

NAME ..... Index No. ....

Signature.....

**P525/1**  
**Chemistry**  
**Paper 1**  
**July/August 2019**  
**2<sup>3</sup>/<sub>4</sub> Hours**



**ACEITEKA JOINT MOCK EXAMINATIONS, 2019**  
**UGANDA ADVANCED CERTIFICATE OF EDUCATION**  
**CHEMISTRY**

**PAPER I**

**2 HOURS 45 MINUTES**

**INSTRUCTIONS TO CANDIDATES:**

- \* Answer all questions in section A and six questions in section B.
- \* All questions must be answered in the spaces provided.
- \* The periodic Table with relative atomic masses is provided.
- \* Illustrate your answers with equations where applicable.
- \* Molar gas constant =  $8.314 \text{ J mol}^{-1}\text{K}^{-1}$ .
- \* Molar volume of a gas at s.t.p is 22.4 litres.

**For examiners use only**

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Marks																		

## SECTION A: (46 Marks)

Answer all the questions

1. (a) Explain what is meant by the term **electron affinity**. (1 mark)

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- (b) Calculate the electron affinity of hydrogen using the following data ;

Enthalpy of atomization of potassium =  $90 \text{ kJ mol}^{-1}$

Bond dissociation energy of hydrogen =  $436 \text{ kJ mol}^{-1}$

First ionization energy of potassium =  $418 \text{ kJ mol}^{-1}$

Lattice energy of potassium hydride =  $710 \text{ kJ mol}^{-1}$

Enthalpy of formation of potassium hydride =  $-62 \text{ kJ mol}^{-1}$  (3 marks)

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2. An organic compound Z has a structure



Name the functional group which is present in Z and in each case name the reagent that can be used to identify the functional group, state the observation made and write equations for the reaction that takes place when the compound is reacted with the reagent.

- (i) Name of the functional group (1/2 mark)

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Reagent. (1/2 mark)

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Observation. (1/2 mark)

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Equation

(1 mark)

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(ii) Name of the functional group (1/2 mark)

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Reagent. (1/2 mark)

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Observation. (1/2 mark)

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Equation (1 mark)

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3. (a) Water was added to anhydrous iron(III) chloride drop wise until there was no further change.

(i) State what was observed. (1 mark)

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(ii) Write equation for the reaction that took place. (1 1/2 marks)

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(b) To the solution formed in (a) was added a piece of magnesium ribbon.

(i) State what was observed. (1 mark)

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(ii) Write equation for the reaction that took place. (1½ marks)

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4. (a) Explain what is meant by the term **isotopes**. (1 mark)

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(b) Bromine has relative atomic mass of 79.9 and consists of two isotopes  $^{79}_{35}Br$  and  $^{81}_{35}Br$ . Determine which of the two isotopes is the most abundant. (2½ marks)

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5. (a) Oxygen diffuses 2.31 times as fast as a compound Z with the formula  $Ni(CO)_n$ .

Determine the molecular formula of Z. (3 marks)

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(b) State the;

(i) Co-ordinate number of nickel in compound Z. (1/2 mark)

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(ii) Oxidation number of nickel in compound Z. (1/2 mark)

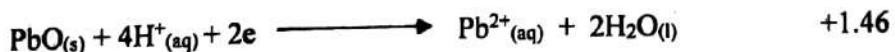
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6. Write equations to show how Phenyl ethanoate can be synthesized from Chloroethane.  
Indicate the reagents and conditions necessary. (4 marks)

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7. The following half cell reactions are given;

E°/V



(a) Write the cell notation for the cell formed by combining the two half cells. (2 marks)

(b) State what will be observed and write equations for the reactions that takes place at;

(i) Anode

Observation

( $\frac{1}{2}$  mark)

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Equation

(1 mark)

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(ii) Cathode

Observation

( $\frac{1}{2}$  mark)

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Equation

(1 mark)

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(c) Calculate the e.m.f of the cell.

(1 mark)

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8. (a) Starting with dodecan-1-ol  $\text{CH}_3(\text{CH})_{10}\text{CH}_2\text{OH}$  describe briefly how a synthetic detergent can be prepared. (4 $\frac{1}{2}$  marks)

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(b) State any two advantages of synthetic detergent over soapy detergents. (1 mark)

9. State what will be observed and write equations for the reaction that takes place when;

- (a) Nickel ethanoate is heated strongly and the gaseous products passed through acidified 2,4-dinitrophenyl hydrazine.

Observation (1½ marks)

Equation(s) (2½ marks)

- (b) Ammonium hydroxide solution is added drop wise until in excess to aqueous solution of Nickel ethanoate.

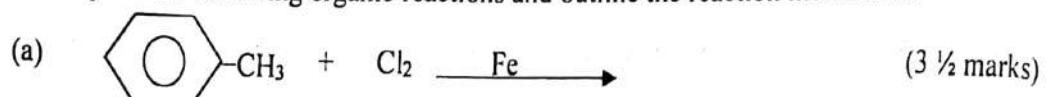
Observation (1½ marks)

Equation(s) (2½ marks)

**SECTION B: (54 Marks)**

**Answer six questions ONLY**

10. Complete the following organic reactions and outline the reaction mechanism



Mechanism

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Mechanism

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Mechanism

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11. (a) Draw the structure and name the shape of the following species. In each case state the oxidation state of the central atom in the structure. (6 marks)

Species	Structure	Shape	Oxidation state
CS <sub>2</sub>			
POBr			
SnO <sub>3</sub> <sup>2-</sup>			

(b) Compare the bond angle of POBr and SnO<sub>3</sub><sup>2-</sup>. Give reason for your answer. (3 marks)

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12. (a) The bond dissociation energies of the following compounds are given;

Elements	Fluorine	Chlorine	Bromine	Iodine
Bond dissociation energies/ kJ mol <sup>-1</sup>	33.3	57.8	46.1	36.2

State and explain variation in bond dissociation energies of the above given elements.

(4marks)

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(b) Bromine and iodine can be prepared by reacting concentrated sulphuric acid with sodium bromide and sodium iodide respectively however chlorine cannot be prepared using the same method. Explain. (3 marks)

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(c) State what will be observed and write equation for the reaction that takes place when concentrated sulphuric acid is added to solid sodium bromide.

Observation (1½ marks)

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Equation (1½ marks)

13. (a) Explain what is meant by the term **partition coefficient**. (1½ marks)

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(b) 100cm<sup>3</sup> of an aqueous solution of X containing 30g per litre of X was shaken with 100cm<sup>3</sup> of trichloromethane. The distribution coefficient of X between trichloromethane and water is 2. Calculate the mass of X which was extracted. (2 ½ marks)

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(c) Calculate the mass of X which will be extracted if the solution of X in (b) is shaken with two successive portions of 50cm<sup>3</sup> of trichloromethane. (4 marks)

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(d) Comment on your answer in (b) and (c) (1 mark)

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(e) State one application of partition coefficient apart from solvent extraction. (1/2 mark)

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14. Write equations to show how the following synthesis can be carried out. In each case indicate the reagents and conditions necessary.

(a) Propanone from ethanol (3 marks)

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(b) Ethanoic acid to Phenyl ethanol. (3 marks)

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(c) 2-Methyl propan-2-ol from 2-Bromo propane. (3 marks)

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15. A compound Y contains by mass 61.02% carbon, 15.25% hydrogen and the rest nitrogen.

(a) Determine the empirical formula of Y. (2 marks)

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(b) Compound Y has a density of  $2.63\text{gdm}^{-3}$  at s.t.p. Determine the molecular formula of Y.

(2 marks)

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(c) Write the structural formula of the possible isomers of Y. (1½ marks)

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(d) Compound Y forms yellow oils when reacted with cold concentrated hydrochloric acid and sodium nitrite.

(i) Identify Y (½ mark)

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(ii) Write equation for the reaction that took place. (1 mark)

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(e) (i) Name the reagent that can be used to confirm the functional group in compound Y. (½ mark)

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(ii) State the observation made. (½ mark)

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(iii) Write equation for the reaction that takes place when the named reagent in (e) (i) is reacted with compound Y. (1 mark)

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16. (a) Iron metal is extracted from one of its ore siderite. The ore is mixed with coke and lime stone and then heated strongly in a blast furnace.  
Write equations for the reactions that lead towards formation of iron metal in the blast furnace. (4½ marks)

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(b) 1.6g of an impure sample of tin (II) chloride was added to an aqueous solution of iron(III) chloride and the mixture heated until there was no further change. The solution was diluted to 250cm<sup>3</sup> with water. 25cm<sup>3</sup> of the solution was acidified with dilute sulphuric acid and titrated with 0.02M potassium permanganate solution. 16.0cm<sup>3</sup> of oxidant was required to reach the end point. Determine the percentage purity of tin(II) chloride. (4 ½ marks)

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17. (a) Distinguish between terms thermosetting plastics and thermosoftening plastics.

Name one example in each case.

(3 marks)

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(b) A polymer Q has a structural formula of



(i) Write the name and structural formula of the monomer of the above given polymer

(1½ marks)

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(ii) Name the type of polymerization by which the above given polymer is formed.

(½ marks)

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(c) When 71.76g of the monomer in (a) i was polymerized  $2.67 \times 10^{-2}$  moles of the polymer was formed.

Determine the;

(i) Molecular mass of the polymer.

(1 ½ marks)

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(ii) Number of monomers in the polymer.

(2 marks)

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(d) State one use of the polymer Q.

( ½ mark)

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**END**

# THE PERIODIC TABLE

1	2													3	4	5	6	7	8
1 H 1.0																		1 H 1.0	2 He 4.0
3 Li 6.9	4 Be 9.0													5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3													13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8		
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131		
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Tn 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	89 Ac (227)																	
			57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175		
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (245)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Es (254)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lw 175		

1. Indicates atomic number.

H

2. Indicates relative atomic mass.

1.0

Name: .....

Centre/Index No: .....

School.....

Signature.....

**P525/1**  
**CHEMISTRY**  
**Paper 1**  
**July/August 2019**  
**2 ¾ hours**



## **WAKISSHA JOINT MOCK EXAMINATIONS**

**Uganda Advanced Certificate of Education**

**CHEMISTRY**

**Paper 1**

**2 hours 45 minutes**

### **Instructions to Candidates**

- Attempt all questions in section A and any six questions from section B.
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.
- Illustrate your answers with equations where applicable.
- Molar gas volume at s.t.p =  $22.4 \text{ dm}^3$

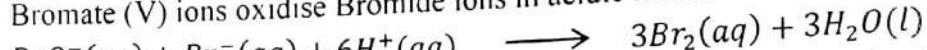
**For Examiner's Use Only**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

## SECTION A (46 MARKS)

Attempt all questions in this section.

1. Bromate (V) ions oxidise Bromide ions in acidic medium according to the equation.



When various concentrations of reactants were mixed at 25°C, the initial rate in each experiment was recorded in the table below.

Expt.	$[BrO_3^-]$ (mol dm <sup>-3</sup> )	$[Br^-]$ (mol dm <sup>-3</sup> )	$[H^+]$ (mol dm <sup>-3</sup> )	Initial rate (mol dm <sup>-3</sup> s <sup>-1</sup> )
1	0.01	0.05	0.02	$3.520 \times 10^{-6}$
2	0.05	0.05	0.02	$1.760 \times 10^{-5}$
3	0.02	0.02	0.02	$2.816 \times 10^{-6}$
4	0.04	0.02	0.04	$2.2528 \times 10^{-5}$

- (a) Calculate the order of reaction with respect to;

(i)  $BrO_3^-$  (01 mark)

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(ii)  $Br^-$  (01 mark)

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(iii)  $H^+$  (01 mark)

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- (b) (i) Determine the overall order of the reaction. (½ mark)
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(i) Write the rate of equation for the reaction. (01 mark)

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- (c) Calculate the value of the rate constant and state its units. (1½ marks)
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2. State what would be observed and write equation for the reaction that would take place when;

(a) Hydrogen peroxide solution is added to Lead (II) sulphide. (02 marks)

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(b) Sodium hydroxide solution is added to a cold solution of ammonium ferrous sulphate. (02 marks)

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(d) Aluminium powder is added to an alkaline solution of sodium nitrate. (02 marks)

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3. (a) A solid organic compound Q contains 41.379% by mass of carbon, 3.448% hydrogen and the rest being oxygen.  
(i) Calculate the empirical formula of Q. (02 marks)

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(ii) Determine the molecular formula of Q. (01 mark)  
(R.F.M of Q = 116)

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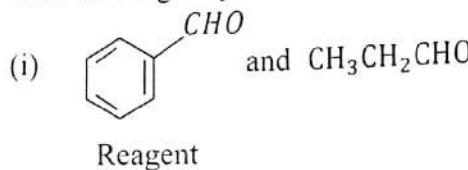
(b) Q reacts with sodium carbonate solution evolving bubbles of a colourless gas and it decolourises liquid Bromine.

(i) Identify Q by its structural formula and IUPAC name. (01 mark)

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(ii) Write equation for the reaction between Q and liquid Bromine. (01 mark)

4. (a) Name a reagent that can be used to distinguish between the following pairs of compounds.  
In each case, state what would be observed if each member of the pair was treated with the reagent you have named.



(0½ mark)

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Observation (01 mark)



(0½ mark)

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Observation (01 mark)

- (b) Write an equation for the reaction(s) that takes place in a(i) and a(ii) above.  
(02 marks)

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5. A direct current of  $0.45\text{A}$  was passed through a dilute solution of Copper (II) sulphate using graphite electrodes for  $5.96$  hours.

- (a) Write an equation for the reaction that took place at the;



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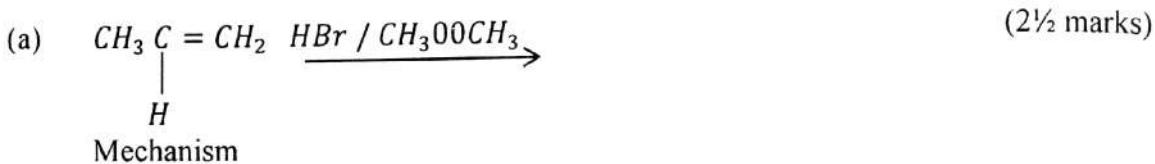
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- (b) Given that  $3.1767\text{g}$  of Copper and  $560\text{cm}^3$  of oxygen at s.t.p were evolved. Calculate the ratio of the quantity of electricity required to produce **1 mole** of each substance at their respective electrodes.  
(03 marks)

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6. (a) Carbon, silicon and Lead are some of the elements that belong to group (IV) of the Periodic Table.  
Write the formula of the most stable oxide of each element. (1½ marks)
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- (b) (i) State the order of acidity of the oxides in (a) above. (0½ mark)
- .....  
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- (ii) Write equation(s) of the oxides with dilute nitric acid. (01 mark)
- .....  
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- (c) State the type of bond in the oxides of Carbon, Silicon and Lead in (a) (01 mark)
- .....  
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7. Nitrogen (IV) oxide dissociates according to the following equation.  
$$2NO_2(g) \rightleftharpoons 2NO(g) + O_2; \Delta H > 0$$
- (a) (i) Write the expression for equilibrium constant,  $K_p$  for the reaction. (01 mark)
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- (ii) State what would happen to the position of equilibrium if pressure was increased. (01 mark)
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- (b) When the mixture was allowed to attain equilibrium at 400°C and 20 atmosphere pressure, Nitrogen (IV) oxide was found to be 25% dissociated. Calculate the value of the equilibrium constant  $K_p$ . (03 marks)
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8. Complete the following equations and in each case, write a mechanism for the reaction.



9. The critical temperature of carbondioxide gas is 31°C.

(a) Define the term "critical temperature". (01 mark)

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(b) On the same axes, sketch graphs to show how the pressure of carbon dioxide varies with volume at;

(i) 20°C (01 mark)

(ii) 50°C (01 mark)

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- (c) (i) Explain the shape of the graph at 20°C. (02 marks)

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- (ii) Identify the temperature in (b) above at which carbon dioxide obeys all the gas laws. Give a reason for your answer. (01 mark)

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## SECTION B (54 MARKS)

Attempt any six questions from this section.

10. (a) Bromobenzene can be isolated from its impurities by steam distillation. State the;

- (i) principles of steam distillation. (03 marks)

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- (ii) conditions that enable the purification of bromobenzene by steam distillation. (1½ marks)

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**Turn Over**

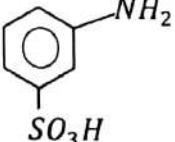
- (b) 20.0g of impure bromobenzene were steam distilled at 95°C and 760mmHg to form a distallate containing 15.345g of water. The saturated vapour pressure of water at 95°C is 680mmHg.  
Calculate the percentage purity of bromobenzene. (3½ marks)

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- (c) State the advantages of steam distillation. (01 mark)

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11. Write equations in each case to show how each of the following conversions can be effected.

- (a)  from benzene. (03 marks)

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- (b) CH<sub>3</sub>OH from ethanamide. (02 marks)

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- (c)  C = NNH<sub>2</sub> from phenylmethanal (2½ marks)

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- (d) (CH<sub>3</sub>)<sub>2</sub>CHBr from propan-1-ol. (1½ marks)

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12. Fluorine and chlorine belong to group VII of the Periodic Table and some of their physical properties are given below.

Element	Fluorine	Chlorine
Boiling point (°C)	-188	-34
Electrode potential (Volts)	+2.87	+1.34

(a) Explain the variation in the;

(i) boiling points (02 marks)

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(ii) electrode potentials (02 marks)

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(b) Write equation for the reactions of Fluorine and Chlorine with;

(i) hot concentrated sodium hydroxide solution. (02 marks)

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(ii) powdered charcoal (01 mark)

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(c) Silver nitrate solution was added to an aqueous solution of chloride ions followed by excess ammonia solution.

(i) State what was observed. (01 mark)

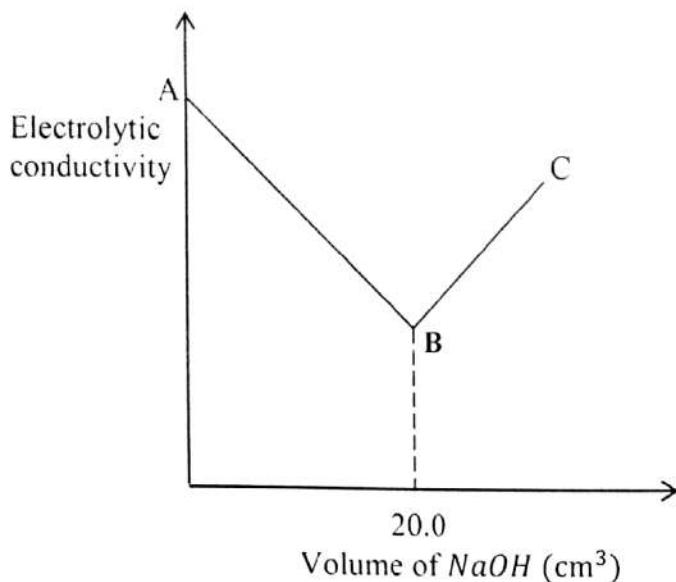
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(ii) Write equation(s) for the reaction(s) that take place. (01 mark)

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**Turn Over**

13. The electrolyte conductivity of  $25\text{cm}^3$  of Copper (II) sulphate varies with volume of  $0.1\text{M}$  sodium hydroxide added according the graph below.



- (a) Define the term electrolytic conductivity. (01 mark)

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- (b) Give a reason why;

- (i) conductivity is high at point A. (1½ marks)

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- (ii) conductivity increases along BC. (1½ marks)

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- (c) Calculate the initial concentration of Copper (II) sulphate solution. (2½ marks)

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- (d) (i) The electrolytic conductivity at A was  $1.536 \times 10^{-2} \Omega^{-1}\text{cm}^{-1}$  at  $25^\circ\text{C}$ . Determine the molar conductivity of the solution of Copper (II) sulphate. (01 marks)

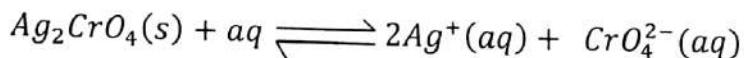
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(ii) State and explain the effect of dilution on your answer in d(i) above.

(1½ marks)

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14. (a) Silver (I) Chromate partially dissociates in water according to the following equation.



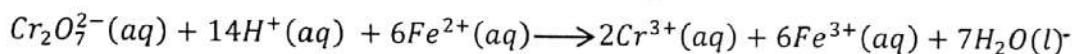
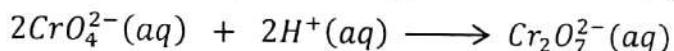
Write the expression for the solubility product, K<sub>sp</sub> of Silver (I) chromate.

