

Name.....Marking Scheme.....Index Number.....Adm.....  
Signature.....  
Date.....

233/2

**CHEMISTRY PAPER 2**

**(THEORY)**

JUNE, 2018

2 hours

KASSU EXAMINATION 2018

**CHEMISTRY**

*(Kenya Certificate of Secondary Education)*

**Instructions**

- ✓ Write your name and index number in the spaces provided above.
- ✓ Sign and write the date of examination in the spaces provided above.
- ✓ Answer **all** the questions in the spaces provided in the question paper.
- ✓ Electronic calculators may be used.
- ✓ All working **must** be clearly shown where necessary.
- ✓ This paper consists of 13 printed pages. Confirm this and that no questions are missing.

For Examiner's Use Only

Question	Maximum Score	Candidate's score
1	11	
2	14	
3	11	
4	12	
5	09	
6	12	
7	11	
Total	80	

1. Study the information below given about elements A, B, C, D, E, F, G and H which form part of the Periodic Table. Letters are not actual symbols of the elements.
- Element A is in period 2 group VI. D is atomic number 15.
  - Element F forms a cation having an oxidation state of +1. The ion of F has three occupied energy levels.
  - B and G belong to the same chemical family but G has one more energy level than B. B loses two electrons to form an ion with electronic configuration 2.8
  - Element C belongs to the same period as B and has one more proton than B.
  - E and H belong to the same group and react by gaining one electron. H has a larger atomic radius than E.

Use the information above to answer the questions that follow.

- a) Which element forms ions with a charge of 2-? Explain. (2 marks)

A VI

It attains stability by gaining two electrons. ✓

- b) What is the nature of the oxide formed by element C.? (1 mark)

Amphoteric ✓

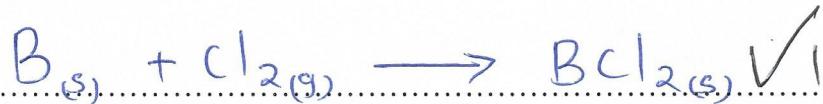
- c) How does the reactivity of H compare with that of E? Explain. (2 marks)

E is more reactive than H. ✓

Reactivity of halogens decreases down the group! Any 1  
E has a smaller atomic radius than H. ✓

d) Write down a balanced chemical equation for the reaction between B and chlorine.

(1 mark)



e) Compare the atomic radii of elements F and G. Compare Explain

(2 marks)

G has a smaller atomic radius than F.  $\checkmark$

G has more protons than F / G has stronger nuclear charge than F.  $\checkmark$  (Any 1)

f) If the oxides of F and D are separately dissolved in water, state and explain the effects of their aqueous solutions on litmus.

(3 marks)

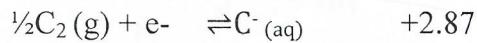
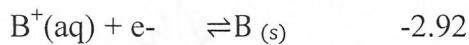
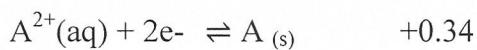
Solution of oxide of F in water turns litmus solution blue while that of oxide of D turns litmus solution red! Oxide of F is alkaline, while that of D is acidic.

2. (a) Study the reduction potentials below.

II

Half cell

$E^\circ$ (Volts)



(i) Identify the weakest oxidizing agent.

B<sub>(s)</sub>

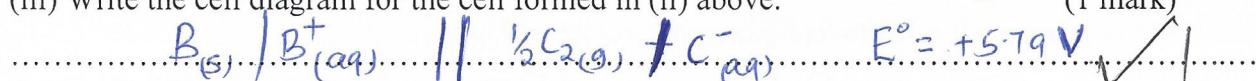
(1 marks)

(ii) Calculate the e.m.f of the cell that would produce the highest output of voltage.

$$E_{cell} = E_{Reduction} - E_{Oxidation} = +2.87 - (-2.92) = +5.79 V \checkmark$$

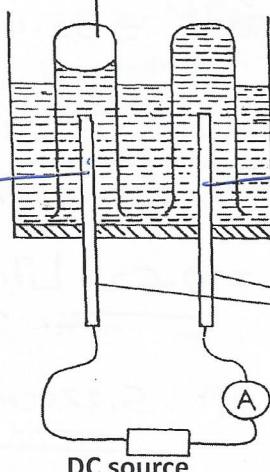
Units Must

(iii) Write the cell diagram for the cell formed in (ii) above.



(b) Study the electrolytic cell below.

