P525/2
Chemistry
Paper 2
Jan – Feb 2021
2 ½ hours

UGANDA MUSLIM TEACHERS' ASSOCIATION

UMTA RESOURCE PAPERS – 2021

UGANDA ADVANCED CERTIFICATE OF EDUCATION
Chemistry
Paper 2
2 hours 30minutes

Instructions to candidates

- *Answer five questions including three questions in section A and any two questions in section B.*
- *Write the answers in the booklet provided.*
- *Mathematical tables and graph papers are provided.*
- *Begin each question on a fresh page.*
- *Non-programmable scientific electronic calculators may be used.*
- *Illustrate your answers with equations where applicable.*

SECTION A

(Answer three questions from this section)

1. (a) Define the following terms;
   i. Eutectic mixture (1mark)
   ii. Eutectic temperature (1 mark)

(b) The table below shows the melting points and compositions of various mixtures of bismuth and cadmium.

Percentage of cadmium (%)	20	35	50	65	80	95
Melting point (°C)	226	190	156	184	242	300

Draw a well labeled phase diagram for cadmium-bismuth system. (5 marks)

Use your graph to;

i. Determine the melting points of pure Cadmium and pure bismuth. (1 mark)
ii. Determine the composition and melting point of the eutectic mixture. (1 mark)
iii. Describe what happens when a liquid mixture containing 90% bismuth at 350°C is gradually cooled. (4 marks)
iv. Determine the mass of bismuth that crystallized when 200g of the mixture containing 25% cadmium was cooled from 300°C to 168°C. (4 marks)

(c) State two similarities and two differences between eutectic mixtures and pure compounds. (3 marks)

2. (a) 3.4 g of an organic compound **Q** on complete combustion produced 5.04 dm^3 of carbon dioxide measured at s.t.p and 2.70g of water. When **Q** was steam distilled at 760mmHg at 95°C, the distilled contained 77.1% by mass of **Q** the saturated vapour pressure of water at 95°C was 526 mmHg.
   i. Explain what is meant b steam distillation. (1 mark)
   ii. Calculate the molecular formula of **Q** (5½marks)

   (Molar gas volume at s.t.p =22.4 dm^3)

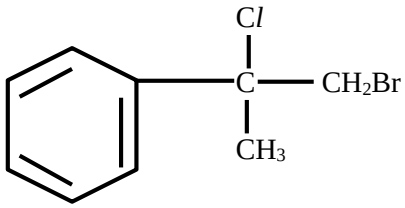
(b) **Q** burns with a sooty flame and liberates hydrogen gas when treated with sodium metal. Write the structural formulae and IUPAC names of four isomers of **Q**. (4 marks)

(c) When **Q** was warned with acidified potassium dichromate solution and treated with neutral iron (III) chloride solution, there was no observable change in each case. Identify **Q**. (1 mark)

(d) Write equation and in each case suggest a mechanism for the reaction which would occur when **Q** is treated with

i. Hot concentrated orthophosphoric acid. (3 ½ marks)
ii. Ethamoyl chloride. (3 ½ marks)

(e) Use equations to show how **Q** can be converted to (1½ marks)



3. (a) Explain two factors that determine the strength of
i. a metallic bond. (4 marks)
ii. an ionic bond. (3 marks)
iii. Van der waal's forces of attraction. (3 marks)

(b) The table below shows melting points of some period elements and their fluorides.

Element	Na	Mg	Al	Si	P
Melting point of element(°C)	98	650	660	1400	44
Fluoride	NaF	MgF_2	AlF_3	SiF_4	PF_5
Melting point of fluoride(°C)	988	1266	1291	-90	-94

Explain the trend in the melting points of the

i. period 3 elements in the table above. (5 ½ marks)
ii. fluorides of period 3 elements in the table above. (4 ½ marks)

4(a) State the partition law and give the conditions under which it is valid. (3 marks)

b(i)Explain what is meant by the term solvent extraction. (1 mark)

(ii) 50.0g of iodine was dissolved in water to make 1000cm^3 of solution. The partition coefficient of iodine between water and carbon disulphide is 0.2 at the temperature of the experiment. Calculate the mass of iodine extracted by shaking the 1000cm^3 of solution with 500cm^3 of carbon disulphide. (2 marks)

(iii) The aqueous solution in b(ii) above was shaken with two successive 250cm^3 portions of carbon disulphide. Calculate the mass of iodine that was extracted. (4 marks)