(01 mark)

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- (b) 1.66g of solid Silver (I) chromate were shaken with water at 25°C and allowed to stand to attain equilibrium. The equilibrium mixture was filtered to form 250cm<sup>3</sup> of saturated solution. 20cm<sup>3</sup> of the saturated solution were pipetted into 1M Sulphuric acid and then titrated with 24cm<sup>3</sup> of 0.001M Iron (II) sulphate in the presence of a redox indicator.

Calculate the K<sub>sp</sub> of Silver (I) chromate at 25°C given; (04 marks)



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- (c) State the effect on the solubility of Silver (I) chromate when to the saturated solution;

(i) silver nitrate solution is added.

(½ mark)

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(ii) ammonia solution is added.

(½ mark)

.....

- (d) Explain your answer in (c) (ii) above.

(3 marks)

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**Turn Over**

15. Zinc and Copper are extracted from Zinc blende ( $ZnS$ ) and Copper pyrites ( $CuFeS_2$ ) respectively. (½ mark)

(a) (i) State the method by which the ores are concentrated.

.....

(ii) Give a reason for your answer in a(i) above. (01 mark)

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(b) The concentrated ores are then roasted in air and the product reduced by carbonmonoxide.

(i) Write equation for the reaction that takes place when each ore is roasted. (02 marks)

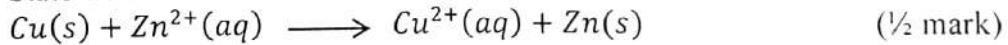
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(ii) State how each metal is purified after reduction. (1½ marks)

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(c) The electrode potentials of  $Zn^{2+}(aq)/Zn(s)$  and  $Cu^{2+}(aq)/Cu(s)$  are -0.76V and +0.34V respectively.

(i) State whether the reaction below is feasible or not.



.....

(ii) Give a reason for your answer in c(i) above. (1½ marks)

.....  
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.....

(d) State one use of each metal. (02 marks)

Zinc .....

Copper: .....

16. (a) An organic compound W contains carbon, hydrogen and nitrogen. On complete combustion, **one mole** of W yielded **one mole** of carbondioxide and **2.5 moles** of water.

The vapour density of W is 15.5.

Calculate the molecular formula of W. (02 marks)

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.....

- (b) Write the structural formula of W. (01 mark)
- (c) W is a liquid at room temperature and it dissolves in water to form a solution of pH 9.20. State the reason why;
- (i) W is a liquid. (02 marks)
- (ii) a solution of W in water has a pH of 9.20. (02 marks)
- (d) An aqueous solution of W was added to Nickel (II) sulphate solution dropwise until in excess.
- (i) State what was observed. (01 mark)
- (ii) Write equation(s) for the reaction(s) that take place. (01 marks)
17. The lowering in vapour pressure of a volatile solvent is a colligative property.

- (a) (i) Define the term colligative property. (01 mark)
- (ii) State one other example of colligative properties. ( $\frac{1}{2}$  marks)

**Turn Over**

- (b) The vapour pressures of different solutions of solute Y dissolved in solvent X at 40°C are given in the table below.

Concentration of Y ( $\text{mol dm}^{-3}$ )	0.00	0.10	0.20	0.30	0.40	0.50
Vapour pressure of solution ( $\text{KN m}^{-2}$ )	16.000	15.971	15.942	15.914	15.880	15.860

- (i) Plot a graph of lowering in vapour pressure ( $\Delta P$ ) against concentration ( $\text{mol dm}^{-3}$ ) (3½ marks)

**(USE GRAPH PAPER ON NEXT PAGE)**

- (ii) Use your graph to determine the relative formula mass of solvent X if it's density is 1.0g/cm<sup>3</sup>. (03 marks)

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- (iii) State two assumptions made in b(ii) above. (01 mark)

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**Turn Over**

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15

# THE PERIODIC TABLE

1	2													3	4	5	6	7	8
1 H 1.0																		1 H 1.0	2 He 4.0
3 Li 6.9	4 Be 9.0													5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3													13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8		
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131		
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Ta 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	89 Ac (227)																	
			57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175		
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Es (254)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lw		

1.  Indicates atomic number.

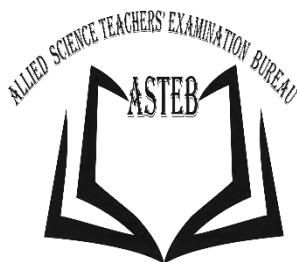
2.  Indicates relative atomic mass.

END

Name:..... Signature:.....

School:..... Centre/Index No. ....

P525/1  
CHEMISTRY  
PAPER 1  
JULY, 2019  
2  $\frac{3}{4}$  HOURS



**ALLIED SCIENCE TEACHERS' EXAMINATION BUREAU**

*Uganda Advanced Certificate of Education*

**MOCK EXAMINATIONS JULY, 2019**

**CHEMISTRY**

**PAPER 1**

**TIME: 2 HOURS 45MINUTES**

**Instructions to Candidates**

Attempt **all** questions in **Section A** and any **six** from **Section B**

All questions are to be answered in the spaces provided only

A periodic table with relevant atomic masses is supplied at the end of the paper.

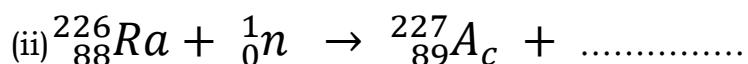
FOREXAMINER'S USE ONLY																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	<b>TOTAL</b>

**SECTION A**  
**Attempt all questions in this section (46 marks)**

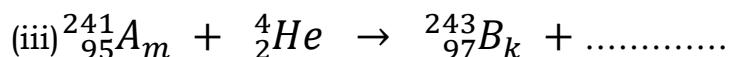
1. a) Complete the following nuclear reactions and name the particles emitted in each case. (1 mark each)



Name of particle .....



Name of particle .....

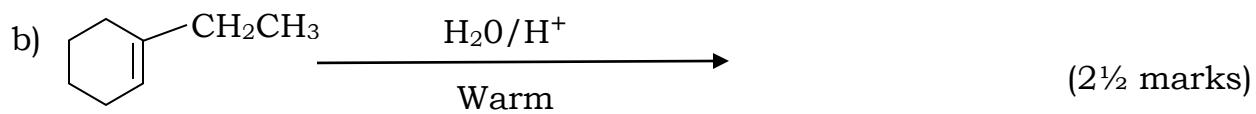
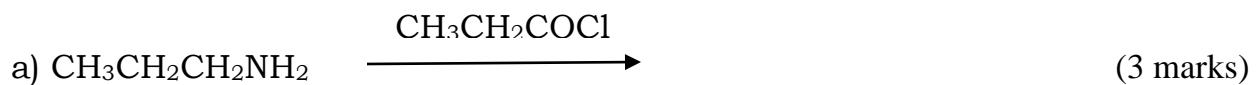


Name of particle .....

- b) The half-life of a radium is 20 minutes. Determine the time taken for radium to decay by 75%. (3 marks)

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2. Complete the following equations and in each case outline the accepted mechanism for the reactions.



3. Beryllium is in group (II) of the periodic table, however it resembles Aluminium which is in group (III) in some of its properties.  
a) State three properties in which Beryllium resembles Aluminium. (3marks)

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- b) Give two reasons for the anomalous behavior of boron. (2marks)

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4. The molecular formula of a compound **M** is C<sub>3</sub>H<sub>6</sub>O. Compound **M** forms a yellow precipitate with iodoform test.

a) Write the structural formulae and names of all the possible isomers of **M**. (2 marks)

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(½mark)

b) (i) Identify M

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(ii) Write equation(s) to show how you would prepare **M** from an alkene.

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(2½marks)

5. a) Write;

(i) an equation for the hydrolysis of ethyl phenyl ammonium chloride. (1½marks)

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(ii) the expression for the hydrolysis constant; K<sub>n</sub> for ethyl phenyl ammonium chloride. (1mark)

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b) A solution containing 0.2 moles of ethyl phenyl ammonium chloride per 500cm<sup>3</sup> has a pH of 3.8. Calculate the;

(i) molar concentration of hydrogen ions in solution. (1½marks)

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(ii) hydrolysis constant, $K_n$  of ethyl phenyl ammonium chloride. (2marks)

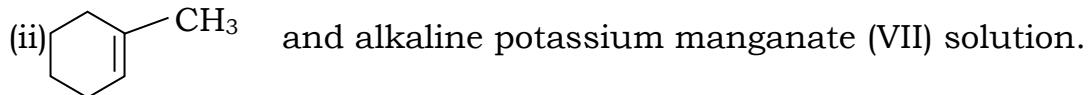
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6. State giving equations what would be observed when the following pairs of substances are mixed.

(i)  $\text{CH}_3\text{CHO}$  and iodine solution in aqueous sodium hydroxide

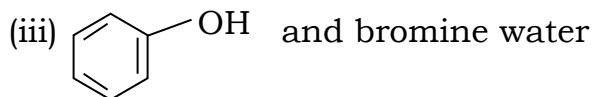
Observation (½mark)

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Observation (½mark)

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Observation (½mark)

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Equation (1 ½marks)

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7. A component in a liquid mixture can be separated using steam distillation.

a) State any two requirements for the component to be separated by steam distiller. (2marks)

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b) A mixture containing a substance **Q** ( $M_r = 90$ ) was steam distilled at 760 mmHg and 98°C. The distillate contained 15% by mass of **Q**. Calculate the saturated vapour pressure of water at 98°C. (2marks)

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8. a) Write the equation of the reaction between water and sodium ethanoate. (1½marks)

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b) To the resultant solution above was added litmus solution, explain the observation made. (2marks)

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9. a) Define transition elements. (2marks)

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b) State the co-ordination number and oxidation states of the central atoms/ions in the following complexes. (3marks)

Complex	Co-ordination number	Oxidation state
$Cr(H_2O)_6Br_3$		

$C_o(CN)_4^{2-}$		
$N_i(NH_3)_6^{2+}$		

**SECTION B (54 MARKS)**  
***Attempt only six questions in this section***

10. A compound Q has a molecular formula  $C_4H_{10}O$  when Q is heated with acidified chromium (VI) oxide, it gave another compound which formed silver mirror with a solution of silver nitrate in excess ammonia.

a) Write the structures and names of possible isomers of Q. [3marks]

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b) When Q was heated with concentrated phosphoric acid, compound R was formed. When ozonolysed and hydrolyzed, R formed two products one which gave a yellow precipitate when reacted with a solution of iodine and sodium hydroxide.

(i) Identify Q [1mark]

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(ii) Write mechanism for the reaction leading to formation of compound R. [3marks]

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(iii) Using equations show how R can be converted to an alcohol. [2marks]

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11. State what was observed and write equation for the reaction that would take place when;

- a) Carbon dioxide gas is bubbled through a solution of potassium manganate (VII)

Observation

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Equation

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- b) Concentrated hydrochloride acid is added drop wise until in excess to aqueous copper (II) sulphate solution.

Observation

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Equation

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- c) Ethyne is bubbled through ammoniacal copper (I) chloride solution.

Observation

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d) Hydrogen peroxide is added to acidified potassium manganate (VII) solution.

Observation

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Equation

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12. An organic compound W contains carbon 79.2% oxygen 15.1% and the rest being hydrogen.

a) Calculate the empirical formula of W.

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b) W was steam distilled at 99°C and  $1.01 \times 10^5 \text{ Pa}$ . The percentage by mass of W in the distillate was 30.5%. If the saturated vapour pressure of water at 99°C was  $9.40 \times 10^4 \text{ Pa}$ , determine;

(i) the relative molecular mass of W [2marks]

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(ii) molecular formula of W [1mark]

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c) W burns in oxygen with a sooty flame.

(i) Identify W.

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(ii) Write a mechanism for the reaction between W and acidified hydroxylamine. [3½marks]

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13. Sodium benzoate undergoes hydrolysis when dissolved in water,

a) Write;

(i) equation for the hydrolysis of sodium benzoate. [1½marks]

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(ii) an expression for the hydrolysis constant of sodium benzoate.

[1mark]

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b)(i) Calculate the molar concentration of the hydroxide ions in a 0.1M sodium benzoate at 25°C.

$$(K_a \text{ for benzoic acid} = 6.30 \times 10^{-5} \text{ mol dm}^{-3}, K_w = 1.0 \times 10^{-14} \text{ Mol}^2 \text{dm}^{-6})$$

(ii) From the results obtained in (b)(i), calculate the hydrogen ion concentration and hence pH of the solution. [2½ marks]

14. The standard electrode potentials for some half-cell reactions are given below;

Half-cell reaction		$E^\circ$ (v)
$PbO(s) + 4H^+(aq) + 2e \longrightarrow Pb^{2+}(aq) + 2H_2O(l)$		+ 1.46
$Sn^{2+}(aq) + 2e \longrightarrow Sn(s)$		- 0.14
$Cr^{3+}(aq) + e \longrightarrow Cr^{2+}(aq)$		- 0.141

a) Write

(i) the cell convention for the cell formed by combining two half cells, one containing acidified lead (II) Oxide and another one containing chromium (II) ions. [1½ marks]

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(ii) equation for the reaction that takes place at the anode. [1mark]

b) State which will be observed at the cathode.

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c)(i) Calculate the e.m.f of the cell formed in (a)(i)  
above.....  
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(ii) State whether the reaction is feasible or not. Give a reason for your  
answer. [1½marks]

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(iii) State what would happen when tin powder was added to an aqueous  
solution of chromium (III) salt. Give a reason for your answer.

[2½marks]

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15. a) A compound R contains by mass carbon = 26.45%, hydrogen =  
3.30%, Copper = 34.99% and the rest being oxygen. Determine the;  
(i) empirical formula of R. [2marks]

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(ii) molecular formula of

R.....

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b) An aqueous solution of R forms a brown precipitate when warmed with iron (iii) chloride solution.

(i) Write the structural formula of R

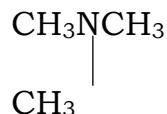
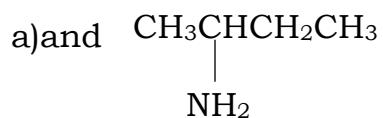
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(ii) State what would be observed and write equation for the reaction that would take place when drops of potassium iodide were added to an aqueous solution of R. [2½marks]

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16. Name the reagent(s) that can be used to distinguish the following pairs

of compounds. In each case state what would be observed if the reagent you stated is reacted with each member of the pair.

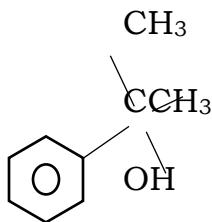
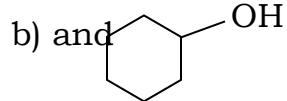


Reagent

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Observation

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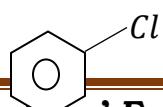
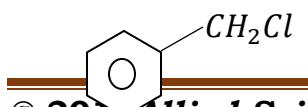


Reagent

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Observation

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c) and

Reagent

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Observation

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17.a) Explain the variation of electro positivity;

(i) across the elements of a period in the periodic table. [2marks]

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(ii) down the members of a group in the periodic table. [3marks]

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b) The table below shows decomposition temperature of the carbonates of group (II) elements.

Metal carbonate	$MgCO_3$	$CaCO_3$	$SrCO_3$	$BaCO_3$
Decomposition temperature ( $^{\circ}C$ )	404	826	1098	1370

(i) State how the decomposition temperature vary for the metal carbonates shown in the table. [1mark]

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**(ii) Explain your answer in (b)(i). [5marks]**  
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**THE PERIODIC TABLE**

1	2													3	4	5	6	7	8
1.0 H 1														1.0 H 1	4.0 He 2				
6.9 Li 3	9.0 Be 4													10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12													27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36		
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54		
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86		
223 Fr 87	226 Ra 88	227 Ac 89																	
			139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71		
			227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103		

**THE END**

NAME:		INDEX NO:	
SCHOOL:		SIGNATURE:	

P525/1  
CHEMISTRY  
Paper 1  
August, 2019  
2½Hrs



## UNNASE MOCK EXAMINATIONS

*Uganda Advanced Certificate of Education*

**CHEMISTRY**

**PAPER 1**

**Time: 2hours 45minutes**

**Instructions**

- ❖ Attempt **all questions in section A** and **only six questions** from section **B**.
- ❖ **All questions are to be answered in the spaces provided.**
- ❖ **A periodic table with relevant atomic masses is supplied at the back of the paper.**
- ❖ **Mathematical tables (3figures) and non-programmable silent scientific calculators may be used.**
- ❖ **A piece of graph should be provided.**

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

**SECTION A [46 MARKS]**  
*Answer all questions in this Section.*

1. Standard electrode potentials for some half-cell reactions are given below.



(a) Write the cell notation of the cell formed when the half cell (i) and (ii) are combined  
.....  
.....  
.....

(1 mark)

(b) Write the overall cell reaction.

(1½ marks)

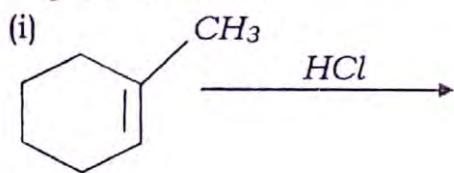
(c) Calculate the E.M.F of the cell.

(1½ marks)

(d) State whether the reaction is feasible or not. Give a reason for your answer.

(1 mark)

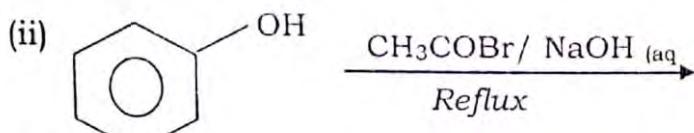
2. (a) Complete the following equations and name the organic product that is predominant.



(1½marks)

Name the product

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(1½ marks)

Name the product

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(b) Write the mechanism for the reaction in (ii).

(1½ marks)

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3. State what would be observed and in each case write the equation(s) for the reaction that takes place when acidified Potassium Manganate (VII) solution is reacted with;

(i) Sulphur dioxide gas.

(2½ marks)

Observation

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Equation

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(ii) Aqueous Potassium iodide.  
Observation

(2½ marks)

### Equation

4. (a) Write;

(i) Equation for ionisation of bromoethanoic acid in water.

(1½ marks)

(ii) The expression for the acid dissociation constant.

(½ marks)

(b) The molar conductivity of nitric acid, sodium bromoethanoate and sodium nitrate are  $421$ ,  $61.2$  and  $89.3\Omega^{-2}\text{cm}^2\text{mol}^{-1}$  respectively at infinite dilution. Calculate the:

(i) Molar conductivity at infinite dilution of bromoethanoic acid. ( $1\frac{1}{2}$  marks)

(ii) Acid dissociation constant  $K_a$ , of a 0.1 M bromoethanoic acid solution.

(The electrolytic conductivity of bromoethamic acid is  $4.38 \times 10^{-3} \Omega^{-1}\text{cm}^{-1}$ ). (3marks)

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5. (a) State the oxidation state of the central atom in each of the following complex ions and in each case give the name of the complex ion.

(4½ marks)

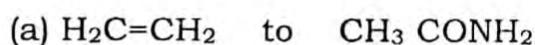
Complex ion	Oxidation state of central atom	Name of complex ion
[Co (NH <sub>3</sub> ) <sub>4</sub> Cl] <sup>+</sup>		
[Cu Br <sub>4</sub> (H <sub>2</sub> O) <sub>2</sub> ] <sup>2-</sup>		
Zn(OH) <sub>4</sub> <sup>2-</sup>		

(b) Explain why transition metals form complex ions.

(02 marks)

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6. Write equations to show how the following conversions can be effected.



(3 marks)

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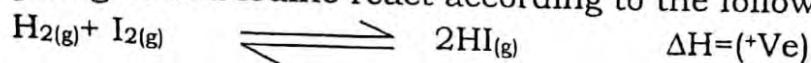
(b)  $\text{CH}_3\text{CHO}$  to  $\text{CH}_3\text{COOCH}_2\text{CH}_3$ .

(2½ marks)

7. (a) State Le chatelier's principle.

(1 mark)

(b) Hydrogen and iodine react according to the following equation.



State what would happen to the position of equilibrium when;

(i) Temperature is lowered

(½ mark)

(ii) Pressure is increased

(½ mark)

(c) When Molar quantities of hydrogen and iodine are reacted in a sealed vessel at  $500^{\circ}\text{C}$  and 10 atmospheres. The equilibrium mixture was found to contain 1.6 moles of hydrogen iodide.

