

Candidate Name

Centre Number

Candidate Number



For Performance Measurement

**ZIMBABWE SCHOOL EXAMINATIONS COUNCIL**  
**General Certificate of Education Ordinary Level**

**CHEMISTRY**

PAPER 2 Theory

**4024/2**

2 hours

**JUNE 2024 SESSION**

Additional materials:  
 Electronic calculator  
 Answer booklet

**INSTRUCTIONS TO CANDIDATES**

Write your name, centre number and candidate number in the spaces at the top of this page and on all separate answer paper used.

Answer **all** questions in **Section A** and any **four** from **Section B**.

At the end of the examination, fasten any separate answer paper used securely to the question paper.

Enter the numbers of **Section B** questions you have answered in the grid.

**INFORMATION FOR CANDIDATES**

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

A copy of the Periodic Table is printed on page 16.

**FOR EXAMINER'S USE****Section A****Section B****TOTAL**

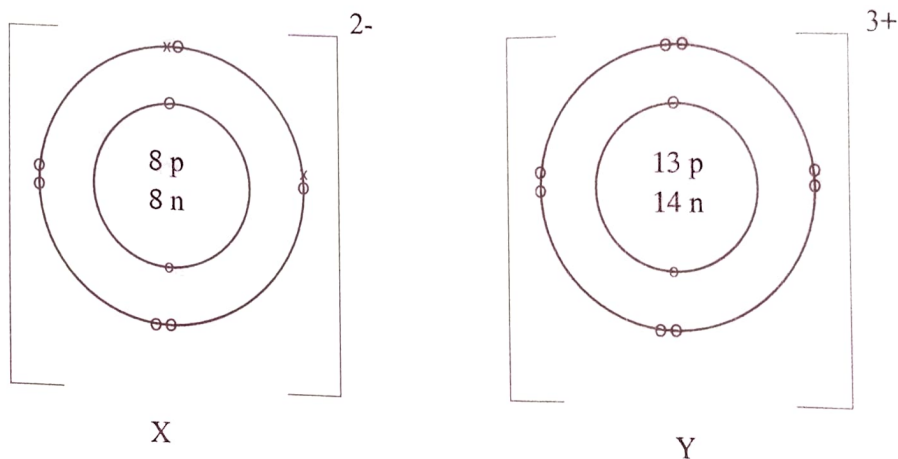
**This question paper consists of 16 printed pages.**  
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## Section A

Answer **all** questions from this section.

Write your answers in the spaces provided on the question paper.

1. (a) **Fig 1.1** shows the dot and cross diagram of two ions of elements represented by X and Y.



**Fig 1.1**

- (i) Write the formula of compound formed when elements represented by X and Y chemically combine.
- .....
- [1]
- (ii) Explain why the compound exists as a solid at room temperature.
- .....
- .....
- [1]



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- (iii) Draw a dot and cross diagram to show the bonding in the compound formed between Y and fluorine.

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[2]

- (b) Explain why

1. a mixture of iodine and sodium chloride can be separated by heating,

2. rain water corrodes buildings.

[2]

- (c) Write balanced chemical equations to describe what happens when

1. magnesium burns in air,

2. barium chloride solution is added to dilute sulphuric acid.

[2]

2. (a) Fig 2.1 shows a chromatogram obtained using solutions of three single dyes (green, brown and purple) and three other substances (D, E and F).