Gas A



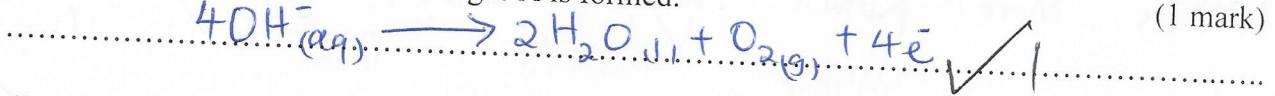
Copper (II) sulphate Solution

Cathode

Graphite electrodes

(i) Identify the anode and cathode on the diagram. (1 mark)

(ii) Write an equation to show how gas A is formed. (1 mark)

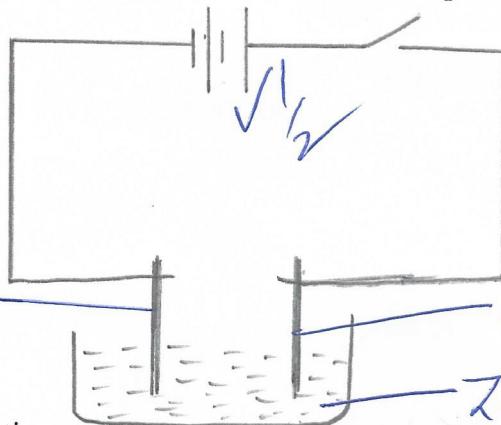


(iii) State two changes that occur in the electrolyte after the experiment. (2 marks)

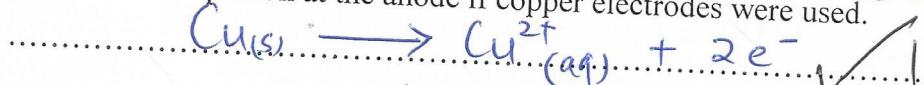
✓ blue colour of solution fades away. ✓

✓ pH of solution reduces. ✓

(iv) Draw a well labelled diagram showing how impure zinc can be purified by electrolysis. (2 marks)



(v) Write the equation at the anode if copper electrodes were used. (1 mark)



(vi) In electrolysis of dilute magnesium sulphate, using inert electrodes, a current of 2A was passed for 1½ hours. Calculate the volume of the gas produced at the anode at s.t.p.

(1F=96500 C, M.G.V=22.4 Litres)

$$Q = It \quad \checkmark \\ = 2 \times (60 \times 75) \quad \checkmark \\ = 9000 \quad \checkmark$$

$$4 \times 96500 C = 22.4 L \quad \checkmark$$

$$\therefore \frac{9000 C \times 22.4 \text{ litres}}{(4 \times 96500 C)} \quad \checkmark$$

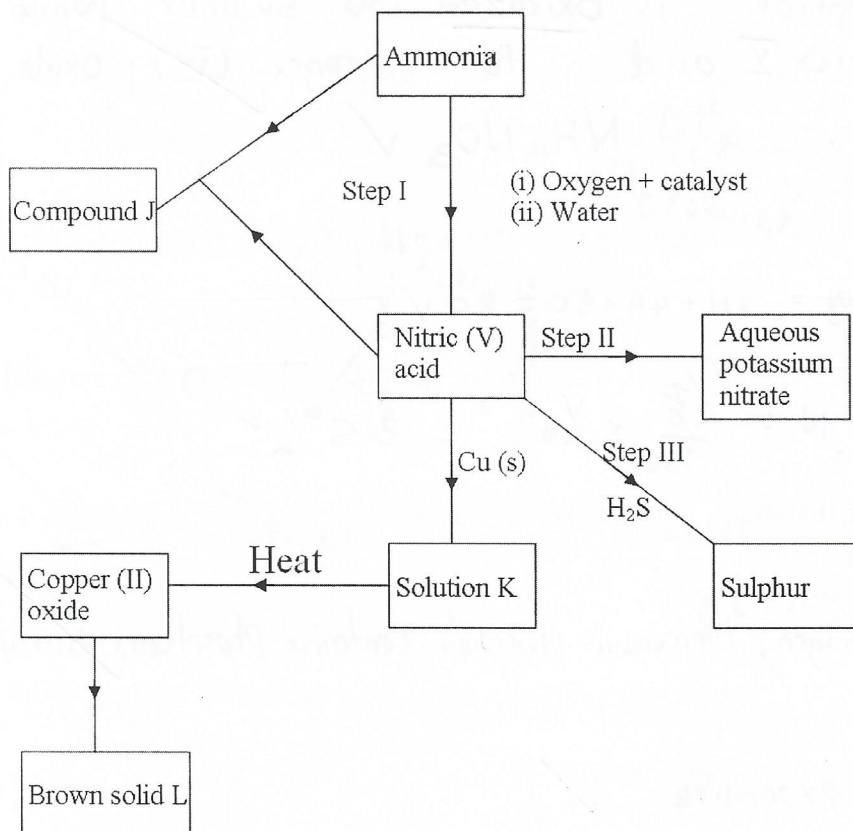
$$= 0.522 \text{ Litres} \quad \checkmark$$