Calculate the equilibrium constant  $K_p$  for the reaction at  $500^{\circ}\text{C}$  (3½ marks)

8. Explain the following observations;

- (a) Silicon (VI) oxide is a solid at room temperature whereas carbon dioxide is a gas at room temperature. (3 marks)

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- (b) Ammonium nitrate is readily soluble in water even though the standard enthalpy of solution has a positive value. (3 marks)

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9. 30g of compound Y depressed the freezing point of 50g of water by  $6.2^{\circ}\text{C}$ .

- (a) Calculate the relative molecular mass of y;

( $K_f = 1.86^{\circ}\text{C}$  per 1000g of water)

(3 marks)

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(b) The empirical formula of Y is  $\text{CH}_2\text{O}$ . Determine its molecular formula.

(01 mark)

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(c) Write equations to show how Y can be converted to chloromethane.

(1½ marks)

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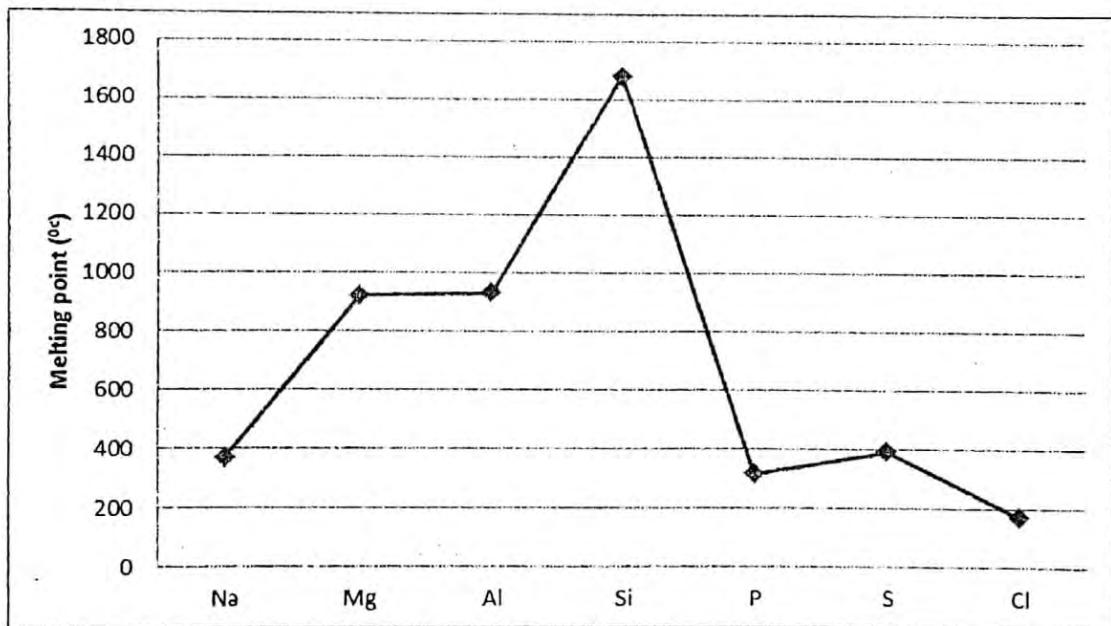
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### SECTION B: (54 MARKS)

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

10. The figure below shows the melting points of the elements in period 3 of the periodic table.



Explain each of the following observations

(i) Magnesium has higher melting point than Sodium.

(3 marks)

(ii) Phosphorous has a lower melting point than sulphur.

(3 marks)

(iii) Silicon has the highest melting point.

(3 marks)

11. A compound R contains 63.69% lead, 14.77% carbon, 1.85% hydrogen and the rest being oxygen.

(a) Calculate the empirical formula of R.

(2½ marks)

(b) A 2% aqueous solution of R freezes at  $-0.14^{\circ}\text{C}$ . Determine the molecular formula of R. (4½ marks)

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(c) R reacts with aqueous iron (III) chloride solution to give a brown solution and a white solid.

(i) Identify R. (½ mark)

(ii) Write equation for reaction that takes place. (1½ marks)

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12. (a) Write equations to show how each of the following chlorides of group (IV) elements of the periodic table can be prepared.

(i) Carbon tetrachloride. (1½ marks)

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(ii) Lead (II) Chloride. (1½ marks)

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(iii) Lead (IV) chloride. (1½ marks)

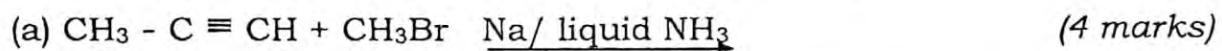
(b) Compare the thermal stability of carbon tetrachloride and lead (IV) chloride.  
(Include equation for the reactions if any). (2½ marks)

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(c) Lead (IV) chloride is covalent whereas lead (II) chloride is ionic. Explain this observation. (02 marks)

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13. Complete the following reactions and in each case write the accepted mechanism leading to the formation of the major product.



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14. Describe the reaction(s) between chlorine and;

(a) Benzene

(4½ marks)

(b) Sodium hydroxide

(4½ marks)

15. Silver carbonate is sparingly soluble in water.

Write;

(i) Equation for solubility of silver carbonate in water.

(1½ marks)

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(ii) The expression for the solubility product for silver carbonate. (1 mark)

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(b) The solubility product for silver carbonate at 20°C is  $8 \times 10^{-12} \text{ mol}^3\text{dm}^{-9}$ .

Calculate the;

(i) Solubility of silver carbonate in water in  $\text{mol dm}^{-3}$  at 20°C

(2 marks)

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(ii) Mass of silver carbonate precipitated in a 0.1M aqueous solution of potassium carbonate. (3 marks)

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(c) State what would happen to the solubility of silver carbonate when aqueous ammonia is added to the solution in b(i). Give a reason for your answer.

(1½ marks)

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16. Oxygen diffused through a porous plug in 1.3 times than an alkyne Y.

(a) (i) Calculate the formula mass of Y.

(2 marks)

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(ii) Determine the molecular formula of Y.

(1½ marks)

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- (c) Y forms a red precipitate with ammoniacal copper (i) chloride solution.  
(i) Identify Y. (1 mark)
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- (ii) Write equations to show how Y can be converted to butan-2-ol. (2½ marks)
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17. (a) (i) State the distribution law. (1 mark)
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- (ii) Under which conditions is the law you have stated in (i) valid. (1 mark)
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- (b) The table below shows the concentration of succinic acid in ether and water at equilibrium in  $\text{mol dm}^{-3}$ .

Experiment number	1	2	3	4	5	6
[succinic acid] water	0.023	0.028	0.036	0.044	0.052	0.055
[succinic acid] Ether	0.15	0.18	0.24	0.30	0.36	0.38

- (i) Plot a graph of [succinic acid] in ether against [succinic acid] in water. (3 marks)
- (ii) Use the graph to determine the distribution constant of succinic acid between Ether and water. (1 mark)

(c) 100cm<sup>3</sup> of ether was shaken with an aqueous solution containing 18g of succinic acid per dm<sup>3</sup> of solution.

Calculate the mass of succinic acid that remained in the aqueous layer.

(2½ marks)

- (d) State one application of the distribution constant. (½mark)

\*\*\*\* END \*\*\*\*

P525/1  
Chemistry  
Paper 1  
July - August 2019  
 $2\frac{3}{4}$  hours

6 copies



UGANDA MUSLIM TEACHERS 'ASSOCIATION

UMTA JOINT MOCK EXAMINATIONS - 2019

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UGANDA ADVANCED CERTIFICATE OF EDUCATION  
Chemistry

Paper 1

2 hour 45 minutes

### INSTRUCTIONS TO CANDIDATES

- Answer all questions in section A and six questions in section B.
- All questions must be answered in the spaces provided.
- The periodic table with relative atomic masses will be provided.
- Molar volume of a gas at s.t.p is 22.4 litres
- Standard temperature = 273K
- Illustrate your answers with equations where applicable
- Molar gas constant  $R=8.314 \text{ Jmol}^{-1}\text{K}^{-1}$ .
- 1 atmosphere =  $101325 \text{ Nm}^{-2}$ .

For Examiners Use Only

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	TOTAL

SECTION A: (46 MARKS)

Answer all questions in this section

1(a) State what happens to the nuclear particles of a radioactive atom on emission of the following

*✓* 1(i) Alpha particle ~~& Both protons and neutrons~~ *✓* (½ mark)

~~reduce by 2 units / Mass number reduces by 4 and atomic number reduces by 2~~ *✓*

ii) Beta particle: ~~protons increase by one unit, neutrons remain unchanged. / Mass no remains unchanged, atomic number increases by one unit.~~ *✓* (½ mark)

iii)  $\gamma$ -rays *✓* (½ mark)

No effect on nuclear particles *✓*

b) A compound P was found to contain an element Q which emits  $\alpha$ - particles and has a half life of 5720 years. Calculate the percentage of Q that will have decayed after 22880 years.

$$t_{\frac{1}{2}} = (0.693/\lambda) \Rightarrow \lambda = 0.693 \cancel{\text{yr}^{-1}}$$

$$= 0.000121 \text{ yr}^{-1}$$

$$2.303 \log\left(\frac{100}{100-x}\right) = 0.000121 \times 22880$$

$$\log\left(\frac{100}{100-x}\right) = 2.772$$

$$\frac{100}{100-x} = 10^{2.772} = \frac{100}{x}$$

$$x = 14.09813 / 15.98 = 0.9498$$

$$\therefore \text{Acc } 94\% \text{ but wrt } 94.0$$

*ACC: Correct alternative.*

5 2. Solid M dissolved in water to give a pale pink solution. Addition of excess sodium hydroxide produced a dirty white precipitate that rapidly turned brown on standing. When nitric acid was added to the solution of M followed by sodium bismuthate solution, the solution changed from pink to purple

a) Identify the cation in M. *X* (½ mark)

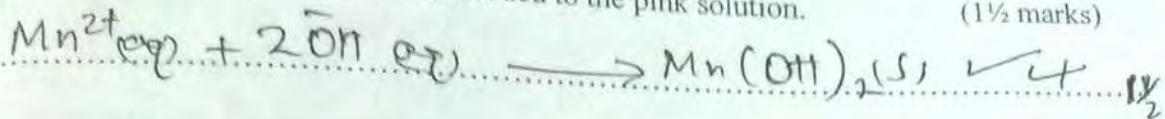
Manganese (II) *ions*  $\text{Mn}^{2+}$

*Acc: Manganese (II)*

Write equation for the reaction.

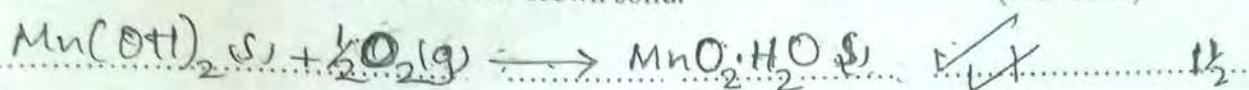
i) When ammonia solution was added to the pink solution.

(1½ marks)



ii) Leading to the formation of the brown solid.

(1½ marks)



iii) Leading to the formation of the purple solution.

(1 ½ marks)



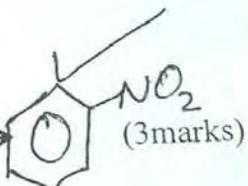
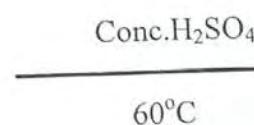
Ans:

5. Complete the following reactions and in each case write a mechanism.

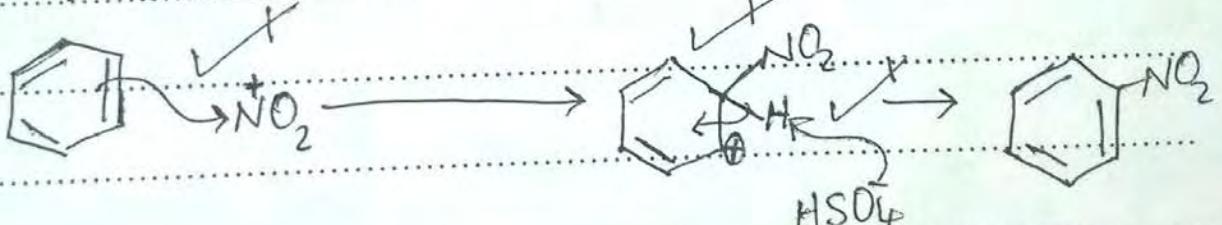
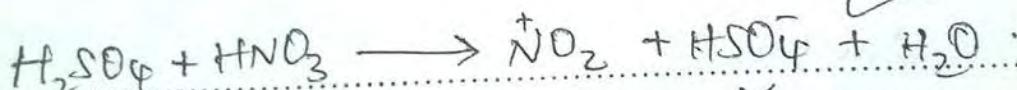
a)



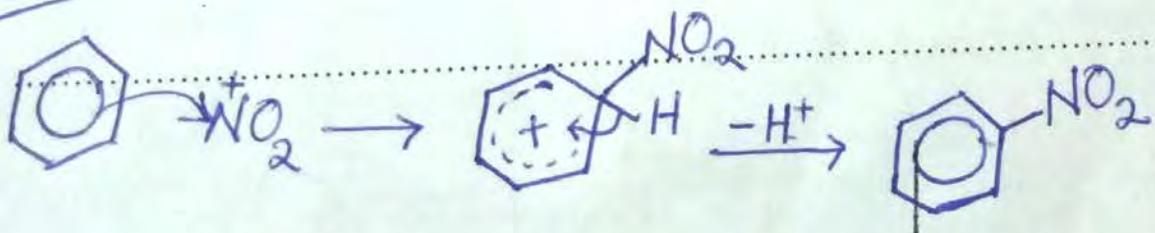
+ Conc. HNO<sub>3</sub>

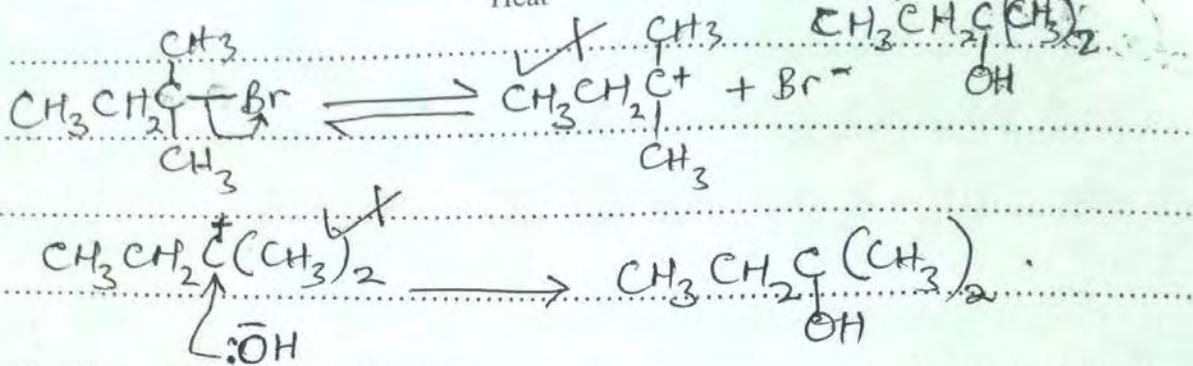
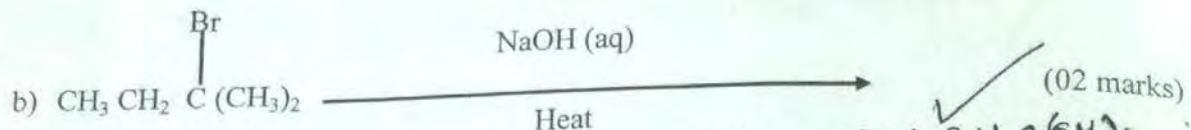


(3 marks)



Ans:





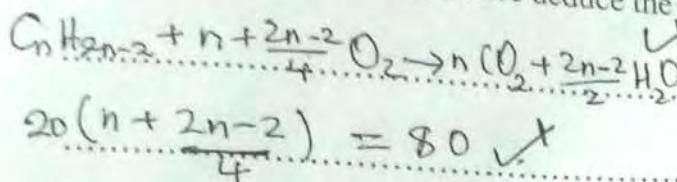
4. Draw the structures and name the shapes adopted by the following species:

(4marks)

Species	Shape	Structure
$\text{SF}_4$	Distorted tetrahedral / Irregular tetrahedral Seesaw	
$\text{NO}_3^-$	Trigonal planar	
$\text{ClO}_4^-$	Tetrahedral	
$\text{SCl}_2$	V-shaped / bent shape	

\* 20 cm<sup>3</sup> of a gaseous hydrocarbon Z with general formula C<sub>n</sub>H<sub>2n-2</sub> were exploded with 100 cm<sup>3</sup> of oxygen and cooled to room temperature. When the residual gas mixture was bubbled through concentrated potassium hydroxide solution, the final volume was found to be 20 cm<sup>3</sup>

a) Calculate the value of n and hence deduce the molecular formula of Z. (2 1/2 marks)



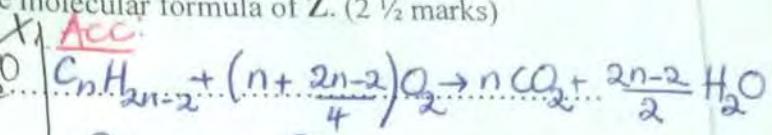
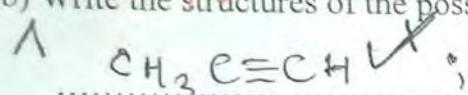
$$\frac{4n + 2n - 2}{4} = 4$$

$$4n + 2n - 2 = 16$$

$$6n = 18$$

(i)  $C_3H_4$  ✓

b) Write the structures of the possible Isomers of Z.

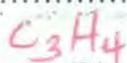


$$\frac{20}{20} : \frac{80}{80} O_2$$

$$n + \frac{2n-2}{4} = 4$$

$$4n + 2n - 2 = 16$$

$$n = 3$$

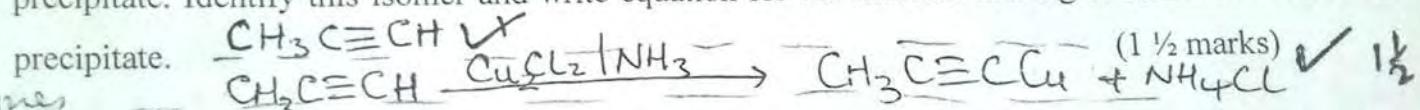


(01 marks)

any 2 01



ii) One of the Isomers react with a solution of copper (i) chloride in aqueous ammonia to give a red precipitate. Identify this isomer and write equation for the reaction leading to formation of the red precipitate.



6. Name a reagent, which when separately reacted with each member of the following pairs gives similar observation. In each case state what would be observed if the reagents you have named reacted with the compounds.

a) CH<sub>3</sub>CH<sub>2</sub>NHCH<sub>3</sub> and CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>NH<sub>2</sub> (02marks)

Reagent Concentrated hydrochloric acid ✓ 01

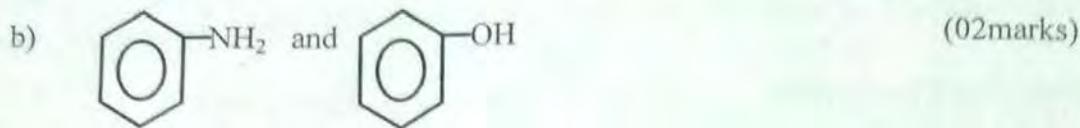
Cold sodium nitrate and (concentrated) hydrochloric acid.

Observation

$CH_3CH_2NHCH_3$  forms a yellow oil. ✓ 01

both form white fumes / solid. ✓

$\text{CH}_3\text{CH}_2\text{CH}_2\text{NH}_2$  - bubbles of a colourless gas.