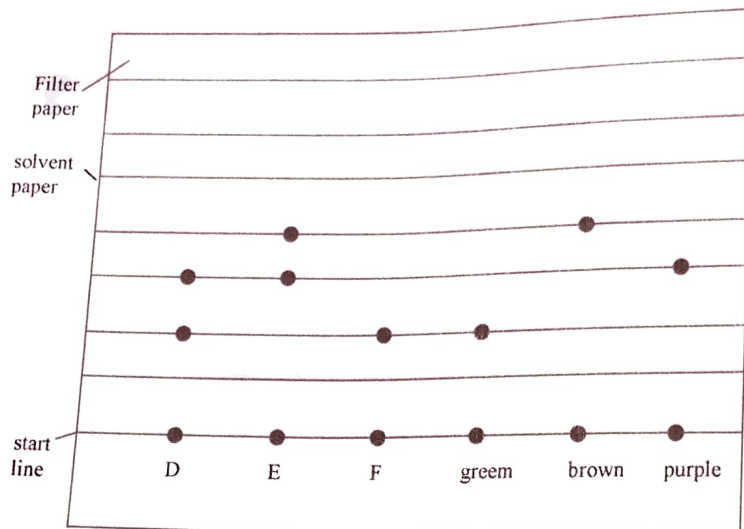


Fig 2.1

- (i) Identify the **two** dyes present in substance **D**.

1.

2.

[2]

- (ii) Identify, with a reason, the dye that is most absorbed by the filter paper.  
*dye*

*reason*

[3]

- (b) (i) Name any **one** factor that enables dyes to be separated by paper chromatography.

[1]

(ii) State **two** other uses of paper chromatography other than separation of dyes.

1.

2.

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[2]

3. (a) Fig 3.1 shows a simple cell.

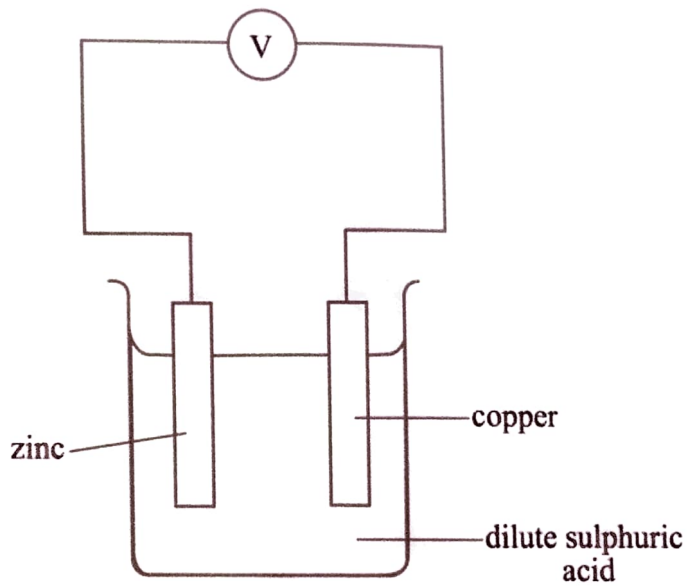


Fig 3.1

(i) Identify the positive and negative electrodes.

*positive*

*negative*

[2]

(ii) Write an equation of the reaction that occurs at the negative electrode.

[1]



(iii) State the observation made on the positive electrode.

[1]

(b) (i) Dilute sulphuric acid can be electrolysed to produce hydrogen and oxygen

Identify the products at the

1 cathode,

2 anode.

[2]

(ii) Write half equations for the reaction at the

1 anode,

2 cathode.

[2]

4. (a) **Table 4.1** is an incomplete Table showing some environmental pollutants and their effects.

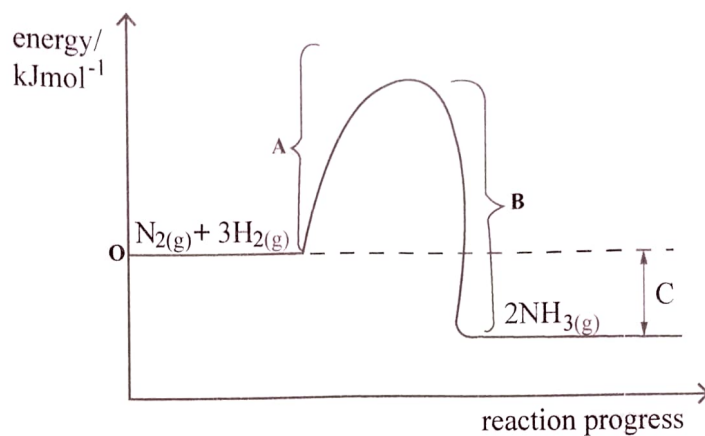
**Table 4.1**

pollutant	environmental effect(s)
<i>NO<sub>2</sub></i>	
<i>CO</i>	
	global warming

Complete the **Table 4.1** by stating the missing information.