Accept 5,220 cm<sup>3</sup>

Units Must

IV

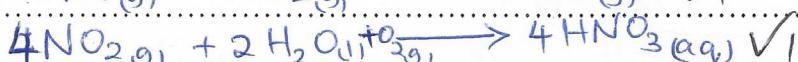
3. The scheme below shows various reactions starting with ammonia. Study it and answer the questions that follow



(a) Name the catalyst used in step I (1 mark)

Platinum - Rhodium ✓ 1

(b) Write any two equations for the reactions that take place in step I. (2 marks)



~~but any 2~~

(c) Name the process that takes place in step II. (1 mark)

Neutralisation ✓ 1

(d) Explain what happens in step III. (2 marks)

Hydrogen sulphide is oxidized to sulphur while it reduces nitric I and to nitrogen (IV) oxide and water.

(e) Write the formula of compound J.  $\text{NH}_4\text{NO}_3$  (1 mark)

(f) Calculate the percentage of nitrogen by mass that is present in compound J. (N=14, H=1, O=16) (2 marks)

$$\text{NH}_4\text{NO}_3 = 2\text{N} + 4\text{H} + 3\text{O} = 80 \quad \checkmark \frac{1}{2}$$

$$\% \text{ of N} = \frac{28}{80} \times 100\% = 35\% \quad \checkmark \frac{1}{2}$$

(g) Give one advantage that ammonium phosphate has over ammonium sulphate as a fertilizer. (1 mark)

In addition to nitrogen, ammonium phosphate contains phosphorus essential for plant growth.

(h) Give one disadvantage of using artificial fertilizer. (1 mark)

they are expensive.  $\checkmark \frac{1}{2}$

4. (a) (i) What is a fuel? (undergoes chemical/nuclear reaction) (1 mark)

A substance that burns to produce useful energy. (W.t.t.e.)  $\checkmark \frac{1}{2}$

(ii) Calculate the heating value of propane,  $\text{C}_3\text{H}_8$ , given that its molar enthalpy of combustion is  $-2200 \text{ kJ mol}^{-1}$ . (C=12, H=1) (2 marks)

$$\text{Molar Mass} = 3\text{C} + 8\text{H} = 44 \text{ g mol}^{-1} \quad \checkmark \frac{1}{2}$$

$$\text{Heating Value} = \frac{-2200}{44} \quad \checkmark \frac{1}{2}$$

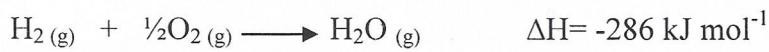
$$= 50 \text{ kJ/g} \quad \checkmark \frac{1}{2}$$

without  
units / wrong units  
penalise  $\frac{1}{2}$  mark

(b) (i) Define molar enthalpy of combustion. (1 mark)

the heat change when one mole of a substance is burnt completely in oxygen.  $\checkmark \frac{1}{2}$

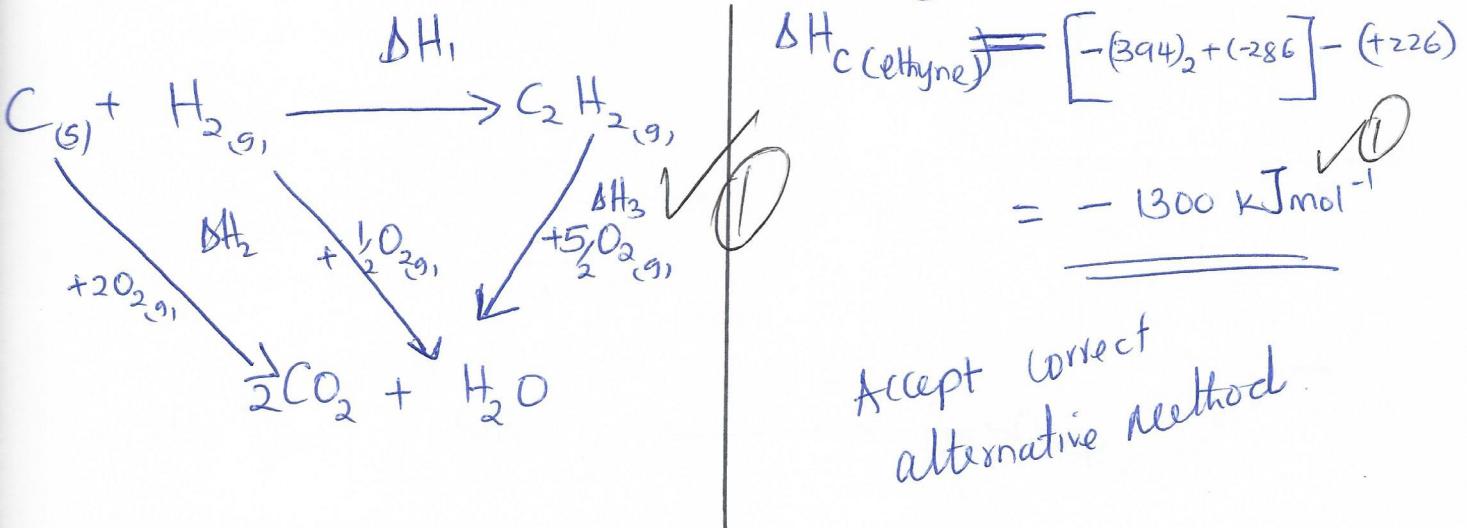
(ii) Use the information provided by the thermochemical equations below to calculate the molar enthalpy of combustion of ethyne. (3 marks)



