

Candidate Name

Centre Number

Candidate Number



For Progress Through Learning

# ZIMBABWE SCHOOL EXAMINATIONS COUNCIL

General Certificate of Education Advanced Level

## CHEMISTRY

## 9189/2

PAPER 2

NOVEMBER 2013 SESSION

1 hour 15 minutes

Candidates answer on the question paper.

Additional materials:

Data Booklet

Mathematical Tables and/or Calculator

TIME 1 hour 15 minutes

### INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

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

### INFORMATION FOR CANDIDATES

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

### FOR EXAMINER'S USE

1	
2	
3	
4	
5	
<b>TOTAL</b>	

This question paper consists of 8 printed pages:

Copyright: Zimbabwe School Examinations Council, N2013.

1 (a) Define the term

(i) *rate equation,*

---

---

(ii) *order of reaction.*

---

---

[2]

(b) For a reaction represented by the equation  $H_2O_{2(l)} + 2I^-_{(aq)} + 2H^+_{(aq)} \rightarrow 2H_2O + I_{2(aq)}$ , the initial rate was measured for various concentrations of reactants. The results are shown in Table 1.

Table 1

experiment number	initial concentration/mol dm <sup>-3</sup>			initial rate mol dm <sup>-3</sup> s <sup>-1</sup>
	H <sub>2</sub> O <sub>2</sub>	I <sup>-</sup>	H <sup>+</sup>	
1	0.010	0.01	1.0	1.67 × 10 <sup>-6</sup>
2	0.005	0.01	1.0	8.3 × 10 <sup>-7</sup>
3	0.010	0.02	1.0	3.5 × 10 <sup>-6</sup>
4	0.010	0.01	0.25	4.17 × 10 <sup>-7</sup>

(i) Deduce the order of reaction with respect to

1. H<sub>2</sub>O<sub>2</sub>, \_\_\_\_\_
2. I<sup>-</sup>, \_\_\_\_\_

(ii) Write down the rate law for this reaction.

---

---

(iii) State the units of  $k$ .

---

(iv) Calculate the rate of reaction when  $[H_2O_2] = 0.005 \text{ mol dm}^{-3}$ ,  
 $[I^-] = 0.02 \text{ mol dm}^{-3}$  and  $[H^+] = 5.0 \text{ mol dm}^{-3}$ .

[6]

(c) Explain why it is important for chemists to understand the factors that affect the rates of chemical reactions.

---



---



---

[3]

[Total: 11]

2

When methylamine and boron trichloride are boiled together, a compound,  $CH_3NH_2BCl_3$  is formed.

(a) Draw dot and cross diagrams to show the bonding in

(i) methylamine,

(ii) the compound  $\text{CH}_3\text{NH}_2\text{BCl}_3$ .

[2]

(b) (i) Describe how shapes of molecules can be explained in terms of the repulsion theory between the electron pairs.

---

---

---

---

(ii) State the shape and bond angle in the  $\text{BCl}_3$  molecule.

shape \_\_\_\_\_

bond angle \_\_\_\_\_

[4]

(c) Name the type of reaction that produces the compound  $\text{CH}_3\text{NH}_2\text{BCl}_3$ .

[1]

(d) Explain why  $\text{CH}_3\text{NH}_2\text{BCl}_3$  does not show hydrogen bonding.

---

---

---

[2]

[Total: 9]