[3]

- (b) **Fig 4.1** shows the energy profile diagram for the manufacture of ammonia by the Haber process.



**Fig 4.1**

- (i) Describe and explain what happens in sections labelled

1. **A,**

.....  
.....  
.....

2. **B.**

.....  
.....  
.....

[4]

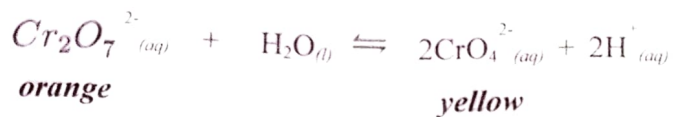
- (ii) Name energy change represented by **C.**

.....

[1]

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5. (a) The inter-conversion between dichromate,  $Cr_2O_7^{2-}$  and chromate (VI) ions,  $CrO_4^{2-}$ , can be shown by the following dynamic equilibrium.



- (i) Define the term *dynamic equilibrium*.

.....

.....

.....

[1]

- (ii) Describe and explain what happens to the equilibrium when
1. the concentration of  $H^+$  ions is increased,

.....

.....

2.  $CrO_4^{2-}$  ions are removed.

.....

.....

.....

.....

[4]

- (b) State the observable changes that occur when sulphur dioxide gas is bubbled in sodium dichromate solution.

.....

.....

[1]

- (c) Name the type of reaction which occurs when

1. fats are boiled in sodium hydroxide,

.....

2. a carboxylic acid reacts with an alcohol.

.....

[2]





## Section B

Answer any **four** questions from this section.

Write your answers on separate answer paper provided.

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6. (a) Fig 6.1 shows a cooling curve of a substance, M.

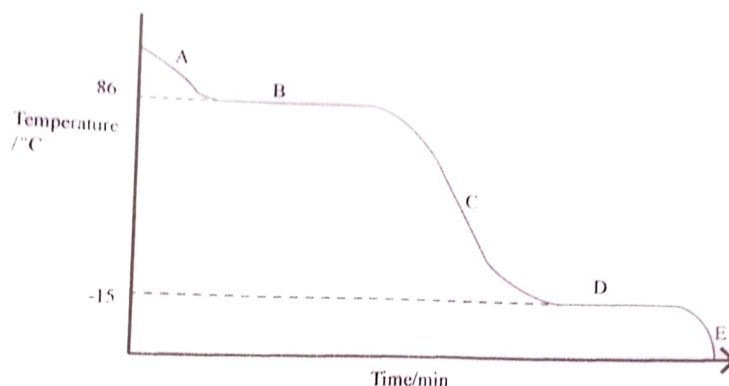
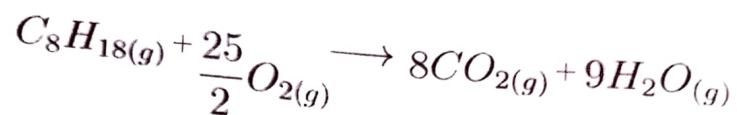