$$\Delta H_3 = -\Delta H_1 + \Delta H_2 = \Delta H_2 - \Delta H_1$$

$$\Delta H_c(\text{ethyne}) \neq [-(394) + (-286)] - (+226)$$

$$= -1300 \text{ kJ mol}^{-1}$$



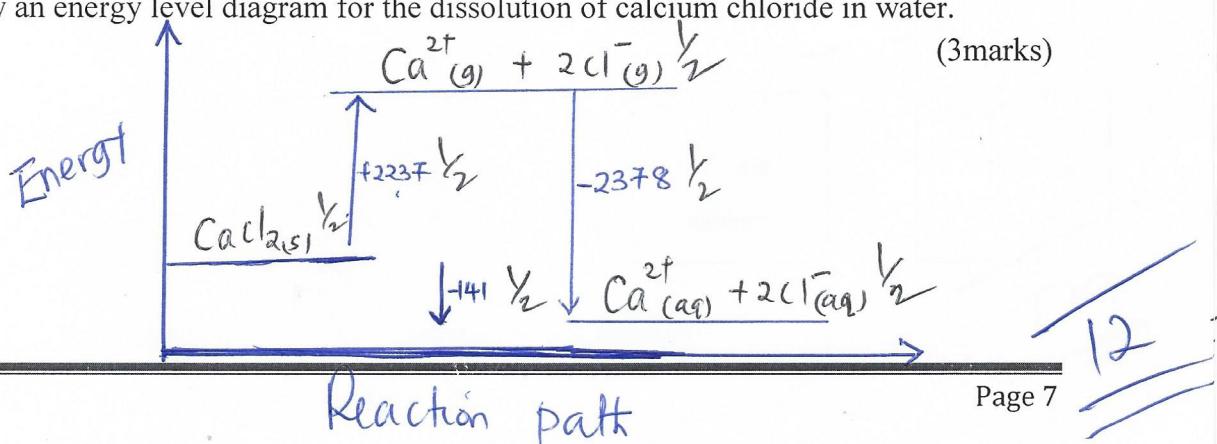
(c) Study the data given below and answer the questions that follow.

Substance/ion	Enthalpy change
CaCl <sub>2</sub> (s)	Lattice energy = -2237 kJ mol <sup>-1</sup>
Ca <sup>2+</sup> (g)	Hydration energy = -1650 kJ mol <sup>-1</sup>
Cl <sup>-</sup> (g)	Hydration energy = -364 kJ mol <sup>-1</sup>