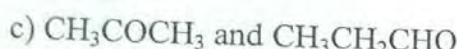
Reagent

bromine water ✓

Observation

both give a white precipitate ✓

02



(02marks)

Reagent

2, 4-dinitrophenyl hydrazine (solvent)  
Trivial name - deny ↗

02

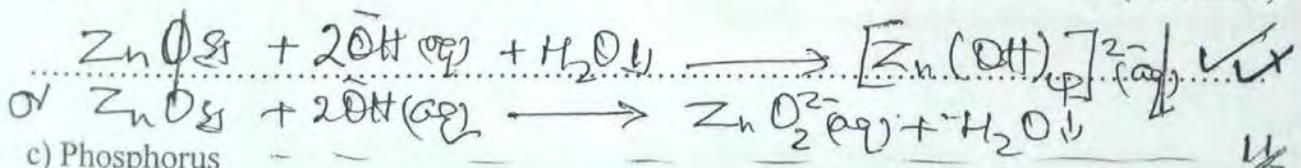
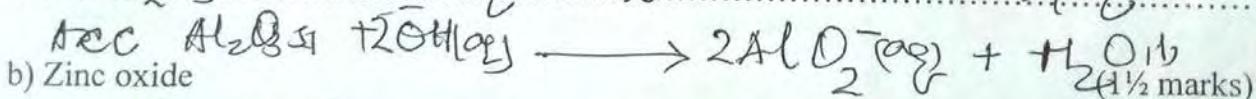
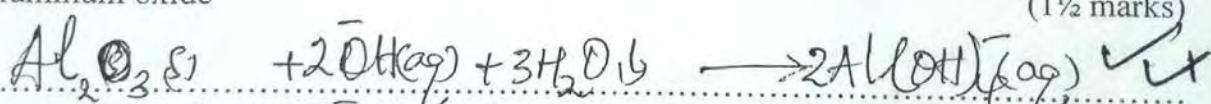
Observation

both give a yellow precipitate / solid. acc orange ppt ✓

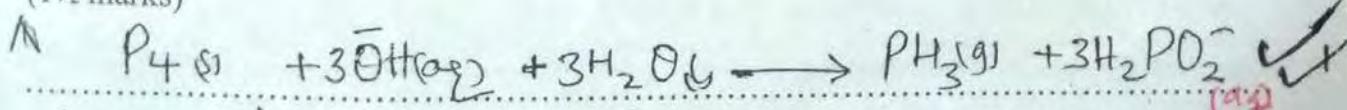
7. Write equation for the reaction of aqueous sodium hydroxide with.

a) aluminum oxide

(1½ marks)



(1½ marks)

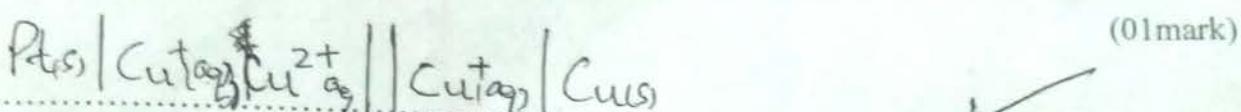


acc: molecular equation

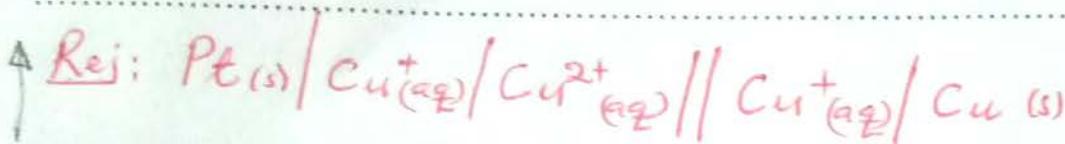
The standard electrode potentials of two half cells are shown below:

$\text{Cu}^{2+}_{(\text{aq})} + \text{e}^- \rightarrow \text{Cu}^+$	$+0.15 \text{ V LHS} \rightarrow \text{Anode}$
$\text{Cu}^+ + \text{e}^- \rightarrow \text{Cu} + 0.52 \text{ V RHS} \text{ Cathode} +$	$E^\circ/\text{V}$
$\text{Cu}^+_{(\text{aq})} \rightarrow \text{Cu}^{2+}_{(\text{aq})} + \text{e}^-$	-0.15 $R - e$
$\text{Cu}(\text{s}) \rightarrow \text{Cu}^+_{(\text{aq})} + \text{e}^-$	-0.52 $L - O$

a) Write the cell notation for the cell for the cell formed by combining the two half cells.



Acc: !!

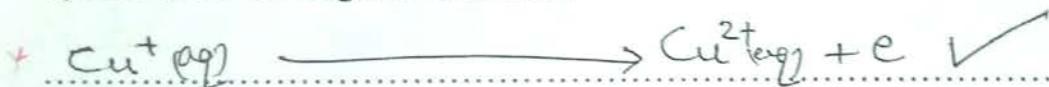


b) Write equation for the:

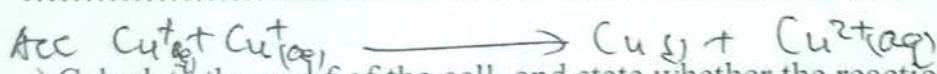
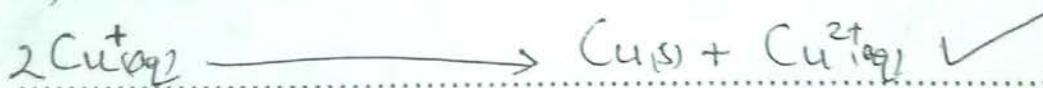
i) reaction at the positive electrode (01mark)



ii) reaction at the negative electrode. (01mark)



iii) overall cell reaction (01mark)



c) Calculate the e.m.f of the cell, and state whether the reaction is feasible or not. (1½ marks)

$$\begin{aligned} E_{\text{cell}} &= E_R - E_L \\ &= +0.52 - +0.15 \end{aligned}$$

$$= +0.37 \text{ V}$$

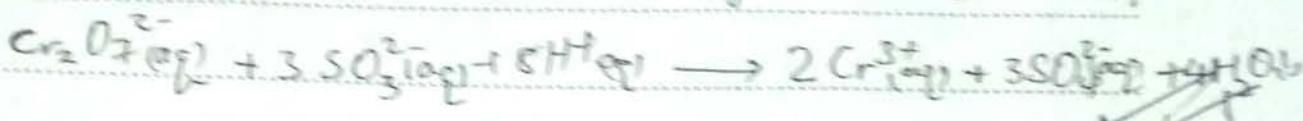
The reaction is feasible ✓

Rej: 0.37 V (ie without +)

9. State what would be observed and write equation for the reaction that would take place when;

- a) drops of sodium sulphite solution are added to acidified potassium dichromate solution.

The orange ~~solution~~ turns to green solution. (02 marks)

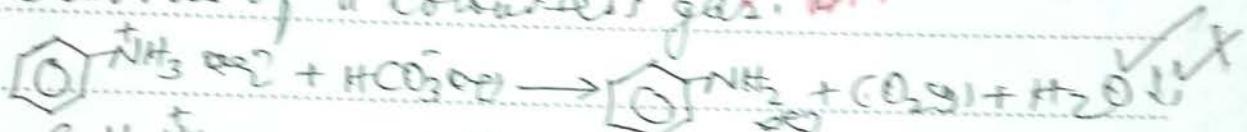


Acc: Molecular equation

mark allocation

- b) A Solution of phenylamine hydrochloride is mixed with a saturated solution of sodium hydrogen carbonate.

bubbles of a colourless gas. (02 marks)



Acc: Molecular Equation

- c) Phenylethyne is reacted with ammoniacal silver nitrate solution.

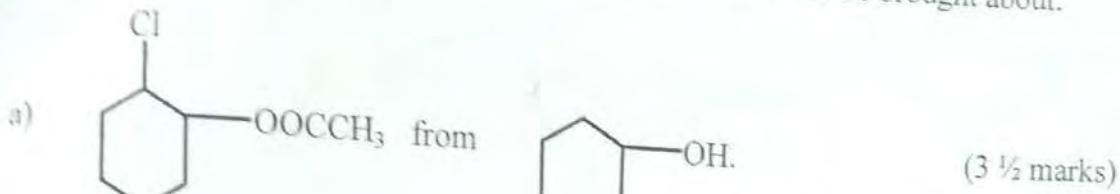
(01% marks)

A ~~white~~ ~~red~~ precipitate. (01% marks)

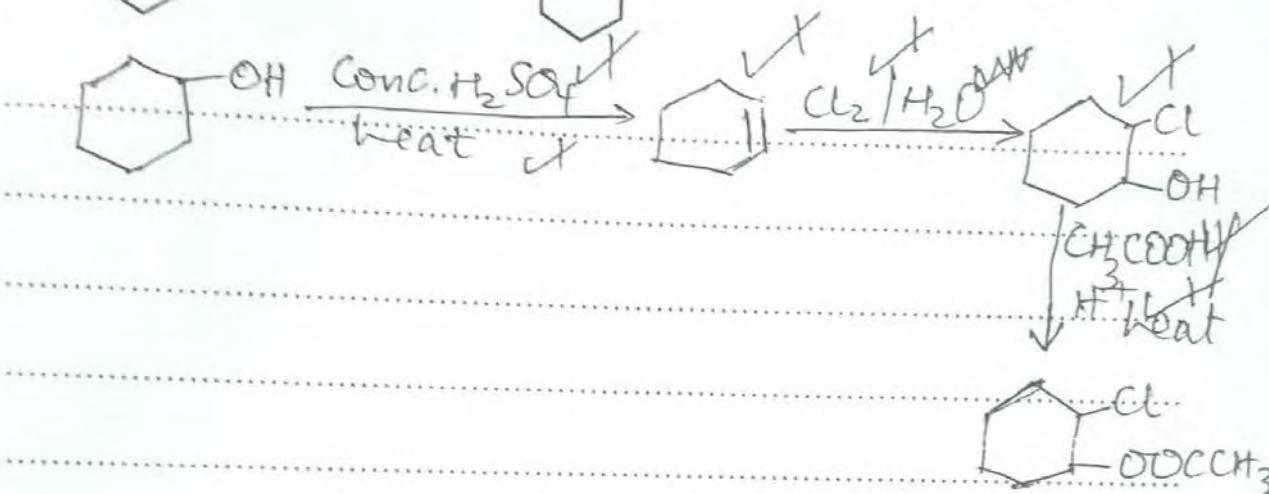


## SECTION B (54 MARKS)

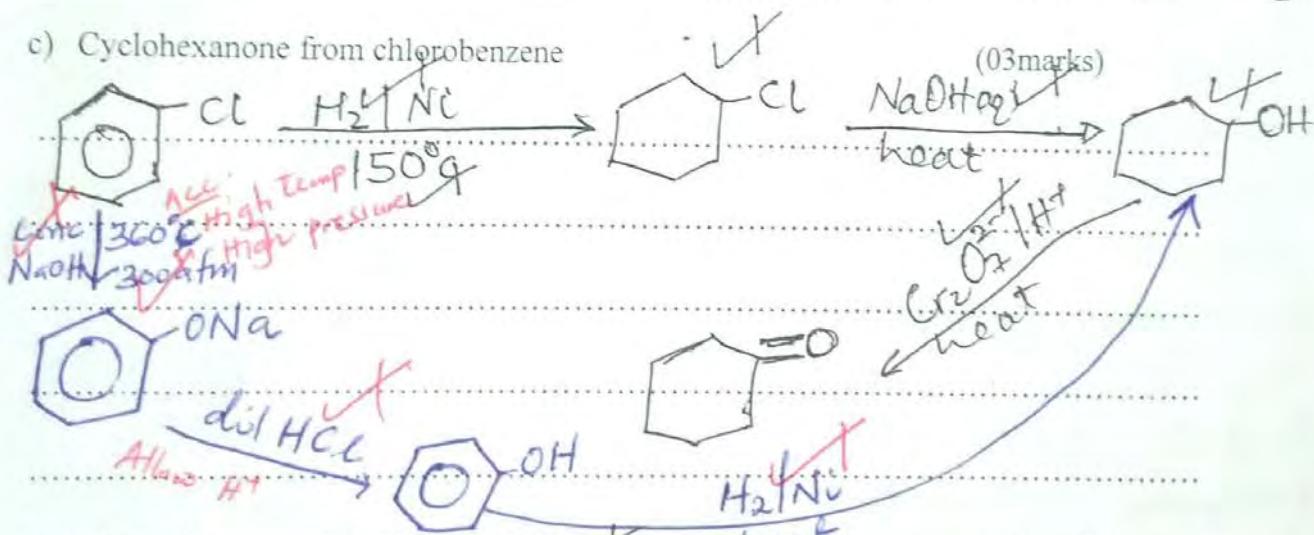
10. Using equations show how the following conversions can be brought about.



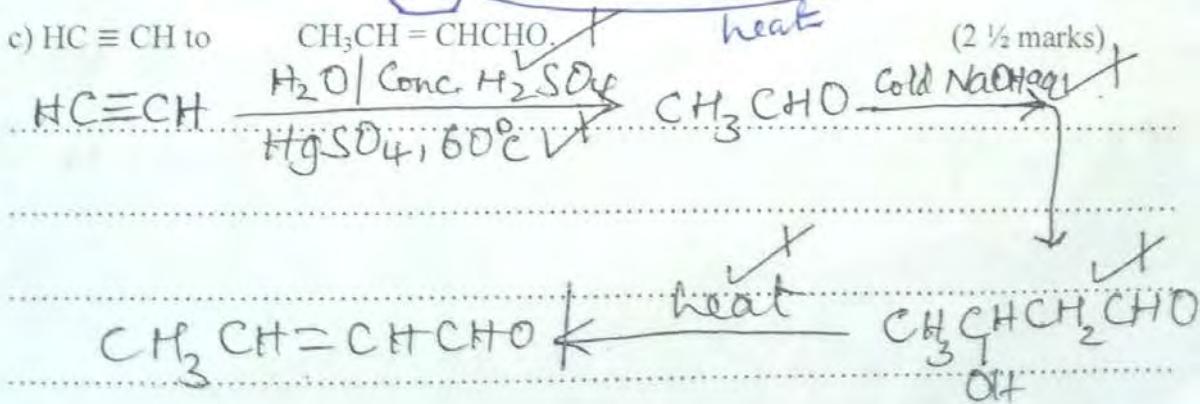
(3 1/2 marks)



c) Cyclohexanone from chlorobenzene



c) HC ≡ CH to



11. (a) State Raoult's law.

(01 mark)

The partial vapour pressure of a given component in an ideal solution is equal to the vapour pressure of the pure component multiplied by its mole fraction at a given temperature.  
*Acc. Relative lowering of vapour pressure is equal to the mole fraction of the non-volatile solute.*

b) The Vapour pressures of propan -1- ol and butan-1- ol are 1460mmHg and 570 mmHg respectively at 24°C.

Calculate:

i) the vapour pressure of a mixture of 50g of propan -1- ol and 36g of butan -1- ol. (3 1/2 marks)

$$M_r \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} = 60 \text{ g} \quad X$$

$$\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} = 74 \text{ g}$$

$$\text{Moles: } \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} = 50/60 = 0.833 \quad X$$

$$\text{moles: } \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH} = 36/74 = 0.486 \quad X$$

$$\text{Total moles} = 0.833 + 0.486 = 1.319 \quad X$$

$$\text{Partial pressures: } \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} = 0.833 \times \frac{1460}{1.319} \quad X$$

$$= 922.05 \text{ mmHg} \quad X$$

$$\text{P.P. } \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} = \frac{0.486}{1.319} \times 570 \quad X$$

$$= 210.02 \text{ mmHg} \quad X$$

Total v.p of mixture:

Partial pressures (Propan-1-ol + Butan-1-ol)  $\quad X$

$$= 922.05 + 210.02 \quad X$$

$$= 1132.07 \text{ mmHg} \quad X$$

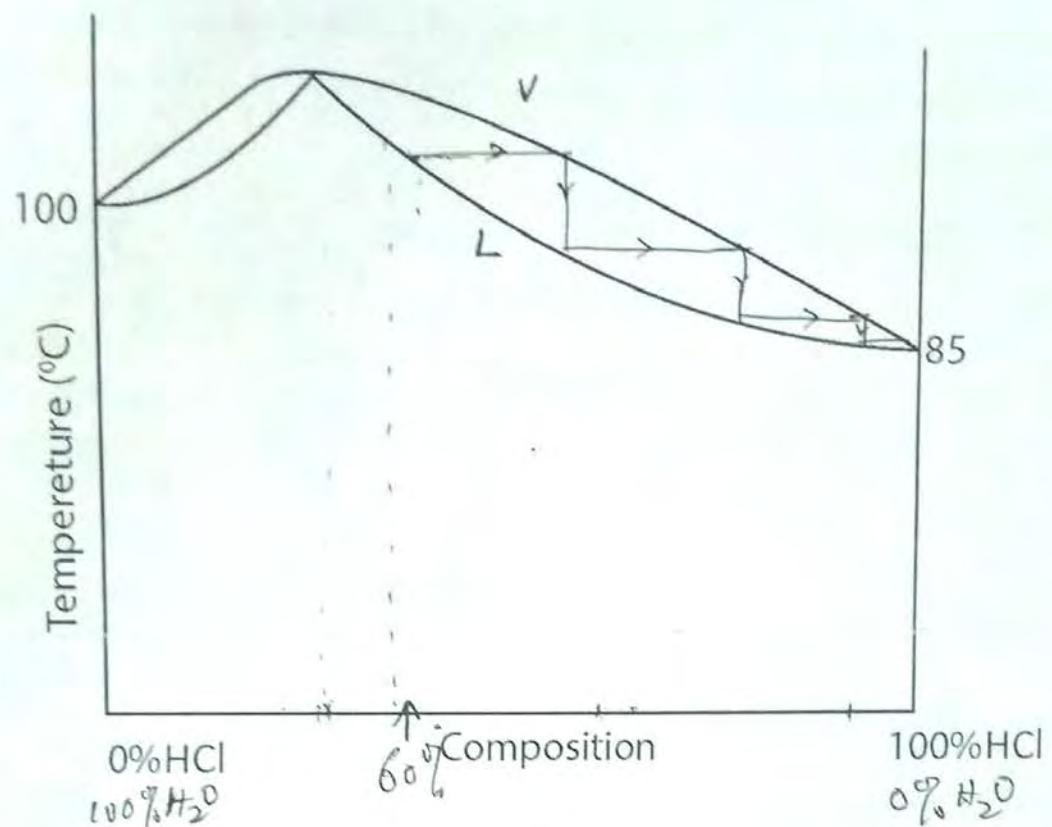
ii) the composition of the vapour above the mixture.

(01 mark)

$$\text{Propan-1-ol} = \left( \frac{922.05}{1132.07} \times 100 \right) = 81.4 \% \quad X \quad \text{Allow } 0.814$$

$$\text{Butan-2-ol} = \left( \frac{210.02}{1132.07} \times 100 \right) = 18.6 \% \quad X \quad \text{Acc. } 0.186$$

A mixture of hydrochloric acid and water deviation from Raoult's law. The temperature-composition diagram for this mixture is shown below.



i) Identify the type of deviation exhibited. (½ mark)

Negative deviation ✓

i) What would happen if a liquid mixture of composition 60% water is distilled? (3marks)

The liquid mixture boils at constant temperature to give a vapour, richer in hydrochloric acid, when cooled, the vapour gives a liquid of the same composition as the vapour. On repeated boiling and cooling, pure hydrochloric acid is obtained as the distillate and the azeotrope as the residue. |

12. When 0.0291g of an organic compound, J containing carbon, hydrogen and oxygen only was burnt in excess oxygen, 0.0581g of carbon dioxide and 0.0239g of water were formed. Calculate the empirical formula of J. (03marks)

$$\text{Carbon: } \frac{12}{44} \times 0.0581 = 0.01589 \text{ C}$$

$$\text{Hydrogen: } \frac{2}{18} \times 0.0239 = 0.00266 \text{ H}$$

$$\text{Oxygen: } 0.0291 - (0.0158 + 0.0026) \\ = 0.0106 \text{ g}$$

C	H	O
0.0158	0.0026	0.0106
12	1	16
0.00132	0.0026	0.000666
0.00132	0.0026	0.000666
0.000665	0.000665	0.000665
15.98	3.9	14.0
2	4	1

Empirical formula is  $\text{C}_2\text{H}_4\text{O}_1$

b) 0.14g of J when vaporized at 20°C and 740 mmHg occupied 39.5cm<sup>3</sup>. Determine:

i) the molecular mass of J from  $PV = nRT$ .

$$Mr = \frac{MRT}{PV}$$

$$= \frac{(0.14 \times 8.314 \times 293)}{(39.5 \times 10^{-6} \times 98658.6)} = 87.5$$

ii) the molecular formula of J.

$$(\text{C}_2\text{H}_4\text{O})_n = 88.$$

$$44n = 88 \quad ; \quad n = 2$$

Acc: 1<sup>st</sup> Principles of using

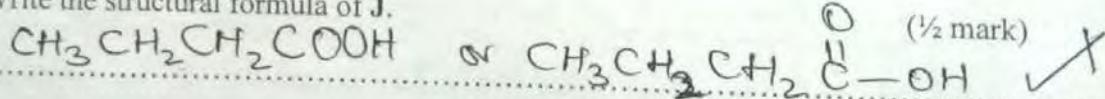
Volume obtained from  $P_1V_1 = P_2V_2$

(02marks)

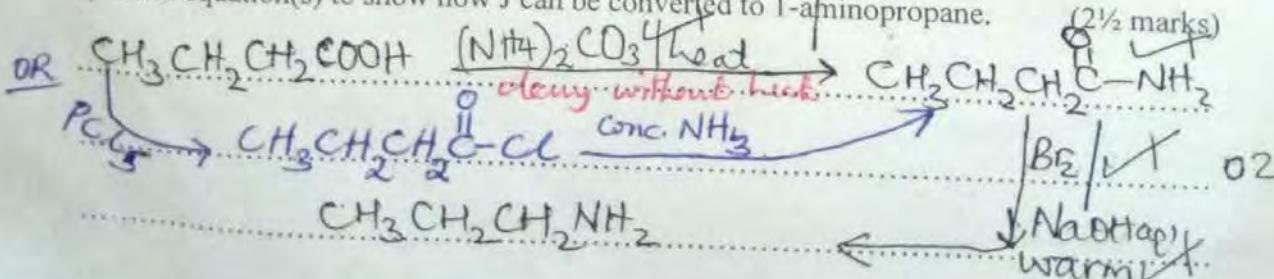
MF of J is  $\text{C}_4\text{H}_8\text{O}_2 + \frac{1}{2}$

c) When a saturated solution of sodium carbonate was added to J, effervescence of a colourless gas occurred.

i) Write the structural formula of J.



ii) Write equation(s) to show how J can be converted to 1-aminopropane.