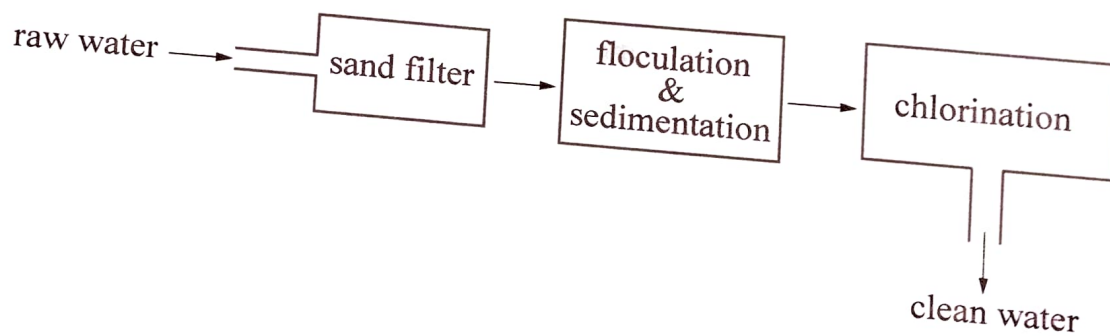
Fig 6.1

- (i) Explain the shape of the curve at section B. [2]
- (ii) Deduce the boiling point of substance M. [1]
- (iii) State the processes occurring at section
1. C,
  2. D. [2]
- (iv) Name the state of the substance at room temperature. [1]
- (v) State and explain the effect of the impurities on the boiling point of substance M. [2]
- (b) Explain why
- (i) different solids do not mix when placed on top of each other, [1]
  - (ii) cigarette smoke can affect a by-stander in the same room. [1]
- (c) Draw an energy level diagram for an endothermic reaction. [2]

- (d) (i) Explain what happens to the anode and cathode when a lead-acid battery is discharging. [2]
- (ii) Describe any **one** way for maintaining and caring of the lead-acid battery. [1]
7. (a) (i) A catalytic converter converts unburnt hydrocarbons such as  $C_8H_{18}$  to harmless wastes. The reaction that occurs is shown.



- Calculate the volume of carbon dioxide produced when 1.96 g of the hydrocarbon reacts. [3]
- (ii) Describe any **two** disadvantages of the use of carbon based fuels. [2]
- (b) (i) **Fig 7.1** shows stages in the purification of water.

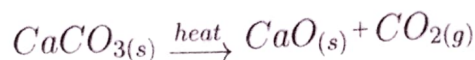


**Fig 7.1**

Describe and explain what happens in

1. sand filters,
  2. flocculation and sedimentation tank.
- (ii) Name any **two** home based water treatment methods. [3]
- [2]

- (c) (i) The chemical equation shows how calcium oxide is produced in large quantities in Lime Kiln.



Calculate the mass of calcium carbonate required to produce 61.60 Kg of calcium oxide. [2]

- (ii) Describe the problems associated with the quarrying of calcium carbonate. [2]

- (iii) Describe the steps that could be taken to overcome the problems in (ii). [1]

8. (a) Fig .8.1 shows how an organic compound, **G**, can be converted to different organic compounds.

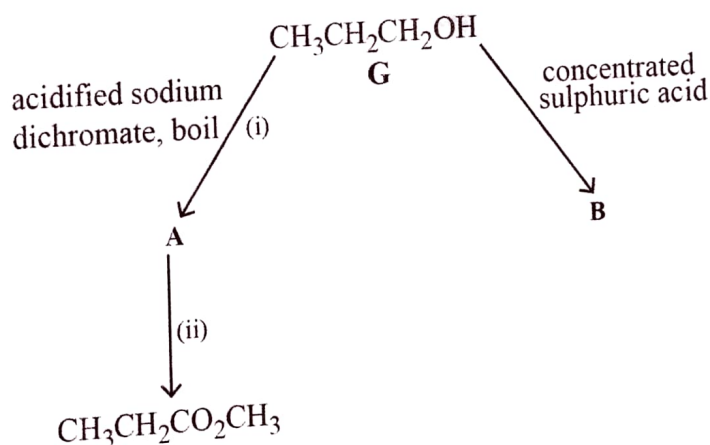


Fig 8.1

- (i) Draw displayed structural formula of

1. **A**,

2. **B**. [2]

- (ii) State the homologous series to which **B** belongs. [1]

(iii) State the type of reaction occurring in

1. reaction (i),

2. reaction (ii).