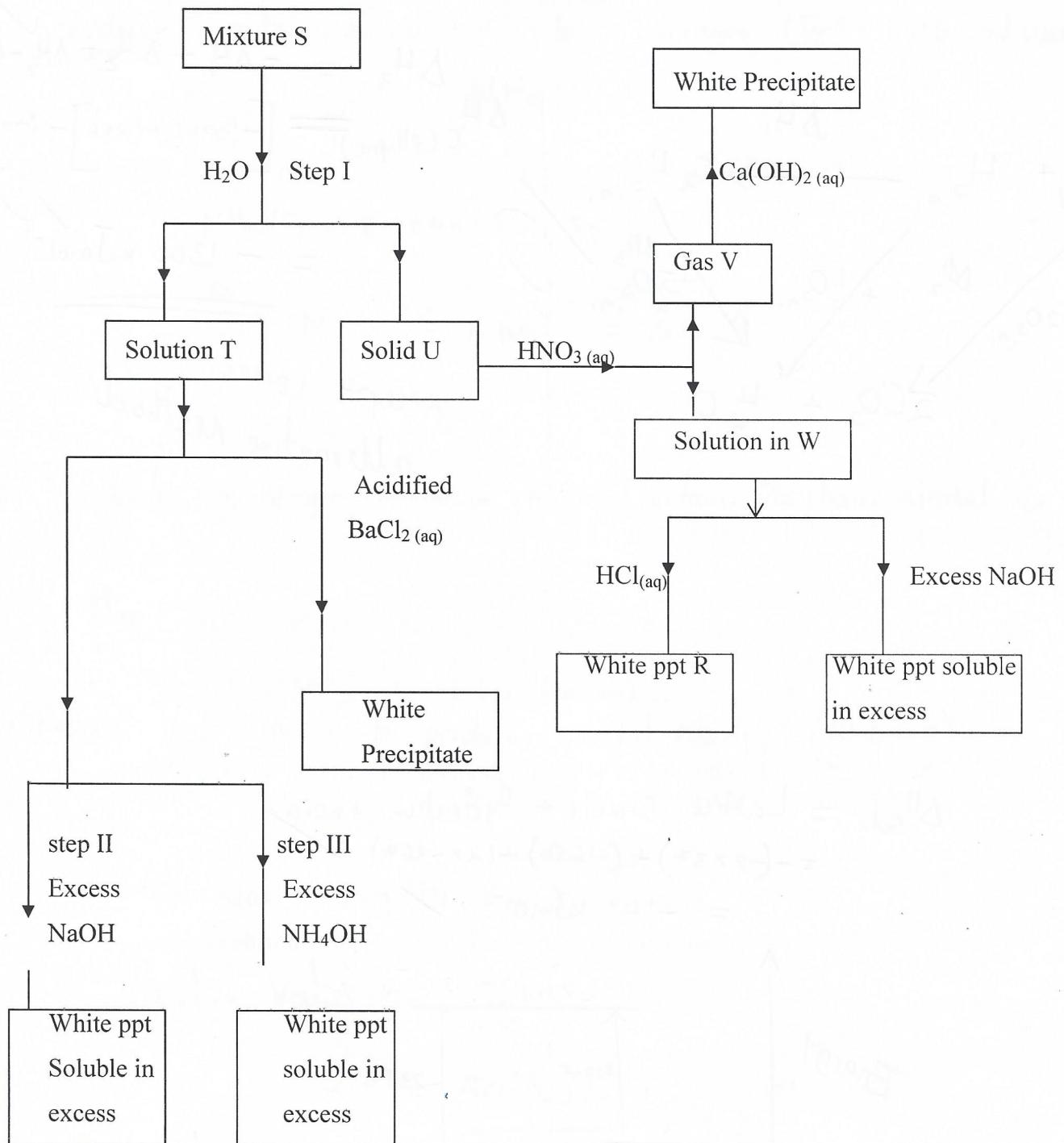
(i) Determine the molar enthalpy of solution of calcium chloride in water. (2 marks)

$$\begin{aligned}\Delta H_{\text{Solv}} &= \text{Lattice Energy} + \text{Hydration energy} \\ &= -(2237) + (-1650) + (2 \times -364) \\ &= -141 \text{ kJ mol}^{-1}\end{aligned}$$

(ii) Draw an energy level diagram for the dissolution of calcium chloride in water. (3 marks)



5. Study the scheme below and answer the questions that follow.



(a) What property of mixture S is shown in step 1. (1 mark)

Mixture of soluble and insoluble salt ✓!

(b) Name the following. (3 marks)

Solid U Lead carbonate ✓!

Gas V Carbon (IV) Oxide ✓!

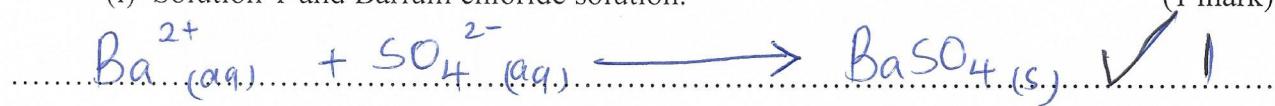
Write the formula of precipitate R .....  $PbCl_2$  ✓!

(c) Identify the ions present in solution T. (1mark)

$Zn^{2+}$  ✓,  $SO_4^{2-}$  ✓

(d) Write an ionic equation for the reaction between.

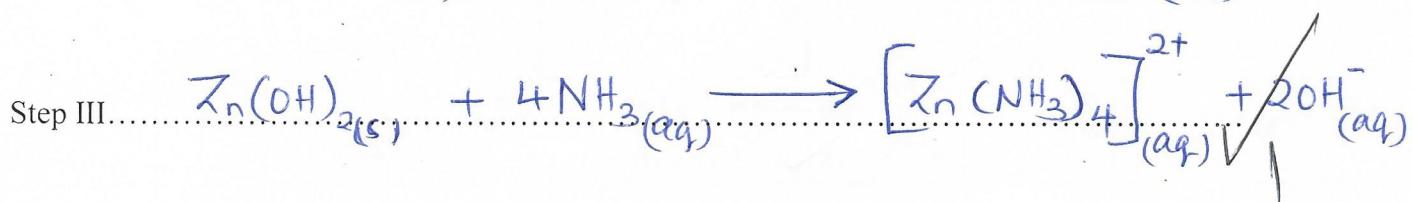
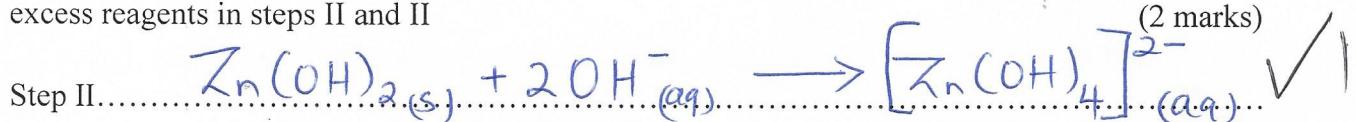
(i) Solution T and Barium chloride solution. (1 mark)