Differentiate between order and molecularity of a reaction.

(02marks)

Order of reaction refers to the sum of the powers to which concentration terms are raised in an experimentally determined rate law, whereas molecularity refers to number of molecules or species involved at the rate determining step of a reaction.

• Order of reaction can be a whole number or fraction whereas Molecularity is always a whole number.

b) The data in the table below was obtained for the reactions.

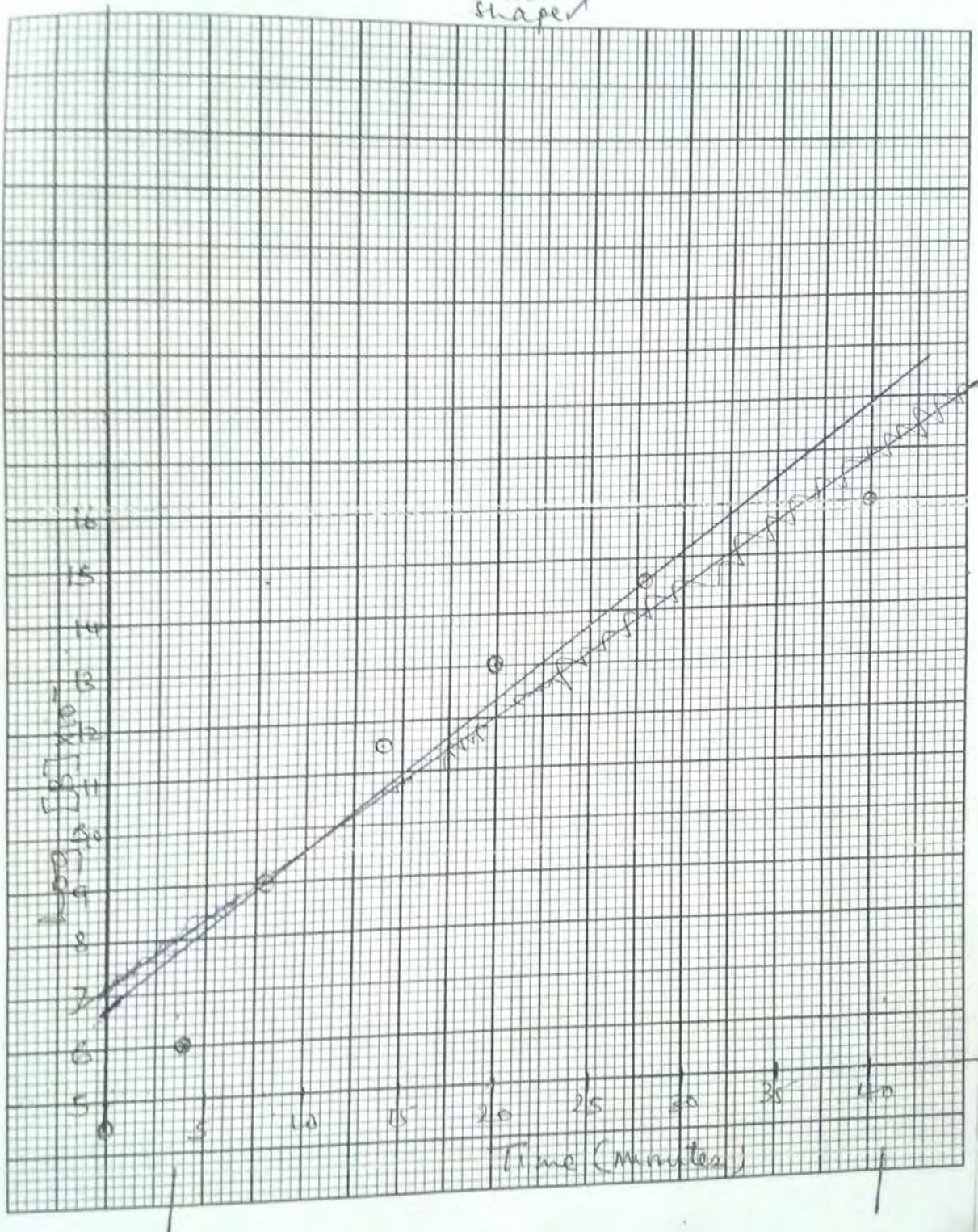


Time (minutes)	4.0	8.0	14.0	20.0	28.0	40.0
$\log_{10}[B]$	0.602	0.903	1.146	1.301	1.447	1.602

Plot a graph of  $\log_{10}[B]$  against time.

(3 marks)

Plotting  
Axes ✓  
Scale  
shape ✓



Determine the:

i) original concentration of B

$$\log_{10} [B] = 0.68 \quad (\frac{1}{2} \text{ mark})$$

$$[B]_0 = 10^{0.68} \quad [B]_0 = 4.7863 \text{ mol dm}^{-3} \quad \times$$

ii) order of reaction.

(01mark)

First order reaction, because plot of  $\log_{10} [B]$  against time is a straight line with a positive gradient which is a first order reaction.

iii) the rate constant.

(1½ mark)

$$\text{rate constant } (k) = \frac{\text{slope}}{2.303} = \frac{1.08}{39}$$

$$\text{slope} = \frac{\text{change in } \log_{10} [B]}{\text{change in time}} \quad k = 0.02769 \text{ min}^{-1} \quad \times$$

$$\text{slope} = \frac{1.78 - 0.7}{40 - 1} \quad \text{Ignore the unit} = 0.064 \text{ min}^{-1}$$

iv) the half life for the reaction.

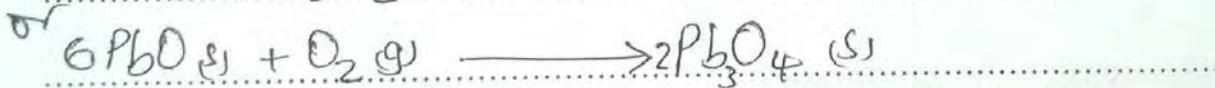
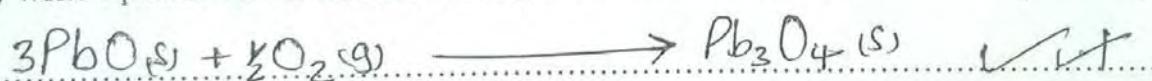
(01mark)

$$t_{\frac{1}{2}} = \frac{\ln 2}{k} \quad 10.83 \text{ minutes}$$

$$t_{\frac{1}{2}} = \frac{0.693}{0.064} = 10.83 \text{ minutes}$$

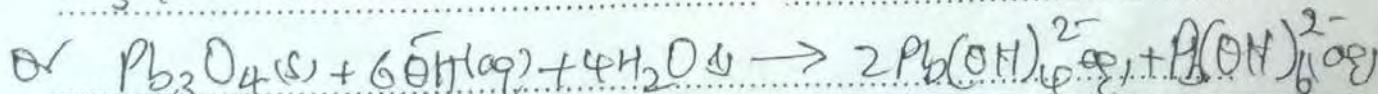
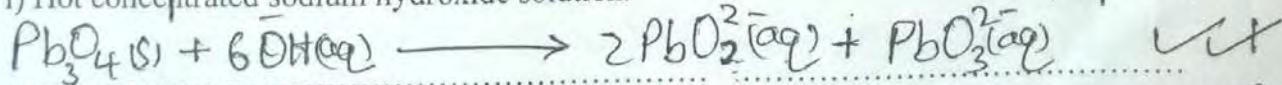
14. Trilead tetroxide (red lead oxide),  $Pb_3O_4$  can be prepared when lead (II) oxide is heated with excess oxygen.

a) Write equation for the reaction leading to the formation of  $Pb_3O_4$ . (1½mark)



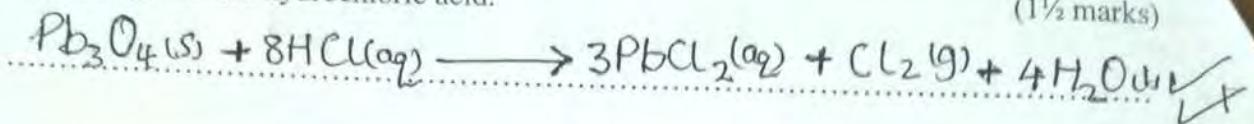
b) Write equation for the reaction of  $Pb_3O_4$  with;

i) Hot concentrated sodium hydroxide solution. (1 ½ marks)



ii) Hot concentrated hydrochloric acid.

(1½ marks)



c) Lead (II) oxide is almost insoluble in dilute hydrochloric acid, but readily dissolves in concentrated hydrochloric acid. Explain this observation.

(4 ½ marks)

In the cold lead(II) oxide reacts with dilute hydrochloric acid to form lead(II) chloride which is sparingly soluble.  $\text{Pb}^{2+}(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{PbCl}_2(\text{aq})$

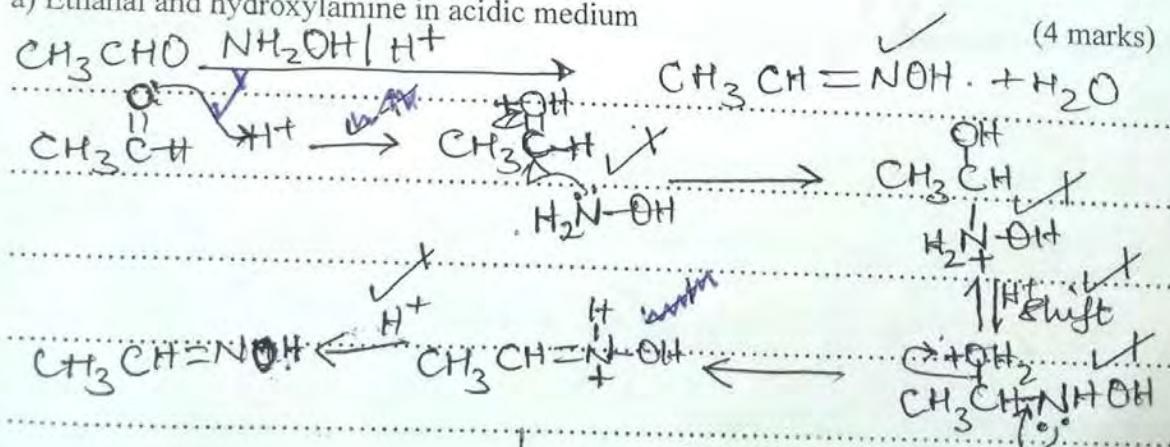
In concentrated hydrochloric acid, the excess chloride ions from the hydrochloric acid react with lead(II) chloride to form a soluble complex of tetrachloroaurate(III) ion.  $\text{PbCl}_2(\text{aq}) + 2\text{Cl}^-(\text{aq}) \rightarrow \text{PbCl}_4^{2-}(\text{aq})$

4k

15. Write equations for the reactions that take place when the following compounds react. In each case write a mechanism.

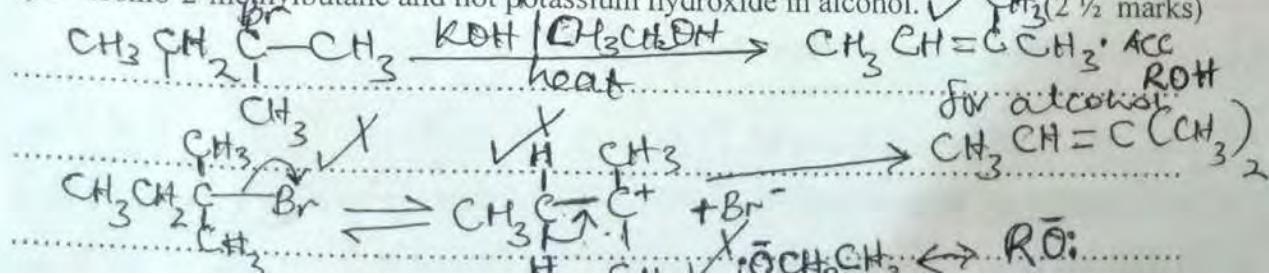
a) Ethanal and hydroxylamine in acidic medium

(4 marks)

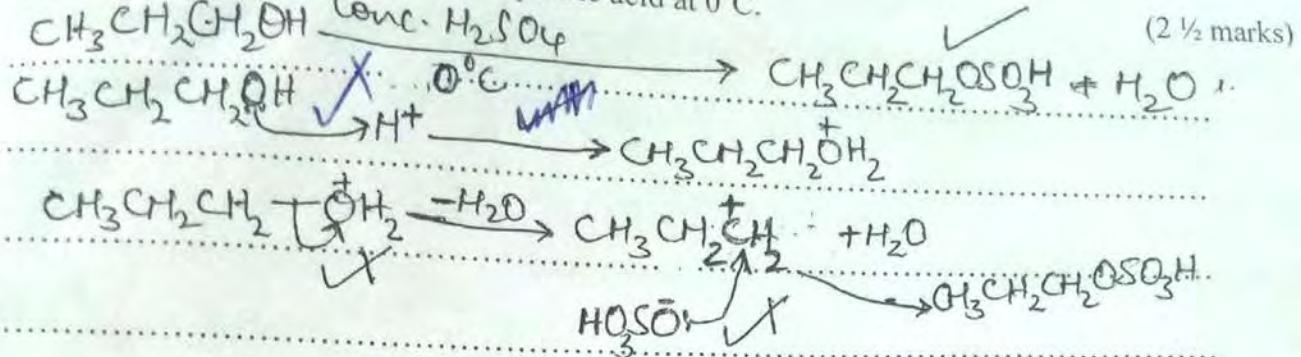


b) 2-bromo-2-methylbutane and hot potassium hydroxide in alcohol.

(2 ½ marks)



c) Propan - 1 - ol and concentrated sulphuric acid at 0°C.

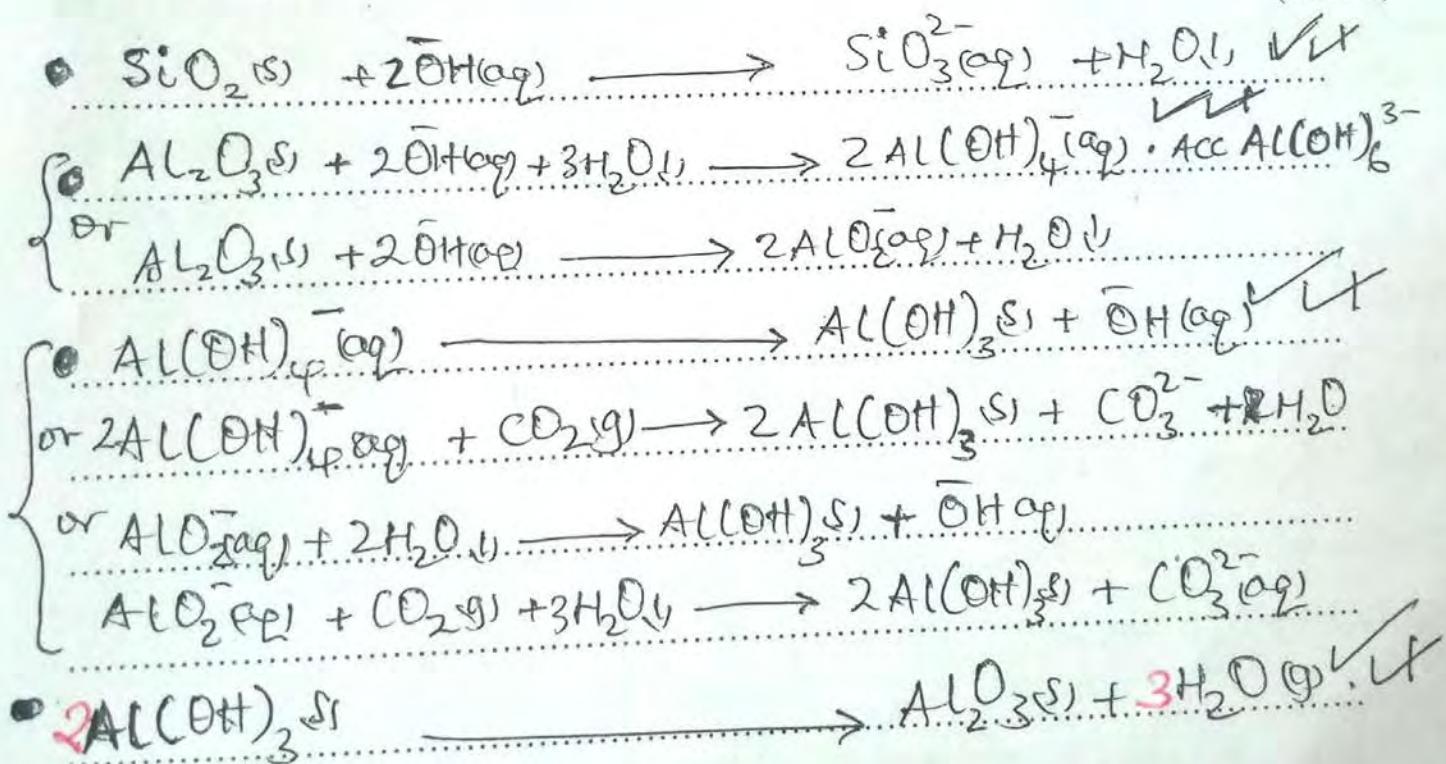


\* 16.a) Name and write the formula of the major ore used in extraction of aluminium. (01mark)

bauxite,  $\text{Al}_2\text{O}_3 \cdot 2\text{H}_2\text{O}$

b) using equations, state how the ore named in (a) is converted to pure aluminum oxide.

(6marks)



c) The aluminium oxide obtained in (b) is mixed with molten cryolite and electrolysed between carbon electrodes to obtain molten aluminium.