3 Fig. 1 shows some of the reactions of magnesium and its compounds.

For  
Examiner's  
Use

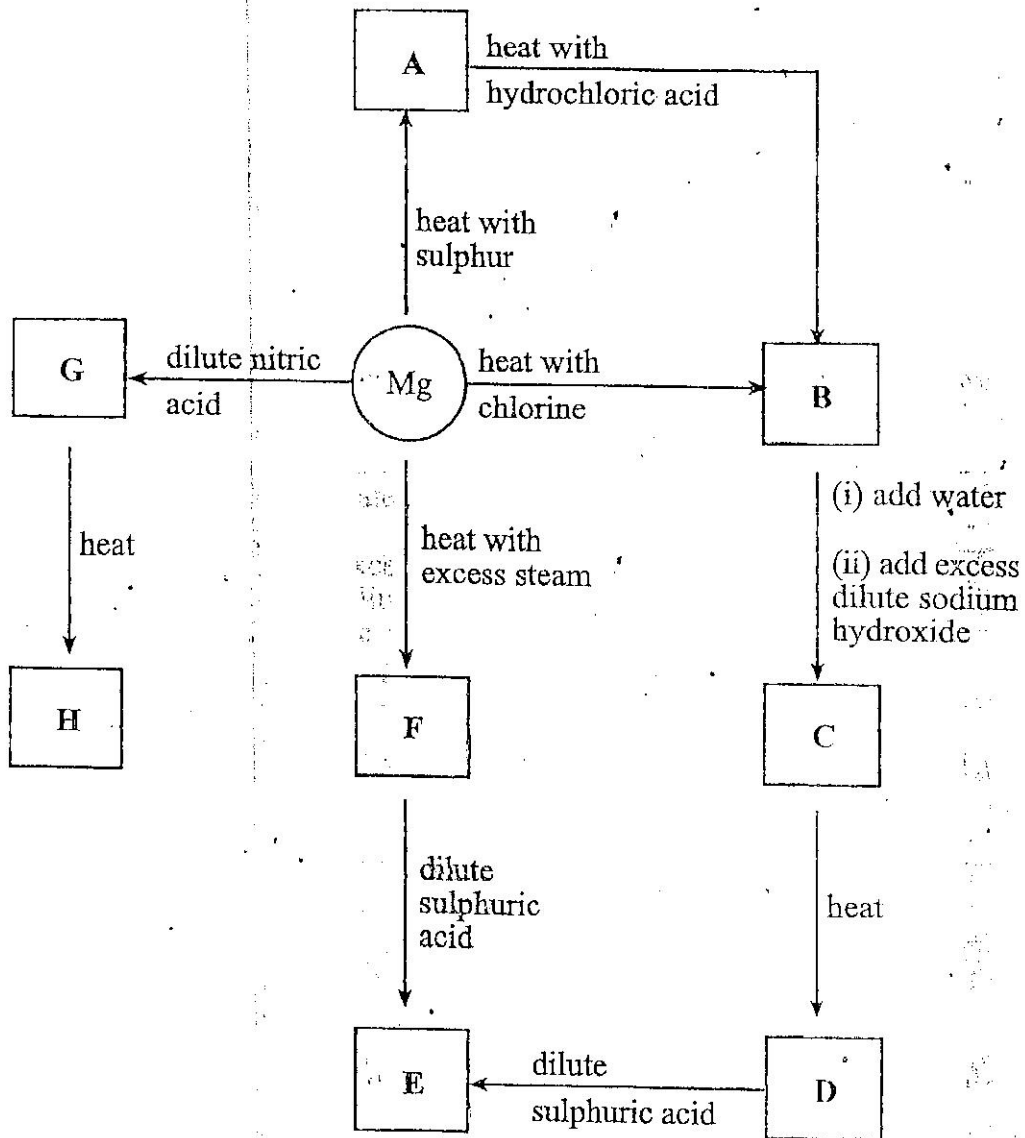


Fig. 1

(a) (i) Use Fig. 1 to complete Table 2.

Table 2

compound	formula of compound	use
A		
B		
C		
D		

(ii) Write a balanced equation for the formation of H from G,

(iii) Explain why compound E easily dissolves in water.

[7]

(b) State and explain how the thermal stability of G would differ if magnesium was replaced with barium.

[3]

[Total: 10]

4 (a) Ethane, reacts with chlorine in the presence of sunlight to form a mixture of chlorinated products. One possible product is  $C_2H_4Cl_2$ .

(i) State the type of mechanism involved in this reaction.

(ii) The initiation step involves the homolytic fission of the Cl-Cl bond. Define the term *homolytic fission*.

(iii) Name the two isomers of  $C_2H_4Cl_2$ .

[4]

(b) When  $C_2H_4Cl_2$  is treated with sodium hydroxide, the products depend on the solvent in which the sodium hydroxide is dissolved.

(i) If an aqueous solution of sodium hydroxide is used;  $C_2H_4Cl_2$  undergoes substitution reactions to form two possible organic products.

Draw the displayed formulas of the two organic products:

*product 1*

*product 2*

(ii) Deduce the structure of the organic product formed when  $C_2H_4Cl_2$  reacts with an ethanoic solution of sodium hydroxide.

[3]  
[Total: 7]

5 Fig. 2 shows the structure of compound A.

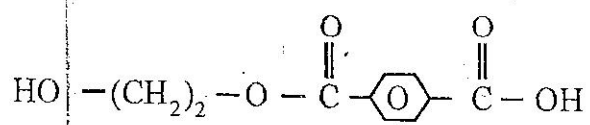


Fig. 2

(a) Deduce the molecular formula of compound A.

[1]

- (b) (i) Compound A undergoes oxidation, hydrolysis and neutralisation reactions.

Complete Table 3 for these reactions.

Table 3

reaction	reagent	conditions
oxidation		
hydrolysis		
neutralisation		

- (ii) Draw the displayed structural formulae of the organic product(s) formed when compound A is

1. oxidised,

2. hydrolysed,

3. neutralised.