(e) Identify mixture S. (1 mark)

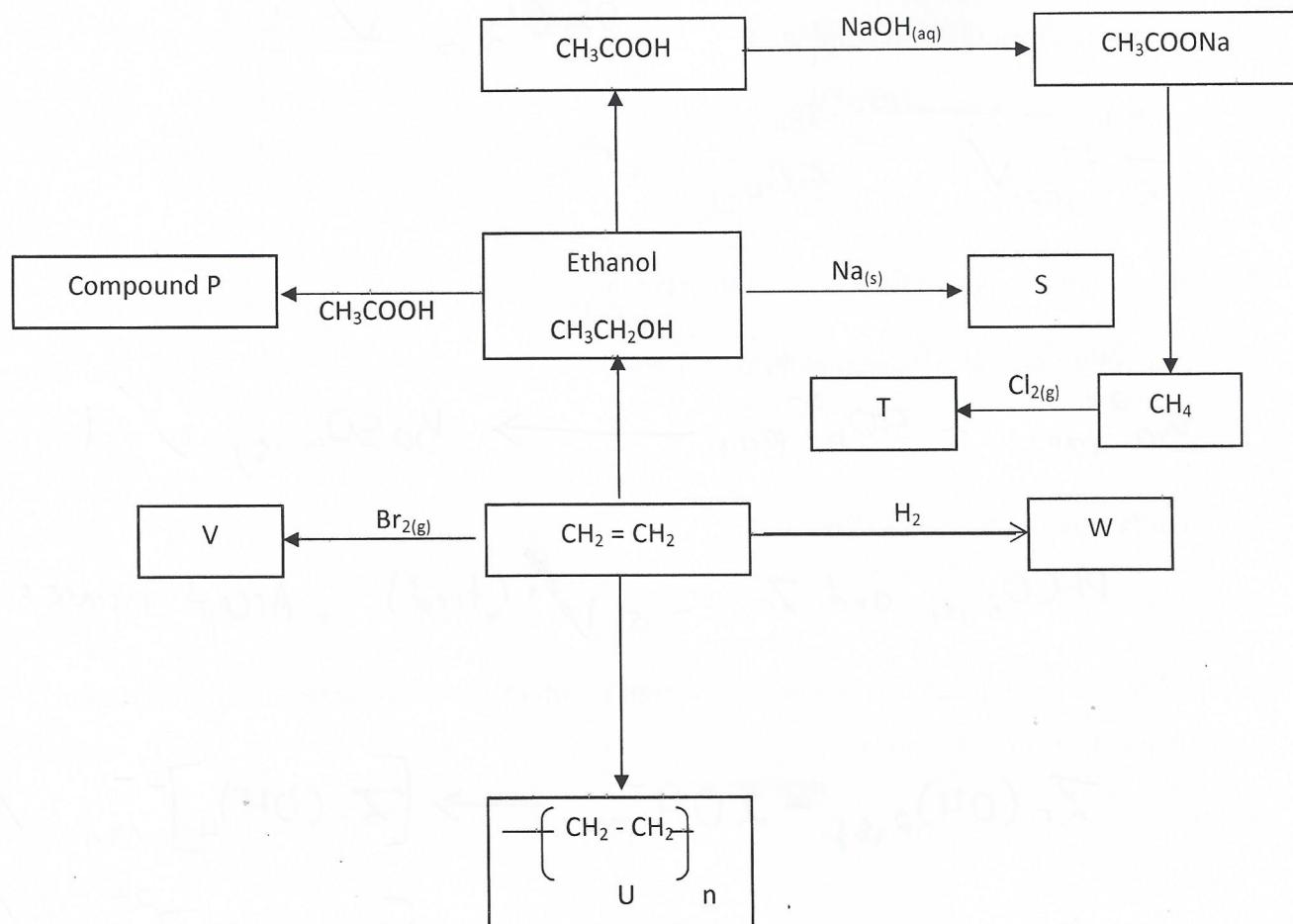
$PbCO_3(s)$  and  $ZnSO_4(s)$ , ✓ (tied) Accept names

(f) Write balanced chemical equations for reactions in which the white precipitates dissolves in excess reagents in steps II and III (2 marks)