State:

i) why the carbon anodes have to be replaced from time to time. (½ mark)

Since they are being continuously burnt in hot oxygen to carbon dioxide. The oxygen produced at anode reacts with them.

ii) the role of cryolite (½ mark)

It lowers the melting point of the ore.

d.i) explain one use of aluminum (Give a property for the use) (01 mark) 01

For electric conducting wires; since it's a good conductor of electricity. (See any correct use with respective property)

17(a) 25cm<sup>3</sup> of 0.5M hydrochloric acid was added to 225cm<sup>3</sup> of water,

Calculate the pH of the resultant solution. (2 ½ marks)

1000cm<sup>3</sup> of HCl contains 0.5 moles ✓

25cm<sup>3</sup> of HCl contain  $(\frac{0.5}{1000} \times 25) = 0.0125$  moles ✓

Total volume = (225+25) = 250cm<sup>3</sup>. ✓ 2½

250cm<sup>3</sup> of HCl contains 0.0125 moles ✓

1000cm<sup>3</sup> of HCl contains  $(\frac{0.0125}{250} \times 1000) = 0.05$  moles/l ✓

pH =  $-\log [H^+] = 0.05 \text{ moles/l}$

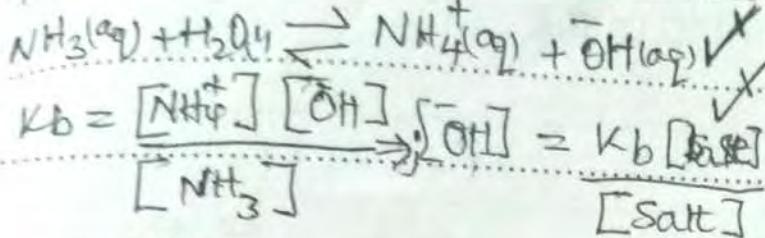
$$= -\log 5.0 \times 10^{-2}$$

$$= 2 - 0.699$$

$$= 1.3$$

Determine the mass of ammonium chloride that should be added to 1dm<sup>3</sup> of a 0.1M ammonia solution at 25°C to give a solution whose pH is 8.5.

$$(K_b \text{ for ammonia} = 1.8 \times 10^{-5} \text{ mol dm}^{-3}, K_w = 1.0 \times 10^{-14} \text{ mol}^2 \text{ dm}^{-6})$$



$$\text{pH} = -\log [\text{H}^+] = 8.5$$

$$[\text{H}^+] = (10^{-8.5}) = 3.16 \times 10^{-9} \text{ M}$$

$$1.0 \times 10^{-14} \times [\text{salt}] = 3.16 \times 10^{-9}$$

$$1.8 \times 10^{-5} \times 0.1$$

$$[\text{salt}] = \frac{3.16 \times 10^{-9}}{1.8 \times 10^{-5}}$$

$$= 0.569 \text{ M}$$

$$\text{MM NH}_4\text{Cl} = 53.49$$

$$\text{Mass. NH}_4\text{Cl} = \frac{53.49}{0.569} = 94.0$$

$$\text{but } [\text{OH}^-] = \frac{K_w}{[\text{H}^+]}$$

$$\frac{K_w}{[\text{H}^+]} = \frac{K_b [\text{base}]}{[\text{salt}]}$$

$$[\text{H}^+] = \frac{K_w [\text{salt}]}{K_b [\text{base}]}$$

Acc any correct working

d) A few drops of sodium hydroxide were added to the solution in (b).

i) State what happened to the pH of the solution.

It remained constant. The pH did not significantly change.

(1/2 marks)

ii) Give a reason for your answer in (i)

The ammonium ions in solution react and remove the added hydroxide ions. The hydrogen hydroxide ions react and remove the hydroxide ions.

(01mark)

# THE PERIODIC TABLE

1	2													3	4	5	6	7	8
1.0 H 1														1.0 H 1	4.0 He 2				
6.9 Li 3	9.0 Be 4													10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12													27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36		
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54		
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86		
223 Fr 87	226 Ra 88	227 Ac 89																	
			139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71		
			227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103		

END

Name: .....

Centre/Index No: .....

School.....

Signature.....

**P525/1**  
**CHEMISTRY**  
**Paper 1**  
**2  $\frac{3}{4}$  hours**

**WAKISSHA**

**Uganda Advanced Certificate of Education**

**CHEMISTRY**

**Paper 1**

**2 hours 45 minutes**

**Instructions to Candidates**

- Attempt all questions in section A and any six questions from section B.
- All questions are to be answered in the spaces provided.
- A Periodic Table with relevant atomic masses is supplied at the end of the paper.
- Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.
- Illustrate your answers with equations where applicable.
- Molar gas volume at s.t.p =  $22.4 \text{ dm}^3$

**For Examiner's Use Only**

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

## SECTION A (46 MARKS)

Attempt **all** questions in this section.

1. Calcium phosphate partially dissociates in water to form a saturated solution of concentration  $3.531 \times 10^{-5} \text{ gdm}^{-3}$  at  $25^\circ\text{C}$ .

(a) Write the;

(i) equation for the partial dissociation of Calcium phosphate in water.

(01 mark)

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.....

(ii) expression for the solubility product,  $\text{K}_{\text{sp}}$ .

(01 mark)

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(b) Calculate the solubility product,  $\text{K}_{\text{sp}}$  of calcium phosphate at  $25^\circ\text{C}$ .

State its units.

(2½ marks)

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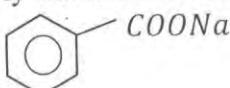
(c) State how the  $\text{K}_{\text{sp}}$  value in (b) above is affected when Calcium nitrate is added to the saturated solution of calcium phosphate at  $25^\circ\text{C}$ .

(½ mark)

.....  
.....

2. Name the reagent that can be used to distinguish between the following pairs of compounds. State what would be observed in each case when a member of each pair is separately treated with the reagent named.

(a)



(aq) and  $\text{CH}_3\text{COONa}$  (aq)

(02 marks)

Reagent

Observations

.....  
.....

- (b)  $(CH_3)_3C - OH$  and  $CH_3COCH_3$  (02 marks)  
Reagent

Observations

3. (a) Write the formulae and state the chemical nature of oxides formed by Beryllium and Barium. (2½ marks)

Element	Formulae of oxide(s)	Chemical nature
Beryllium		
Barium		

- (b) Write equation(s) for the reaction(s) between the oxide(s) of;  
(i) Beryllium with sodium hydroxide solution. (01 mark)

- (ii) Barium with dilute mineral acids. (02 marks)

4. The physical states of chlorine, Bromine and Iodine at 298K and 760mmHg are gas, liquid and solid respectively.

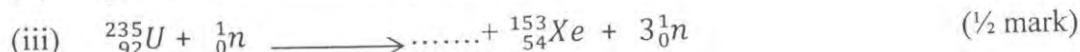
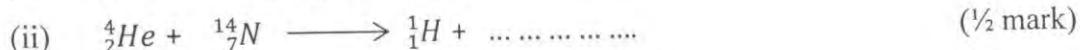
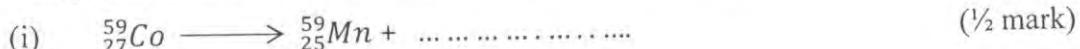
- (a) State reasons why the physical states vary among the group VII elements. (01 mark)

- (b) Write equation(s) for the reaction(s) that take place when;  
(i) excess Chlorine gas is bubbled into sodium thiosulphate solution. (01 mark)

Turn Over

- (ii) Iodine is added to dilute potassium hydroxide solution and the resultant mixture warmed. (01 marks)
- .....  
.....

5. (a) Complete the following equations for the nuclear reactions.



- (b) Identify the type of nuclear reaction that occurs in;

(i) a(i) above. (½ mark)

.....  
.....

(ii) a(iii) above. (½ mark)

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.....

- (c) A fossil was found to contain 0.125g of carbon-14 isotope after 22400 years. Calculate the mass of carbon-14 in the living tissue given that the half-life of carbon-14 is 5600 years. (2½ marks)
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6. An organic compound Q has a molecular formula,  $C_2H_4Cl_2$ .

- (a) Write the structural formulae and IUPAC names of all possible isomers of Q. (02 marks)
- .....  
.....

- (b) Each isomer in (a) above was separately refluxed with concentrated sodium hydroxide solution and the resultant cold mixture tested with Brady's reagent.

- (i) State what would be observed in each case. (02 mark)
- .....  
.....

- (ii) Write equation(s) to show the reaction(s) that take place on reflux of each isomer with sodium hydroxide. (02 marks)
- .....  
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7. (a) Butane-1, 4-dioic acid is a weak acid.  
(i) Define the term weak acid. (01 mark)

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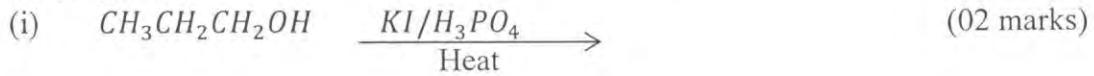
(ii) Write an equation to show that butane-1, 4-dioic acid is weak. (01 mark)

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- (b) 1.18g of butane-1,4-dioic acid were dissolved in distilled water to make  $200\text{cm}^3$  of solution whose pH was 3.20.  
Calculate the acid ionization constant  $K_a$  for butane-1, 4-dioic acid and state its units. (04 marks)

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8. (a) Complete the following equations and in each case, write a mechanism for the reaction.



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- (b) State one reason why  $\text{H}_3\text{PO}_4$  cannot be replaced by conc.  $\text{H}_2\text{SO}_4$  in (a)(i) above. (01 mark)

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Turn Over

9. (a) Propanone reacts with Iodine in acidic medium according to the equation;



The kinetics of the reaction was examined by measuring the colour intensity of the reaction mixture.

- (i) Sketch a graph to show how colour intensity varies with time. (01 mark)

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- (ii) Give a reason for your answer in a(i) above. (01 mark)

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- (b) Briefly outline one other method by which the rate of the reaction in (a) above can be measured. (02 marks)

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- (c) The rate equation for the reaction is given by;

$$\text{Rate} = k[CH_3COCH_3]$$

State the effect on the rate of reaction when;

- (i) concentration of Iodine is doubled while the concentration of propanone remains constant. (½ mark)

.....

- (ii) temperature is increased. (½ mark)

.....

- (iii) the concentrations of both Iodine and propanone are doubled. (01 mark)

## SECTION B (54 MARKS)

Attempt any **six** questions from this section.

10. (a) The partition coefficient of solute X between benzene and water at 25°C is 5.0.

- (i) State three conditions under which the partition coefficient remains valid at 25°C. (1½ marks)

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- (ii) Calculate the volume of benzene that extracts 80% of solute X from 50cm<sup>3</sup> of its aqueous solution at 25°C. (2½ marks)

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- (iii) State one method by which the percentage of solute X extracted in a(ii) above can be increased. (01 mark)

.....  
.....

- (b) Ions of univalent metal M react with excess aqueous ammonia to form a soluble complex.



Equal volumes of aqueous ammonia and 0.1M aqueous solution of M<sup>+</sup> ions were shaken with 1000cm<sup>3</sup> of chloroform.

At equilibrium, the concentration of ammonia in the chloroform layer was 0.025 moldm<sup>-1</sup>.

10cm<sup>3</sup> of the aqueous layer required 18.10cm<sup>3</sup> of 0.4M nitric acid for complete neutralization.

Calculate the;

- (i) concentration of free ammonia in the aqueous layer. (2½ marks)

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**Turn Over**

- (ii) partition coefficient of ammonia between water and chloroform.  
(1½ marks)

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.....

11. (a) A saturated compound R contains 38.710% carbon and 51.613% oxygen.  
The density of R at s.t.p is  $2.7662\text{ g l}^{-1}$ .  
(i) Calculate the empirical formula of R. (02 marks)

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- (ii) Determine the molecular formula of R. (02 marks)

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- (b) R reacts with sodium metal to liberate hydrogen gas but gives no effervescence on addition of sodium carbonate solution.

- (i) Write the structural formula of R. (01 mark)

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- (c) R combines with benzene -1, 4-dicarboxylic acid to form a polymer called Terylene.

- (i) State the type of polymerization that leads to the formation of Terylene. (01mark)

- (ii) Write the structural formula of Terylene. (01 mark)

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(iii) State any one use of Terylene. (01 mark)

.....

12. Chromium, Vanadium and Iron are transition elements which form compounds in variable oxidation states.

(a) Calculate the oxidation state of the transition element in each of the following chemical species.

(i)  $VO_3^-$  (½ mark)

.....

(ii)  $K_2MnO_4$  (½ mark)

.....

(iii)  $Fe(H_2O)_6^{3+}$  (½ mark)

.....

(b) State any two other general properties of transition elements. (01 mark)

.....

(c) In acidic medium,  $VO_3^-$  react according to the half equation.



(i) State what would be observed when the acidified solution of  $VO_3^-$  is warmed with zinc dust. (01 mark)

.....

(ii) Write an equation for the redox reaction that occurs in c(i) above.

(1½ marks)

.....

(d) State what would be observed and write an equation for the reaction when;

(i) Sodium hydroxide solution is added to a solution containing  $Fe(H_2O)_6^{3+}$  ions.

Observation (½ mark)

.....

Equation (01 mark)

.....

(ii) Hydrogen sulphide gas is bubbled into an aqueous solution of  $K_2MnO_4$ .

(01 mark)

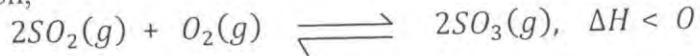
Observation

.....

Equation (1½ mark)

Turn Over

13. (a) In the contact process, sulphurtrioxide is produced according to the reversible reaction;



- (i) Write the expression for the equilibrium constant, Kc for the reaction. (½ mark)

.....  
.....

- (ii) When 1 mole of sulphurdioxide was mixed with 2 moles of oxygen in a 2 litre vessel and the reaction carried out at 200°C, 1.92 moles of oxygen remained in the equilibrium mixture. Calculate the value for the equilibrium constant, Kc. (2½ marks)

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- (b) State the effect of each of the following changes on the yield of sulphurtrioxide. Give a reason for your answer.

- (i) increasing the temperature to 350°C. (01 mark)

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- (ii) absorption of sulphurtrioxide by 98% sulphuric acid. (01 mark)

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- (c) The sulphur trioxide obtained is used to prepare sulphuric acid which acts as a solvent of freezing point 10°C. A solution containing 0.630g of nitric acid in 200g of sulphuric acid freezes at 8.760°C.

- (i) Calculate the relative formula mass of nitric acid in sulphuric acid. (Cryoscopic constant of sulphuric acid is 6.2°C  $Kg^{-1} mol^{-1}$ ) (02 marks)

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- (ii) Explain your answer in c(i) above. (02 marks)  
(Theoretical R.F.M of nitric acid = 63.0)

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14. (a) State how each of the following compounds can be prepared.

- (i) Lead (IV) oxide. (1½ marks)

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- (ii) Lead (IV) chloride. (1½ marks)

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.....

(b) Write equations for the reaction between;

- (i) Lead (IV) oxide and Manganese (II) sulphate solution in the presence of hot concentrated nitric acid. (1½ marks)

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.....

- (ii) Lead (IV) chloride and water (1½ marks)

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.....

(c) Potassium chromate (VI) solution was added to Lead (II) acetate solution followed by excess sodium hydroxide solution.

- (i) State what was observed. (01 mark)

.....  
.....

- (ii) Write equation(s) for the reaction(s) that took place. (02 marks)

.....

15. The hydration energies of Lithium ions, Rubidium ions and Sulphate ions are -505, -375 and -561  $\text{kJ/mol}^{-1}$  respectively.

- (a) What is meant by the term hydration energy? (01 mark)

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Turn Over

(b) (i) Compare the hydration energies of Lithium ions and Rubidium ions. (01 mark)

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(c) Calculate the enthalpy of solution of Rubidium sulphate given that the lattice energy of Rubidium sulphate is  $-1236 \text{ kJ mol}^{-1}$ . (3½ marks)

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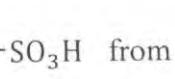
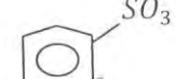
(d) State whether Rubidium sulphate is soluble in water or not. Give a reason for your answer. (1½ marks)

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16. Write equations to show how the following compounds can be synthesized.

(a) 2-hydroxyethanoic acid from ethanoic acid. (03 marks)

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(b) HO SO<sub>3</sub>H from 

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(c) 2-methylpropan-2-ol from propanone.

(2½ marks)

17. The conductivity of solution X varies with concentration as shown in the table below.

Concentration (mol dm <sup>-3</sup> )	0.01	0.04	0.09	0.16	0.25
Conductivity $\Omega^{-1} cm^{-1} \times 10^{-3}$	1.340	4.760	9.360	13.920	17.750

- (a) What is meant by the term electrolytic conductivity? (01 mark)

.....  
.....

- (b) Plot a graph of molar conductivity against the square root of concentration. (03 marks)

From your graph.

- (i) State whether X is a strong or weak electrolyte. Give a reason for your answer. (01 mark)

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.....

- (ii) Determine the molar conductivity of X at infinite dilution. (½ mark)

.....  
.....

- (c) Calculate the ratio of X to sodium chloride required to give a solution of molar conductivity  $125.4 \Omega^{-1} cm^2 mol^{-1}$ . (02 marks)

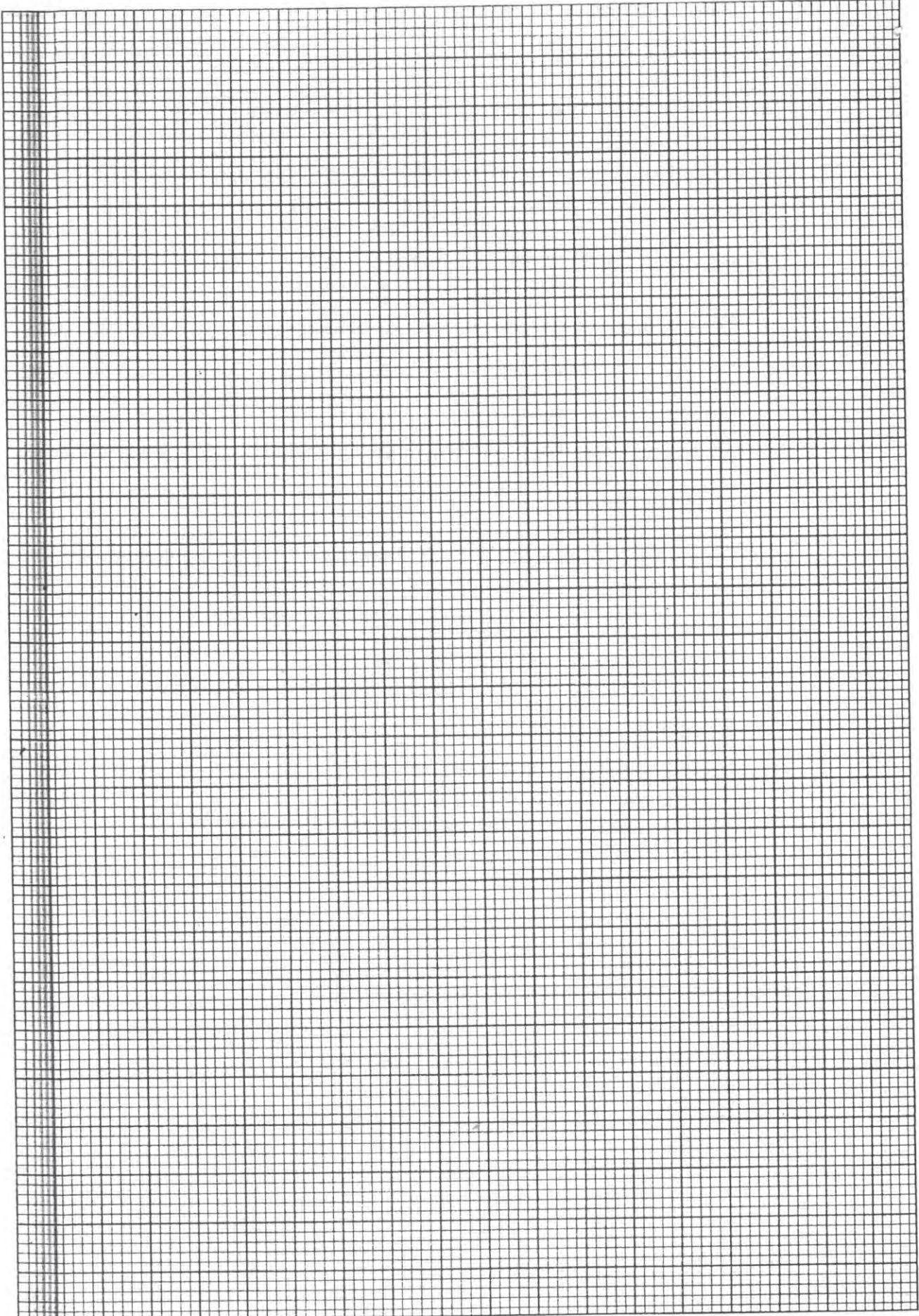
(Molar conductivity of sodium chloride =  $109 \Omega^{-1} cm^2 mol^{-1}$ )

.....  
.....

- (d) State one other factor that affects conductivity. (1½ marks)

.....  
.....