[2]

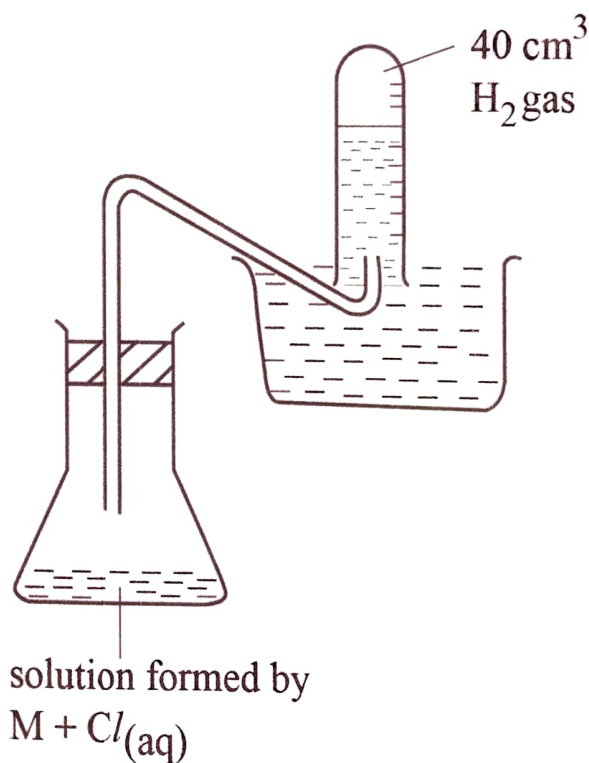
(iv) State the observable changes that occur in

1. reaction (i),

2. reaction (ii).

[2]

(b) (i) **Fig. 8.2** shows results when a metal, **M**, was reacted with dilute hydrochloric acid.



**Fig 8.2**

The experiment was repeated with metals N and P. The results are shown in the table.

metal	volume of hydrogen/cm <sup>3</sup>
N	0
P	12

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Arrange the three metals, **M**, **N** and **P** in decreasing order of reactivity.

[1]

(ii) Explain the order in (i).

[3]

(iii) **M** forms an ion,  $M^{2+}$ .

Write a balanced chemical equation for the reaction of **M** with dilute hydrochloric acid.

[2]

(c) A substance **X** with an  $M_r$  value of 34 is composed of 5.90 % hydrogen and 94.10 % oxygen.

Calculate the molecular formula of **X**.

[2]

9. (a) (i) An element, **X**, of atomic mass 88, reacts with chlorine to form a chloride containing 44.7% chlorine.

Calculate the empirical formula of the chloride.

[4]

(ii) Suggest the type of bonding that exist between **X** and chlorine.

[1]

(b) (i) A mass of 0.048 g of magnesium was reacted with excess dilute hydrochloric acid at r.t.p to produce hydrogen.

Write a balanced chemical equation for the reaction.

[2]

(ii) Calculate the volume of the gas produced at r.t.p.

[3]

- (c) (i) Fig 9.1 shows part of a polymer.

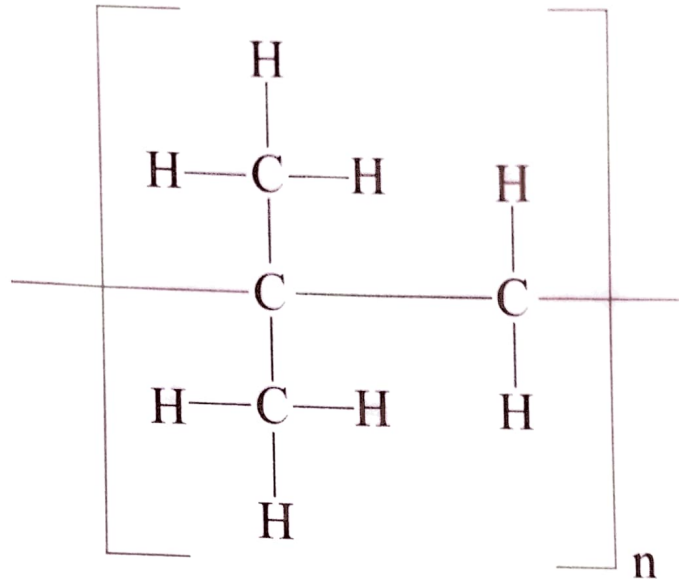
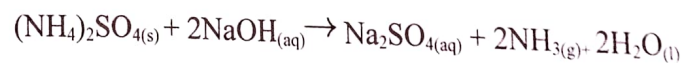


