ of nitrogen dioxide is produced by $\frac{331 \times 2 \times 1.5}{4 \times 22.4} = 11.1\text{g}$ of Pb(NO₃)₂
14. (a) (i) What is meant by the term sewage? (1 mark)
Sewage: is the product formed when waste matter enters water.
- (ii) Explain the role of bacteria in sewage treatment. (2 marks)
The metabolic activities of bacteria in presence of oxygen break down organic matter to harmless substances such as carbon dioxide and water
- (iii) State two uses of sewage sludge (2 marks)
Organic manure and fuel
- (b)(i) What is water treatment (1 mark)
Water treatment is any process that improves the quality of water to make it appropriate for a specific end-use.
- (ii) Name four water pollutants (4 marks)

detergents, sewage, used oil, plastics

(iii) Mention three characteristics of a polluted water (3 marks)

- bad odor/smell
- bad color
- colored water
- bad taste

(c) Describe a test for purity of water (2 marks)

has a boiling point of 100°C at standard temperature and pressure

End