Turn Over



# THE PERIODIC TABLE

1	2													3	4	5	6	7	8
1 H 1.0														1 H 1.0	2 He 4.0				
3 Li 6.9	4 Be 9.0													5 B 10.8	6 C 12.0	7 N 14.0	8 O 16.0	9 F 19.0	10 Ne 20.2
11 Na 23.0	12 Mg 24.3													13 Al 27.0	14 Si 28.1	15 P 31.0	16 S 32.1	17 Cl 35.4	18 Ar 40.0
19 K 39.1	20 Ca 40.1	21 Sc 45.0	22 Ti 47.9	23 V 50.9	24 Cr 52.0	25 Mn 54.9	26 Fe 55.8	27 Co 58.9	28 Ni 58.7	29 Cu 63.5	30 Zn 65.7	31 Ga 69.7	32 Ge 72.6	33 As 74.9	34 Se 79.0	35 Br 79.9	36 Kr 83.8		
37 Rb 85.5	38 Sr 87.6	39 Y 88.9	40 Zr 91.2	41 Nb 92.9	42 Mo 95.9	43 Tc 98.9	44 Ru 101	45 Rh 103	46 Pd 106	47 Ag 108	48 Cd 112	49 In 115	50 Sn 119	51 Sb 122	52 Te 128	53 I 127	54 Xe 131		
55 Cs 133	56 Ba 137	57 La 139	72 Hf 178	73 Tt 181	74 W 184	75 Re 186	76 Os 190	77 Ir 192	78 Pt 195	79 Au 197	80 Hg 201	81 Tl 204	82 Pb 207	83 Bi 209	84 Po (209)	85 At (210)	86 Rn (222)		
87 Fr (223)	88 Ra (226)	89 Ac (227)																	
			57 La 139	58 Ce 140	59 Pr 141	60 Nd 144	61 Pm (145)	62 Sm 152	63 Sm 150	64 Eu 152	65 Tb 159	66 Dy 162	67 Ho 165	68 Er 167	69 Tm 169	70 Yb 173	71 Lu 175		
			89 Ac (227)	90 Th 232	91 Pa 231	92 U 238	93 Np 237	94 Pu (244)	95 Am (243)	96 Cm (247)	97 Bk (247)	98 Cf 251	99 Es (254)	100 Fm (257)	101 Md (256)	102 No (254)	103 Lw		

1.  Indicates atomic number.

2.  Indicates relative atomic mass.

END

P525/1

**CHEMISTRY**

**Paper 1**

**Mar./Apr. 2021**

**2<sup>3</sup>/<sub>4</sub> hours**



**WAKISO-KAMPALA TEACHERS' ASSOCIATION (WAKATA)**

**WAKATA PRE UNEB EXAMINATIONS 2021**

**Uganda Advanced Certificate of Education  
CHEMISTRY**

**Paper 1**

**2 hours 45 minutes**

**INSTRUCTIONS TO CANDIDATES:**

*Answer all questions in section A and six questions in section B*

*All questions must be answered in the spaces provided.*

*The periodic table, with relative atomic masses is attached at the end of the paper.*

*Mathematical table (3 figure table) are adequate or non programmable scientific electronic calculators may be used.*

*Illustrate your artucess with equations were applicable.*

*Molar gas constant,  $R = 8.314 \text{ Jk}^{-1} \text{ mol}^{-1}$*

*Molar volume of gas at S.t.p is 22.4 litres.*

For Examiner's Use Only																	Total
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	

## SECTION A (46 MARKS)

*Answer all questions in this section.*

1. An alkene,  $Q$ , diffuses through a porous partition in 120 seconds. Under similar conditions the same volume of oxygen diffuses in 112 seconds.

(a) Calculate the molar mass of  $Q$ . (02marks)

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(b) Determine the formula and write the structure of  $Q$ . (02marks)

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(c) Write the equation and mechanism for the reaction of  $Q$  and hydrogen chloride solution.

*(02½marks)*

2. (a) State conditions for the reaction between aluminium oxide and sulphuric acid and write the equation for the reaction that takes place

*(02½marks)*

Conditions

.....  
.....

Equation

.....  
.....

(b) The resultant solution in (a) was mixed with aqueous sodium carbonate solution.

State what would be observed and write equation for the reaction that takes place *(02½marks)*

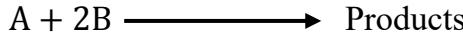
Observation

.....  
.....

Equation

.....  
.....

3. The following experimental results were obtained for the reaction



Experimental No.	Initial concentration ( $\text{mol l}^{-1}$ )		Initial rate ( $\text{mol l}^{-1} \text{s}^{-1}$ )
	A	B	
1	$3.0 \times 10^{-2}$	$3.0 \times 10^{-2}$	$2.7 \times 10^{-5}$
2	$3.0 \times 10^{-2}$	$6.0 \times 10^{-2}$	$5.4 \times 10^{-5}$
3	$6.0 \times 10^{-2}$	$3.0 \times 10^{-2}$	$10.8 \times 10^{-5}$

(a)(i) Deduce the order of reaction with respect to:

*(01mark each)*

A: .....

B: .....

(ii) Write the expression for the rate equation

(0½marks)

(b) The rate of reaction under certain conditions of temperature and pressure is  $x$ .

Express the rate in terms of  $x$  when the following changes are made. (0½mark each)

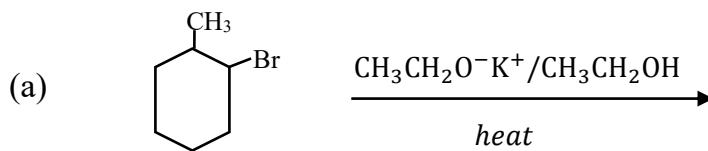
(i) The concentration of **B** is halved while the concentration of **A** remains unchanged.

(ii) The rate constant is doubled by increasing temperature, but keeping the concentrations of **A** and **B** unchanged.

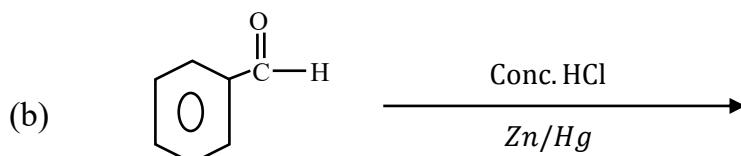
(iii) If 90% of **B** is removed by precipitation without affecting concentration of **A**.

(c) Calculate the value of the rate constant and state its units (02marks)

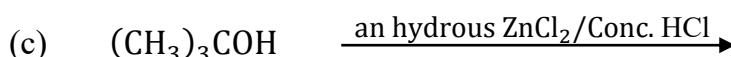
4. Complete the following reaction equations and write the IUPAC names of the main organic product in each case. (1½mark each)



Name of product .....



Name of product .....



Name of product .....

5. (a) Write half equations(s) to show the action of hydrogen peroxide as; (01mark each)

(i) an oxidizing agent

(ii) a reducing agent

Turn Over

(b) State what is observed and in each case write equation of reaction that takes place when hydrogen peroxide is added to the following mixtures; (01½mark each)

- (i) acidified Potassium chromate (vi) solution

Observation

.....  
.....

Equation

.....  
.....

- (ii) Iron (ii) sulphate in dilute sulphuric acid

Observation

.....  
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Equation

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- (c) Give **one** reason why hydrogen peroxide is not used in estimation of concentration of Iron (ii) ions in volumetric analysis. (01mark)

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6. (a) Explain what is meant by the term **first electron affinity**. (01mark)

.....  
.....

- (b) State **three** factors that can affect electron affinity (01½marks)

.....  
.....

- (c) The first electron affinities of some elements of period 3 are given in the table below

Element	Al	Si	P	S
First electron affinity (kJmol <sup>-1</sup> )	-44	-134	-71.7	-200

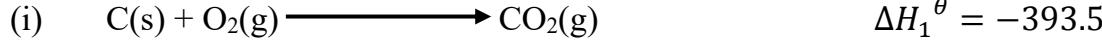
- (i) State the trend in variation of electron affinities (01½marks)

.....  
.....

- (ii) Explain your answer in (c)(i) above (02marks)

.....  
.....

7. (a) The enthalpies of some reactions are given below in  $\Delta H^\theta / \text{kJmol}^{-1}$



(b) (i) From your answer in (a) state whether Phenol is a stable compound or not. (0½mark)

(ii) Give a reason for your answer in (b)(i) above (01mark)

(c) Write equation(s) to show how Phenol can be synthesized from chloro benzene

(01½marks)

8. Draw the structures and name the shape of each of the following species (05marks)

Species	Structure	Shape
H <sub>2</sub> S		
H <sub>2</sub> O		
NO <sub>3</sub> <sup>-</sup>		
ICl <sub>2</sub>		
CO <sub>3</sub> <sup>2-</sup>		

9. (a) Define the term “Steam distillation” (01mark)

(b) At one atmosphere steam distillation of a certain liquid of relative molecular mass 114.5

takes place at 97°C. If the vapour pressure of water at the same temperature is 0.68

atmospheres, calculate the composition of the distillate. (03marks)

(c) State **two** advantages of steam distillation over fractional distillation

(01mark)

## SECTION B (54MARKS)

Attempt any **six** questions in this section.

10.(a) Define the term **Molar conductivity**

(01mark)

(b) State **three** factors which can affect molar conductivity of an electrolyte.

(01½marks)

(c) The resistance of a 0.1M Potassium chloride solution in a conductance cell is  $47.85\Omega$ .

The resistance of a solution of 0.02M sodium nitrate in the same cell is  $254\Omega$ .

The conductivity of Potassium chloride solution is  $1.29 \Omega^{-1}\text{m}^{-1}$

Calculate the:

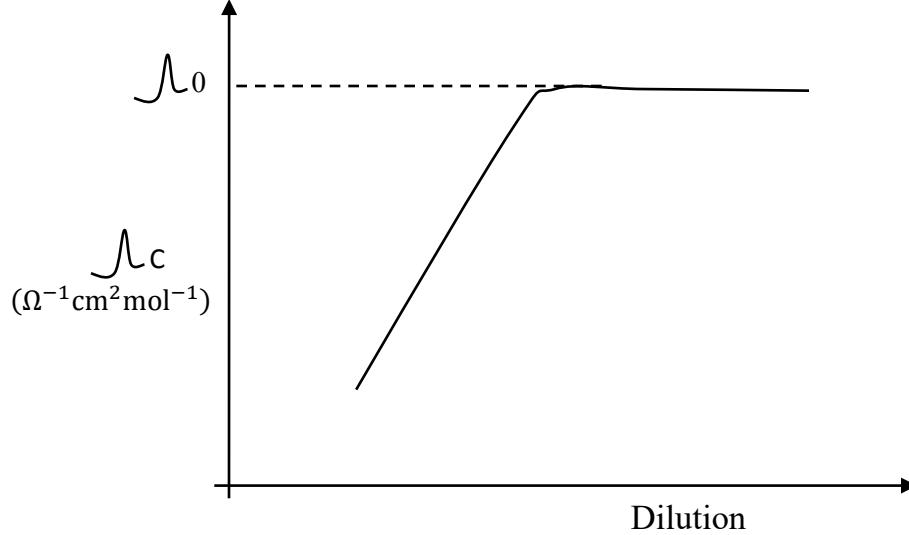
(i) cell constant

(01½marks)

(ii) molar conductivity of sodium nitrate

(02½marks)

(d) The graph below shows the variation of molar conductivity of a strong electrolyte with dilution.



Briefly explain the shape of the graph

(02½marks)

**11.** Write equations for the reactions which would take place and in each case, state what would be observed when:

- (a) Ammonia solution is added dropwise until in excess to an aqueous solution of Nickel (ii) sulphate. (04marks)

Observation

Equation(s)

- (b) Excess concentrated hydrochloric acid is added to aqueous solution of Cobalt (ii) sulphate.

(02½marks)

Observation

Equation

- (c) Sodium carbonate solution is added dropwise until in excess to an aqueous solution of

Iron (iii) sulphate (02½marks)

Observation

Equation

**12. (a) State**

- (i) the distribution law (02marks)

- (ii) four conditions under which the law is valid (02marks)

- (b) 15g of a substance W was dissolved in water to make  $500\text{cm}^3$  of solution. If the distribution coefficient of W between water and ether is 0.3. Calculate the mass of W extracted by shaking the  $500\text{cm}^3$  of solution with

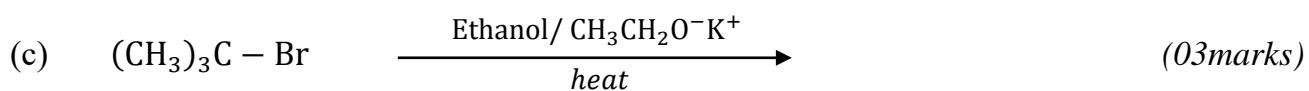
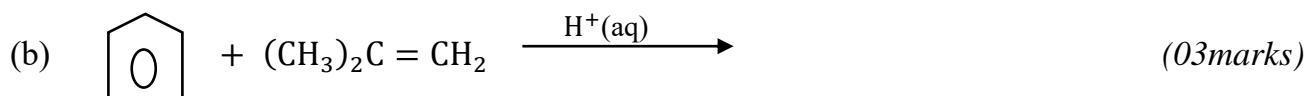
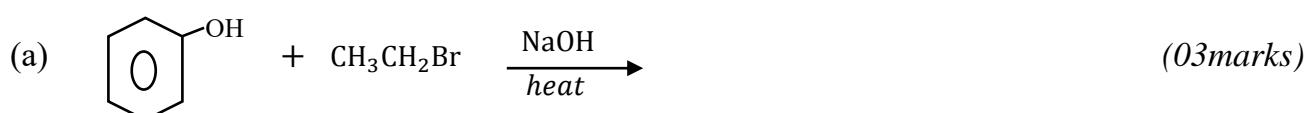
- (i)  $200\text{cm}^3$  of ether (02marks)

**Turn Over**

(ii) Two successive portions of 100cm<sup>3</sup> of ether

(03marks)

13. Complete the following equations and in each case write the mechanism for the reaction.



14. Carbon, silicon and lead are some of the elements in group (iv) of the periodic table.

(a) State **three** properties in which carbon differs from silicon and lead (03marks)

(b) Write equations for the reactions of sodium hydroxide solution with

(i) Carbon monoxide (01½marks)

(ii) Silicon dioxide

(01½marks)

(iii) Lead (ii) oxide

(01½marks)

(c) Write equation for the reaction between lead (iv) oxide and warm concentrated hydrochloric acid.

(01½marks)

15. Methanoic acid (*bp* 101<sup>0</sup>C) and water (*bp* 100<sup>0</sup>C) are immiscible in all proportions. They form a maximum boiling point mixture containing 78% methanoic acid which boiled at 108<sup>0</sup>C.

(a) Sketch a labelled boiling point composition diagram for mixtures of methanoic acid and water.

(03marks)

(b) Briefly describe

(i) Why methanoic acid and water form a maximum boiling point mixture. (04marks)

(ii) What happens when a mixture containing 30% methanoic acid is fractionally distilled

(02marks)

16. (a) What is meant by the term “**common ion effect**” (01mark)

(b) Lead (ii) chloride is sparingly soluble in water. Write the :

(i) Equation of solubility of lead (ii) chloride in water (01½marks)

(ii) Expression for the solubility product, K<sub>SP</sub> of lead (ii) chloride

(0½mark)

Turn Over

(c) The solubility of lead (ii) chloride is  $2.0 \times 10^{-5} \text{ mol l}^{-3}$  at  $250^{\circ}\text{C}$ . Calculate the concentration of the following ions in a saturated solution of lead (ii) chloride

(i) Lead (ii) ions

(02marks)

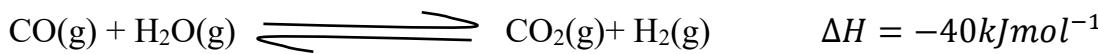
(ii) Chloride ions

(01mark)

(d) Calculate the concentration of a solution in  $\text{mol/l}$  of lead (ii) nitrate that should be added to the saturated solution in (c) in order to reduce the concentration of the chloride ions to a third of the original value.

(03marks)

17. (a) Carbon monoxide reacts with steam according to the following equation



(i) Write the expression for the equilibrium constant,  $K_C$ .

(01mark)

(ii) Equal number of moles of carbonmonoxide and steam were made to react in one litre vessel. When equilibrium was attained at  $850^{\circ}\text{C}$ , the vessel was found to contain 16.7% of carbonmonoxide. Calculate the value of  $K_C$  for the reaction.

(03½marks)

(b) State giving reasons how the concentration of carbondioxide would be affected if at equilibrium:

(i) The temperature was reduced

(01½marks)

(ii) The pressure was increased

(01½marks)

(iii) An inert gas was added at constant temperature

(01½marks)

1	2													3	4	5	6	7	8
1.0 H 1														1.0 H 1	4.0 He 2				
6.9 Li 3	9.0 Be 4													10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10
23.0 Na 11	24.3 Mg 12													27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Tl 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36		
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54		
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86		
223 Fr 87	226 Ra 88	227 Ac 89																	

139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71					
227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103					

END



NAME ..... STREAM .....

P525/1

CHEMISTRY

PAPER 1

2<sup>3/4</sup> Hours

UGANDA ADVANCED CERTIFICATE OF EDUCATION  
MOCK EXAMINATIONS 2020  
SENIOR SIX CHEMISTRY  
PAPER I  
TIME; 2 hours 45 minutes

**INSTRUCTIONS TO CANDIDATES**

- \*Answer all questions in section A and six questions in section B
- \*All questions must be answered in the spaces provided
- \*The periodic Table with relative atomic masses is provided.
- \*Illustrate your answers with equations where applicable
- \* Molar gas constant =  $8.314 \text{ J mol}^{-1}\text{K}^{-1}$
- \*Molar volume of a gas at s.t.p is 22.4 litres

For examiners use only

No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total
Marks																		

**SECTION A (46 Marks)**  
**(Answer all the questions )**

1 (a) Explain what is meant by the term ionization energy

(1½ marks )

(b) The table below gives the first, second, third and fourth ionization energies (in  $\text{kJmol}^{-1}$ ) of five elements P ,Q ,R ,S and T. The letters are not the usual symbols for the elements.

	1 <sup>st</sup>	2 <sup>nd</sup>	3 <sup>rd</sup>	4 <sup>th</sup>
P	800	2400	3700	25000
Q	900	1800	14800	21000
R	500	4600	6900	9000
S	1090	2400	4600	6200
T	1310	3400	5300	7500

1 (a) In which group does element R belong to? Give a reason.

Group

( ½ mark )

Reason

(1 mark ).

(b) Which of the above element is likely to form an amphoteric oxide? Give a reason.

Element

( ½ mark )

Reason

(1 mark)

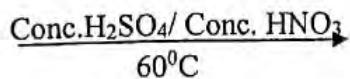
(c) Write the formula of ion formed by element P .

(1 mark)

(d) Write an equation for the reaction involving ionization energy of value  $5300 \text{ kJmol}^{-1}$  for element T.

( 1 mark)

(2) Complete the following organic reactions and outline the reaction mechanism.



Mechanism

( 4 marks )

(3) (a) 2.0g of phosphorous when dissolved in 37.4g of carbon disulphide raised the boiling point of the by  $1.003^\circ\text{C}$ . Boiling point constant for carbon disulphide is  $2.35^\circ\text{C mol}^{-1}\text{kg}^{-1}$ . Determine the molecular formula of phosphorous in carbon disulphide.

( 4 marks )

(b) Comment on your answer in (b). State the reason.

( $1\frac{1}{2}$  marks)

(2 marks )

(4) A compound Q contains by mass 34.46% by mass iron and the rest chlorine. Compound Q has vapour density of 81.25.

(a) Determine;

(i) the empirical formula of Q.

(1½ marks)

(ii) the molecular formula of Q

(2 marks)

(b) State what will be observed and write equation for the reaction that takes place when sodium hydroxide solution is added drop wise until in excess to an aqueous solution of compound Q.  
Observation

(1 mark)

Equation(s)

(1 mark)

(5) Complete the table by indicating the formula of the chloride, type of bond and type of structure of each of the elements given.

Element	Formula of chloride	Type of bond	Type of structure
Aluminium			
Silicon			
Magnesium			

(4½ marks)

(6)(a) Explain what is meant by the term anomalous behavior.

( 1½ marks )

(b) Give reasons why lithium shows anomalous behavior from other members of group (I) elements.

( 1½ marks )

(c) State any three anomalous behavior of lithium as compared to other group (I) elements.