09

6. The flow chart below shows some chemical reactions. Study it and answer the questions that follow.



- a) Write the name and formula of the organic compounds P, V and W. (3 marks)

Compound	Name	Formula
P	Ethyl ethanoate ✓	CH <sub>3</sub> COOCH <sub>2</sub> CH <sub>3</sub> ✓
V	1,2-dibromoethane ✓	CH <sub>2</sub> Br-CH <sub>2</sub> Br ✓
W	Ethane ✓	CH <sub>3</sub> CH <sub>3</sub> ✓

b) Name the process that leads to the formation of substance:

V Addition reaction ✓ 1 (1 mark)

T Substitution ✓ 1 (1 mark)

P Esterification ✓ 1 (1 mark)

c) Give one necessary condition for the formation of compound P. (1 mark)

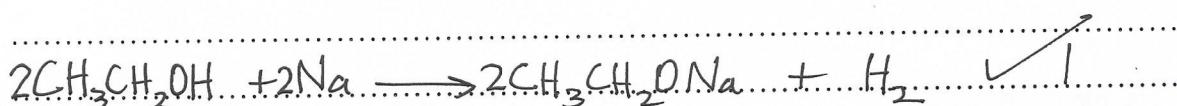
drops of concentrated sulphuric (VI) acid ✓ 1

d) If the relative molecular mass of compound U is 84,000 , determine the value of n.

( C = 12, H= 1.0) (2 marks)

$$\begin{aligned} (12 \times 2 + 1 \times 4)n &= 84\,000 \quad \checkmark \\ 28n &= 84\,000 \\ n &= 3,000 \quad \checkmark \end{aligned}$$

e) Write an equation for the reaction leading to the formation of substance S. (1 mark)



f) State and explain the observations made when the following substances are burnt in excess air. (2 marks)

W

Burns with a blue flame ✓

It is a saturated hydrocarbon ✓

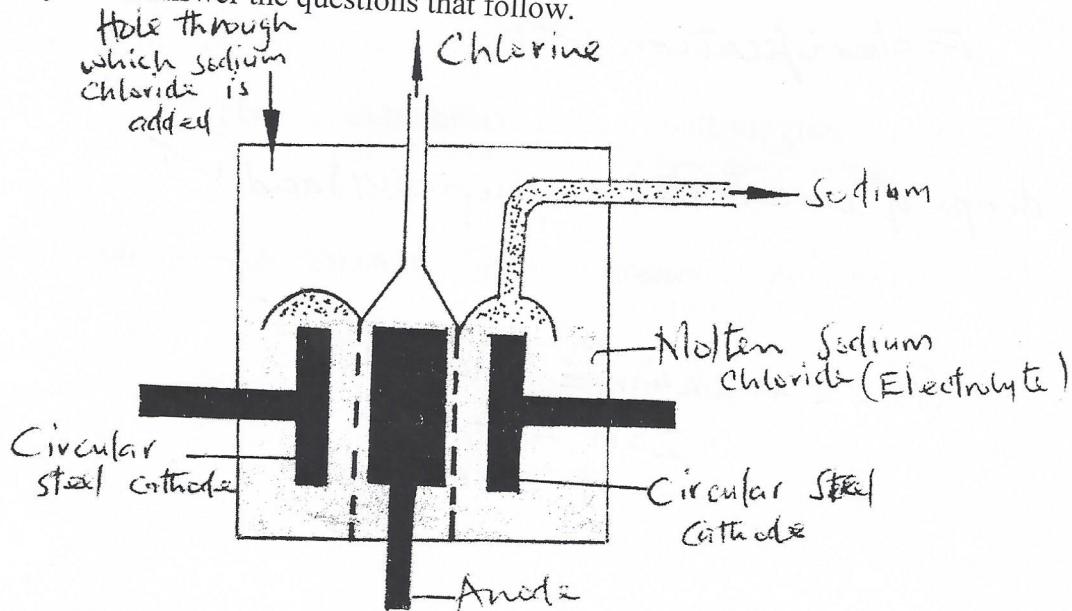
$\text{C}_2\text{H}_4$

Burns with a luminous/smoky/sooty/yellow flame ✓

It is an unsaturated hydrocarbon ✓

7. I (a) Below is a diagram of a process used for the production of sodium.

Study it and answer the questions that follow.



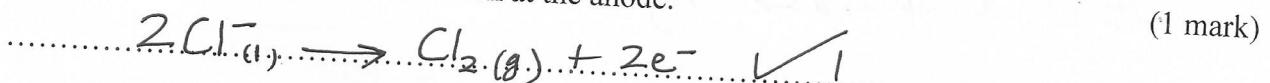
(i) Name the process.

.....Downs' Process..... ✓ / 1 (1 mark)

(ii) What is the role of the steel gauze diaphragm?

Prevents sodium and chlorine formed at the electrodes from recombining ✓ / 1 (1 mark)

(iii) Write an equation for the reaction at the anode.