Fig 9.1

- Deduce the structural formula of the monomer(s). [1]
- (ii) State the type of polymerization that forms this polymer. [1]
- (iii) Describe two environmental problems associated with the disposal of the polymer. [2]
- (iv) Suggest one method of disposing off the polymer. [1]
10. (a) A mass of 0.54 g impure ammonium sulphate fertilizer reacted with warm sodium hydroxide solution. 140.00 cm<sup>3</sup> of ammonia gas were produced at room temperature and pressure. The chemical equation for the reaction is shown:



Calculate the

- concentration of sodium hydroxide solution,
- percentage purity of the fertilizer.

[6]



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- (b)** Describe how pure crystals of sodium sulphate are produced. [3]
- (c)** **(i)** Describe and explain the difference in reactivity of magnesium and barium. [4]
- (ii)** Explain why a white solid is observed when calcium is added to magnesium sulphate solution. [2]

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### DATA SHEET The Periodic Table of the Elements

		Group																																																																					
		I		II		III										IV		V		VI		VII		O																																															
		1		2		3										4		5		6		7		8																																															
		Hydrogen														Helium																																																							
7	Li	9	Be	11	B	12	C	14	N	16	O	19	F	20	Ne	3	Li	4	Be	5	B	6	C	7	N	8	O	9	F	10	Ne	11	Na	12	Mg	13	Al	14	Si	15	P	16	S	17	Cl	18	Ar																								
19	K	20	Ca	21	Sc	22	Ti	23	V	24	Cr	25	Mn	26	Fe	27	Co	28	Ni	29	Cu	30	Zn	31	Ga	32	Ge	33	As	34	Se	35	Br	36	Kr	37	Rb	38	Sr	39	Y	40	Zr	41	Nb	42	Mo	43	Tc	44	Ru	45	Rh	46	Pd	47	Ag	48	Cd	49	In	50	Sn	51	Sb	52	Te	53	I	54	Xe
55	Rb	56	Sr	57	Y	58	Zr	59	Nb	60	Mo	61	Tc	62	Ru	63	Rh	64	Pd	65	Ag	66	Cd	67	In	68	Sn	69	Sb	70	Te	71	I	72	Xe	73	Ra	74	Ac	75	Fr	76	Ra	77	Ac	78	Fr	79	Ra	80	Ac	81	Fr	82	Ra	83	Ac	84	Fr	85	Ra	86	Ac								
87	Fr	88	Ra	89	Ac	90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr	104	Th	105	Pa	106	U	107	Np	108	Pu	109	Am	110	Cm	111	Bk	112	Cf	113	Es	114	Fm	115	Md	116	No	117	Lr										

\*58-71 Lanthanoid series  
\*90-103 Actinoid series

Key  
 a = relative atomic mass  
 X = atomic symbol  
 b = proton (atomic) Number

140	Ce	141	Pr	144	Nd	150	Pm	150	Sm	152	Eu	157	Gd	159	Tb	162	Dy	165	Ho	167	Er	169	Tm	173	Yb	175	Lu
58	Ce	59	Pr	60	Nd	61	Pm	62	Sm	63	Eu	64	Gd	65	Tb	66	Dy	67	Ho	68	Er	69	Tm	70	Yb	71	Lu
90	Th	91	Pa	92	U	93	Np	94	Pu	95	Am	96	Cm	97	Bk	98	Cf	99	Es	100	Fm	101	Md	102	No	103	Lr

The volume of one mole of any gas is 28 dm<sup>3</sup> at room temperature and pressure (r.t.p.)