(3 marks)

(7) The energy changes accompanying certain reactions are given below;

	$\Delta H / \text{kJmol}^{-1}$
$\text{Fe}_{(s)} + \text{H}_2\text{SO}_{4(aq)} \longrightarrow \text{FeSO}_{4(aq)} + \text{H}_2(g)$	-10
$\text{H}_2(g) + \text{S}_{(s)} + 2\text{O}_{2(g)} \longrightarrow \text{H}_2\text{SO}_{4(l)}$	-300
$2\text{FeSO}_{4(aq)} + 2\text{H}_2\text{SO}_{4(aq)} \longrightarrow \text{Fe}_2(\text{SO}_4)_3{}_{(aq)} + 2\text{H}_2\text{O}_{(l)} + \text{SO}_{2(g)}$	-20
$\text{H}_2\text{SO}_{4(l)} + \text{aq} \longrightarrow \text{H}_2\text{SO}_{4(aq)}$	-60
$\text{SO}_{2(g)} + 2\text{H}_2\text{O}_{(l)} \longrightarrow \text{H}_2\text{SO}_{4(aq)} + \text{H}_2(g)$	-80

Calculate the enthalpy of formation for;

(a)  $\text{FeSO}_4$  in solution.

( 2 marks )

(b)  $\text{Fe}_2(\text{SO}_4)_3$  in solution

( $2\frac{1}{2}$  marks)

(c) Which of the two substances is thermodynamically more stable? Give reason for your answer.

( $1\frac{1}{2}$  marks)

(8) Name a reagent that can be used to distinguish between iodobenzene and iodoethane. State the observations made.

Reagent

(1 mark)

Observation

(2 marks)

(9) When a few drops of phenolphthalein indicator is added to aqueous solution of sodium sulphite a pink solution is formed. Explain.

(3 marks)

SECTION B ( 54 Marks)

( Answer six questions)

(10(a) Explain what is meant by the term salt hydrolysis.

(1 marks)

(b) 50cm<sup>3</sup> of 0.1M sodium hydroxide solution was added to 50cm<sup>3</sup> of 0.1M ethanoic acid.

Calculate the PH of the resultant solution formed.

(  $K_w = 1.0 \times 10^{-14}$  and  $K_a$  for ethanoic acid =  $1.8 \times 10^{-5}$  )

( 4 marks )

(c) A 0.1M ammonia solution is 4% ionized.

(i) Write equation for ionization of ammonia in water.

(1mark )

(ii) Calculate the PH of the solution. State the assumptions made.

( 3 marks)

- (11) State what will be observed and write equation(s) for the reaction that occur when;
- (a) Dilute sulphuric acid is added to aqueous solution of potassium chromate.

Observation (1mark)

Equation (1 $\frac{1}{2}$  marks )

- (b) Aqueous ammonia is added drop wise until in excess to a solution containing aluminium nitrate .

Observation ( 1 mark )

Equation (1 $\frac{1}{2}$  marks )

- (c) Ethyne is bubbled through ammoniacal silver nitrate solution.

Observation ( 1 mark )

Equation ( 1 mark )

- (d) Carbon dioxide is bubbled through aqueous solution of sodium thiosulphate.

Observation (1 $\frac{1}{2}$  mark)

Equation (1 $\frac{1}{2}$  marks )

- (12) Write equations to show how the following synthesis can be carried out. In each case indicate the reagents and conditions necessary.

- (a) Ethylmethanoate from bromo methane.

( 3 marks )

(b) Ethane-1,2-diol from chloro ethane

( 3 marks )

(c) Propan-1-ol from propyne.

( 3 marks )

- (13) The table below shows the hydrides of the group (VII) elements and their boiling points.

Hydrides	HF	HCl	HBr	HI
Boiling points / K	253	188	206	238

- (a) Explain the trend in the boiling points of the hydrides.

(4 marks)

(b) The hydrides form acid solutions when dissolved in water. Arrange the hydrides of HBr , HCl and HI in order of increasing acid strength. Give reason for your answer.

( 3marks)

(c) Write equation to show how hydrogen chloride and hydrogen bromide can be prepared.

(i) Hydrogen chloride

( 1 mark)

(ii) Hydrogen bromide

( 1 mark)

(14) (a) During extraction of aluminium the ore is first roasted in air ,crushed and then heated strongly with sodium hydroxide solution.

(i) Write the formula and the name of the ore from which aluminium metal is extracted.

Formula (1/2 mark )

Name (1/2 mark )

(ii) State the purpose of sodium hydroxide solution in the reaction above.

( Use equation(s) where necessary to illustrate your answer)

(4 marks)

(b) Write equation(s) to show how the pure ore is obtained from the solution formed after heating the impure ore with sodium hydroxide.

(2 marks)

(c) (i) Name the process by which pure aluminium metal is obtained the ore in (b) above.

( $\frac{1}{2}$  mark)

(ii) Name the compound added to the ore before the process mentioned in (c) i is carried out. State the use of the compound.

( $1\frac{1}{2}$  marks)

(15) Explain briefly each of the following;

(a) Generally salts of group (I) elements have higher melting points than corresponding salts of group (II) elements.

(3 marks)

(b) Sodium sulphate is very soluble in water whereas calcium sulphate is only sparingly soluble.

( 3 marks )

- (c) When sodium hydroxide solution is added drop wise until in excess to aqueous solution of lead (ii) salt a white precipitate is formed which dissolves in excess.

(3 marks )

(16) (a) Explain what's meant by term **order of reaction**

(b) The data in the table below were obtained for the reaction between a bromo alkane and hot aqueous sodium hydroxide.

Time (min)	0	9	18	27	40	54	72	105
Concentration of the bromoalkane	0.106	0.096	0.086	0.077	0.065	0.054	0.043	0.030

(i) Plot a graph of concentration of the bromo alkane against time.

(3marks)

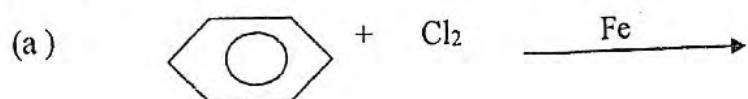
(ii) From the graph determine the order of reaction. Give a reason for your answer.

(1½ marks)

(iii) State whether the bromo alkane is primary, secondary or tertiary. (1/2 mark)

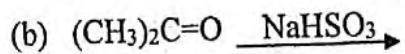
(iv) Draw a labeled energy profile diagram for the reaction. (3 marks)

(17) Complete the following organic reactions and outline the reaction mechanism.



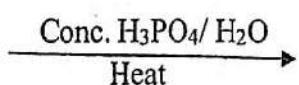
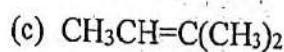
Mechanism

(3 marks)



Mechanism.

(3 marks)



Mechanism.

(3 marks)

END.

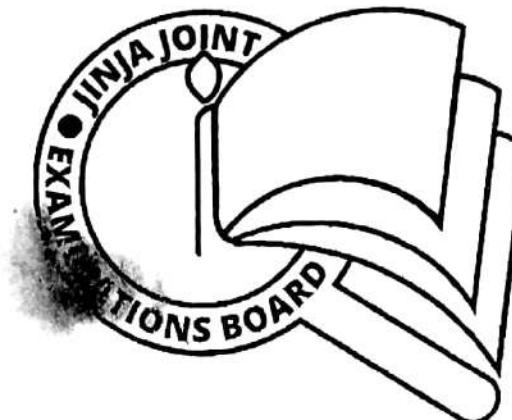
# THE PERIODIC TABLE

1	2													3	4	5	6	7	8									
1.0 H 1														1.0 H 1	4.0 He 2													
6.9 Li 3	9.0 Be 4													10.8 B 5	12.0 C 6	14.0 N 7	16.0 O 8	19.0 F 9	20.2 Ne 10									
23.0 Na 11	24.3 Mg 12													27.0 Al 13	28.1 Si 14	31.0 P 15	32.1 S 16	35.4 Cl 17	40.0 Ar 18									
39.1 K 19	40.1 Ca 20	45.0 Sc 21	47.9 Ti 22	50.9 V 23	52.0 Cr 24	54.9 Mn 25	55.8 Fe 26	58.9 Co 27	58.7 Ni 28	63.5 Cu 29	65.7 Zn 30	69.7 Ga 31	72.6 Ge 32	74.9 As 33	79.0 Se 34	79.9 Br 35	83.8 Kr 36											
85.5 Rb 37	87.6 Sr 38	88.9 Y 39	91.2 Zr 40	92.9 Nb 41	95.9 Mo 42	98.9 Tc 43	101 Ru 44	103 Rh 45	106 Pd 46	108 Ag 47	112 Cd 48	115 In 49	119 Sn 50	122 Sb 51	128 Te 52	127 I 53	131 Xe 54											
133 Cs 55	137 Ba 56	139 La 57	178 Hf 72	181 Ta 73	184 W 74	186 Re 75	190 Os 76	192 Ir 77	195 Pt 78	197 Au 79	201 Hg 80	204 Tl 81	207 Pb 82	209 Bi 83	209 Po 84	210 At 85	222 Rn 86											
223 Fr 87	226 Ra 88	227 Ac 89												139 La 57	140 Ce 58	141 Pr 59	144 Nd 60	147 Pm 61	150 Sm 62	152 Eu 63	157 Gd 64	159 Tb 65	162 Dy 66	165 Ho 67	167 Er 68	169 Tm 69	173 Yb 70	175 Lu 71
														227 Ac 89	232 Th 90	231 Pa 91	238 U 92	237 Np 93	244 Pu 94	243 Am 95	247 Cm 96	247 Bk 97	251 Cf 98	254 Es 99	257 Fm 100	256 Md 101	254 No 102	260 Lw 103

Name ..... Centre/Index No...../.....

Signature .....

P525/1  
CHEMISTRY  
Paper 1  
DECEMBER, 2020  
 $2\frac{3}{4}$  hours.



## JINJA JOINT EXAMINATIONS BOARD

*Uganda Advanced Certificate of Education*

MOCK EXAMINATIONS –DECEMBER, 2020

### CHEMISTRY

(Principal Subject)

Paper 1

2 hours 45 minutes.

#### INSTRUCTIONS TO CANDIDATES:

Answer ALL questions in part A and Six questions from part B.

All questions are to be answered in the spaces provided.

The Periodic Table with relative atomic masses is provided at the back.

*For Examiner's Use Only*

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

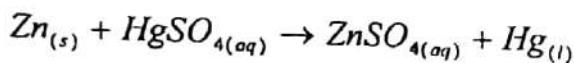
## PART A (46 MARKS)

1. (a) (i) Write the general electronic configuration of group (IV) elements. (½ mark)
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- (ii) State the common oxidation states of group (IV) elements in their Compounds. (01 mark)
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- (b) What is meant by the term inert pair effect? (01 mark)
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- (c) State and explain the trend in inert pair effect down group (IV) elements. (03 marks)
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2. (a) An aqueous solution containing  $5.48 \text{ g dm}^{-3}$  of Y has osmotic pressure of  $7.093 \times 10^4 \text{ NM}^{-2}$  at  $25^\circ\text{C}$ . calculate the;
- (i) Molecular mass of Y (02 marks)
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- (ii) Freezing point of solution (freezing point depression constant for water is  $1.86^{\circ}\text{C mol}^{-1}\text{kg}^{-1}$ ) ..... (2½ marks)

(b) State two assumptions made in the calculation in (a) (01 mark)

3. The equation for the redox reaction that occurs in an electrochemical cell is shown below.



- (a) Write the cell notation (1½ marks)

(b) Write equation for the reaction that takes place at the:

- (i) Cathode (1½ marks)

(ii) Anode (1½ marks)

(c) The standard reduction potentials for the half cell reactions at the cathode and anode are +0.6IV and -0.76V respectively.

Calculate the EMF of the cell

(1½ marks)

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4. (a) Methylbutanoate can be reduced to two alkanols.

Write;

(i) The equation for the reduction of methylbutanoate

(01 mark)

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(b) Name the reagent (s) that can be used to distinguish between butanoic acid and methylbutanoate and state what would be observed if each compound is separately treated with the reagent. (03 marks)

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5. An aqueous solution contains 80cm<sup>3</sup> of 0.02M ammonia solution and 60cm<sup>3</sup> of 0.02M ammonium nitrate.

Calculate the PH of the solution.

(K<sub>b</sub> for ammonia =  $1.8 \times 10^{-5}$  mol dm<sup>-3</sup> at 25°C.)

(4½ marks)

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6. Phosphorous, Silicon and sulphur are some of the elements in the third period of the periodic table.

(a) Write down the formula of the oxide of each element in its highest oxidation state. (1½ marks)

- (b) Write equations for the reactions, if any between the oxides in (a) and water  
(04 marks)

7. Write equations to show how the following conversions can be affected.

(a) Benzoic acid to phenylamine (03 marks)

(b) Phenol to methylbenzene (04 marks)

8. Cobalt forms a complex of formula  $\text{Co}(\text{NH}_3)_5\text{SO}_4\text{Br}$ .
- (a) State the oxidation state and the coordination number for cobalt in the complex. (01 mark)

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- (b) Write the formulae for the ionization isomers of the complex. (02 marks)

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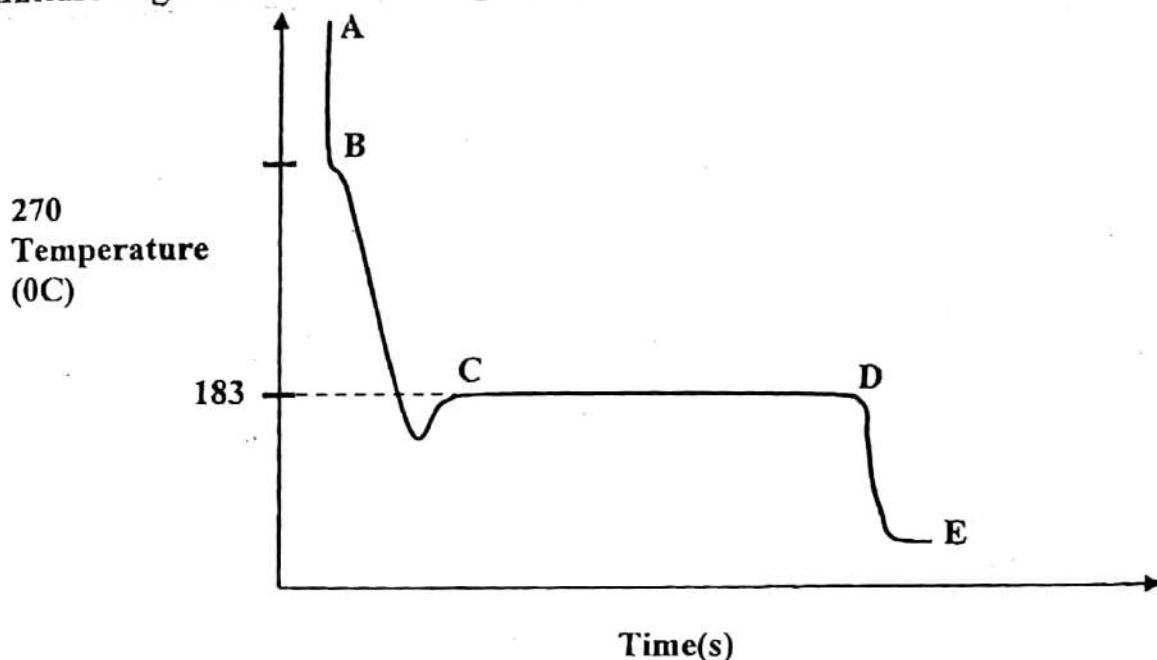
- (c) Name the reagent that can be used to distinguish between the isomers in (b) (01 mark)

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9. (a) Define the term eutectic mixture. (01 mark)

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- 7
- (b) A cooling curve for a mixture of 25% Sn and 75% Pb that forms a eutectic mixture is given below.



State what happens to the mixture along regions.

(02 marks)

AB;  
BC;  
CD;  
DE;

### SECTION B (54 Marks)

10. An amine Z contains 77.42% carbon, 7.52% hydrogen and the rest nitrogen.

(a) Calculate the empirical formula of Z. (2½ marks)

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(b) Determine the molecular formula of Z (the vapor density of Z = 46.5)

(2½ marks)

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(c) Z burns with a sooty flame and reacts with bromine water forming a white precipitate. Identify Z.

(03 marks)

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11. Explain the following observations.

(a) Carbon dioxide is a gas at room temperature whereas silicon (IV) oxide is a solid.

(03 marks)

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- (b) When an aqueous solution of silver nitrate is added to a solution containing potassium chloride and potassium chromate (VI) a white precipitate is formed instead of a red precipitate yet  $K_{sp}$  of silver chloride is  $1 \times 10^{-10} \text{ mol}^2\text{dm}^{-6}$  and  $K_{sp}$  of silver chromate is  $1.3 \times 10^{-12} \text{ mol}^3\text{dm}^{-9}$ . (03 marks)
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- (c) Lead (IV) chloride exists whereas lead (IV) bromide does not. (03 marks)
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12. The elements beryllium, magnesium and calcium belong to the group II of the periodic table, but beryllium differs in some of its properties from the group members.

- (a) State three properties in which beryllium differs from the rest of the group members. (03 marks)
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- (b) Give three reasons why beryllium shows different properties from the rest of the group members. (1  $\frac{1}{2}$  marks)
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- (c) Write equations for the reactions between water and the following carbides.

(i) Beryllium carbide

(1  $\frac{1}{2}$  marks)

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(ii) Magnesium carbide

(1  $\frac{1}{2}$  marks)

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(iii) Calcium carbide

(1  $\frac{1}{2}$  marks)

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13. (a) What is meant by the term salt hydrolysis?

(01 mark)

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- (b) Sodium sulphide undergoes hydrolysis. Write the;

(i) equation for the hydrolysis of sodium sulphide.

(1  $\frac{1}{2}$  marks)

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(ii) expression for the hydrolysis constant  $K_h$ , for sodium sulphide.

(01 mark)

(c) Calculate the PH of a solution containing  $3.9 \text{ gdm}^{-3}$  of sodium sulphide.  
(the hydrolysis constant for sodium sulphide =  $1.25 \times 10^{-10} \text{ moldm}^{-3}$ )  
(3  $\frac{1}{2}$  marks)

(d) State whether an aqueous solution of sodium chloride is acidic, basic or neutral. (give a reason for your answer) (02 marks)

14. (a) Sketch a graph to show how conductivity of an aqueous solution of ammonia varies with concentration. (02 marks)

(b) Explain the shape of the graph in (a)

(03 marks)

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(c) Molar conductivities of some electrolytes at infinite dilution at 298K are given in the table below.

Electrolyte	Molar conductivity ( $\Omega^{-1}\text{cm}^2\text{mol}^{-1}$ )
Sodium chloride	126.5
Hydrochloric acid	426.2
Sodium hydroxide	248.4

(i) Use the above data to calculate the molar conductivity of water at infinite dilution at 298K. (1½ marks)

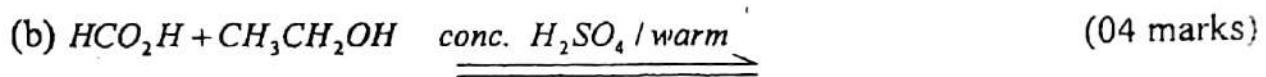
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(ii) Calculate the degree of ionization of water at 298K. (2½ marks)

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(conductivity of water =  $5.5 \times 10^{-3}\Omega^{-1}\text{cm}^{-1}$  and 1 mole of water occupies a volume of  $18\text{ cm}^3$ )

15. Complete the following equations and outline the accepted mechanism(s) for the reactions.



16. (a) State three properties exhibited by copper as a transitional element.

(1  $\frac{1}{2}$  marks)

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(b) Describe reactions of copper with nitric acid.

(2  $\frac{1}{2}$  marks)

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(c) An aqueous solution of ethane – 1, 2 – diammine was added to a solution of copper (II) sulphate. (1  $\frac{1}{2}$  marks)

(i) State what is observed

(1  $\frac{1}{2}$  marks)

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(ii) Write equation (s) for the reactions that take place. (01 mark)

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17. (a) Explain what is meant by the following terms.

(i) Rate constant

(01 mark)

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(ii) Order of reaction.

(01 mark)

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(b) The iodination of propanone in the presence of an acid occurs according to the following equation;  $CH_3COCH_3 + I_2 \xrightarrow{H^+} CH_3COCH_2I + HI$

The following Kinetic data was obtained for the above reaction.

Time (s)	0	3600	7200	10800	14400
Concentration of propanone ( $\text{mol dm}^{-3}$ )	0.241	0.157	0.105	0.069	0.046

Plot a graph of concentration of propanone against time.

(03 marks)

(c) Use the graph to;

(i) Deduce the order of reaction with respect to propanone. (Order of reaction w.r.t iodine is zero). (1½ marks)

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(ii) Determine the rate constant, K.

(2½ marks)

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