(b) The electrolyte is a molten mixture containing  $\text{Na}^+$  and  $\text{Ca}^{2+}$  cations.

(i) What is the source of  $\text{Ca}^{2+}$  ions?

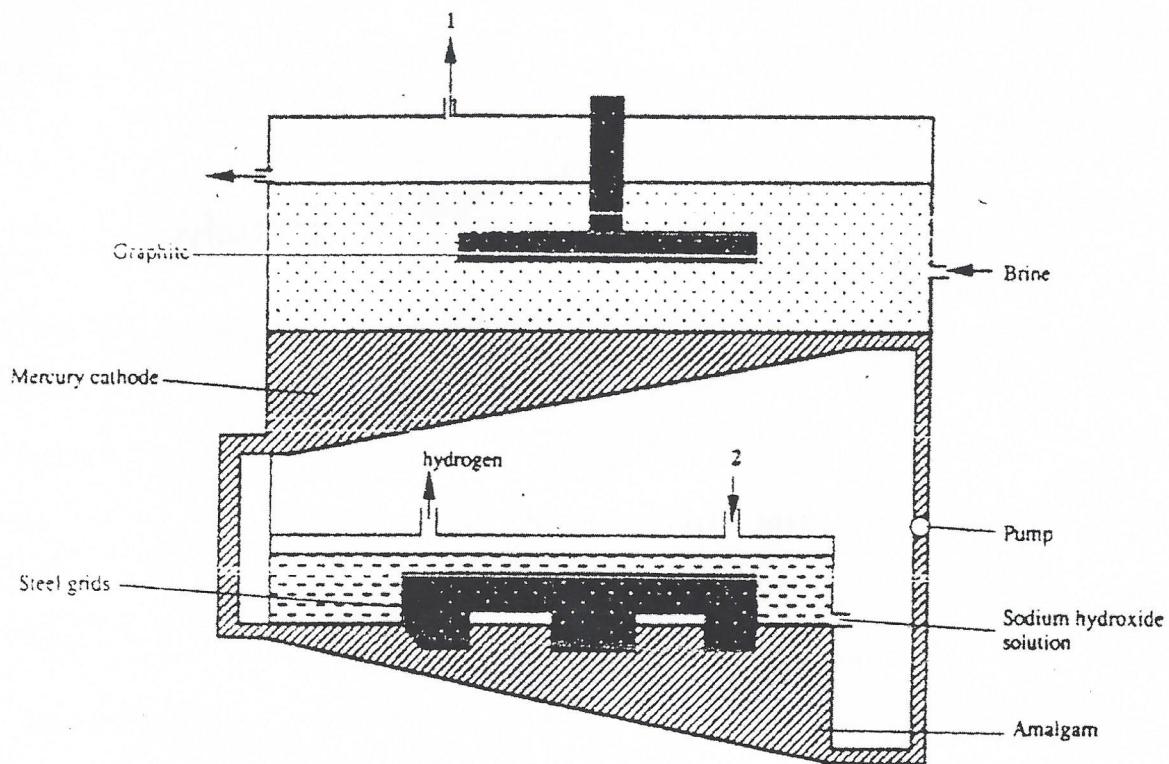
.....Calcium chloride /  $\text{CaCl}_2$ ..... ✓ / 1 (1 mark)

(ii) Give a reason why  $\text{Ca}^{2+}$  ions are not discharged.

.....Lower concentration than  $\text{Na}^+$ ..... ✓ / 1 (1 mark)

.....Has a higher negative reduction/electrode potential than  $\text{Na}^+$ .....

II. (a) The diagram below represents a mercury cathode cell that can be used to manufacture sodium hydroxide. Study it and answer the questions that follow.



(i) Name the substance:

I. labelled 2. .... Water. ✓1 ..... (1 mark)

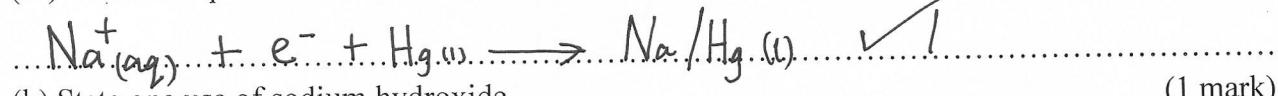
II. labelled 1. .... Chlorine. ✓1 ..... (1 mark)

(ii) Give two reasons why mercury is recycled. (2 marks)

• Minimise on cost ✓1

• Prevent pollution of the environment ✓1

(iii) Write an equation for the reaction that occurs at the mercury cathode. (1 mark)



(b) State one use of sodium hydroxide.

• Manufacture of soapy/soapless detergents ✓1 (any one)  
 • Paper making  
 • Textile industry  
 • Extraction of aluminium from its ores (accept any other correct use)