(c)The table below shows the results of partition of ammonia between 0.1m nickel(II) sulphate and trichloromethane. Excess ammonia reacts with nickel (ii) ions in solution to form a complex$[Ni(NH_3)_n]^{2+}$

$[NH_3]$ (0.1M $NiSO_4$)	0.72	0.94	1.19	1.43	1.70	1.92
$[NH_3]$ $CHCl_3$	0.01	0.03	0.05	0.07	0.09	0.11

i. Plot a graph of $[NH_3]$ (0.1M $NiSO_4$) against $[NH_3]$ $CHCl_3$ (03 marks)

ii. Determine the value of n in the complex $[Ni(NH_3)_n]^{2+}$ (1mark)

iii. Excess ammonia solution was added to 0.1M nickel(II)sulphate solution. Trichloromethane was added to the resultant mixture. The mixture was shaken and left to stand until equilibrium was established. 25cm^3 of the organic layer required 20cm^3 of 0.04M hydrochloric acid for complete neutralization, while 25cm^3 of the aqueous layer required 35cm^3 of 1M hydrochloric acid for complete neutralization. Determine the partition coefficient ,K_D of the ammonia between water and trichloromethane.

(6 marks)

SECTION B

(Answer two questions from this section)

5. Explain the following observations

(a) Hydrogen chloride gas can be prepared by reacting concentrated sulphuric acid with sodium chloride however hydrogen bromide cannot be obtained from sodium bromide using the same method. (5 marks)

(b) An aqueous solution of chromium (III) chloride is acidic. (3½ marks)

(c) A mixture of water (boiling point 100°C) and aminobenzene (boiling point 184°C) boils at 98°C at l atmosphere. (3 ½ marks)

(d) When propene is reacted with bromine in the presence of sodium chloride 1-bromo-2-chloropropane as well as 1, 2-dibrompppropropane are formed. (4 marks)

(e) Ethylamine is a stronger base than phenyl amine although both are primary amines. (4 marks)

6(a)(i)Explain what is meant by the term 'complex ion' (2 marks)

(ii) State two factors that favour complex formation. (1 mark)

(b) A mixture of nickel(II) sulphate and chromium(III) chloride was dissolved in water to form a solution **X**. solution **X** was divided into two portions; to the first portion of solution **X**, sodium hydroxide solution was added drop wise until in excess and the resultant mixture was filtered.

(i) To the filtrate, hydrogen peroxide was added followed by dilute sulphuric acid. State what was observed and write equations for the reactions that took place. (4 ½ marks)

(ii) To the residue, ammonia solution was added dropwise until no further change occurred. State what was observed and write equation for the reaction that took place. (2 ½ marks)

(iii) To the resultant mixture in b (ii) above, dilute hydrochloric acid was added dropwise until the solution was just acidic. State what was observed and write equations for the reaction(s) that took place. (4 ½ marks)

(c)(i) To the second portion of solution **X**, barium nitrate solution was added. Write an ionic equation for the reaction that took place. (1½ marks)

(ii) The resultant mixture was filtered, and to the filtrate, silver nitrate solution was added followed by ammonia solution dropwise until in excess. State what was observed and write equation(s) for the reaction(s) that took place (4 marks)

7(a) What is meant by the following?

i. Saturated solution (1 mark)
ii. Solubility of a salt (1 mark)
iii. Solubility product (1 mark)

(b) The solubility product of silver phosphate at 25°C is 1.4×10^{-21} mol^{-4} dm^{-12}

Calculate the;

i. Solubility of silver phosphate in gdm^{-3} at 25°C (4 marks)

ii. Molar concentration of silver ions in the saturated solution of silver phosphate at 25°C. (1 mark)

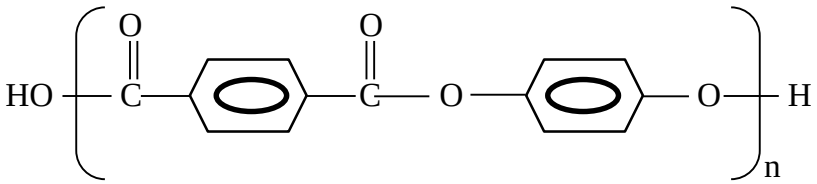
(c)(i) Describe an experiment to determine the solubility product of strontium hydroxide in the laboratory at 25°C (6 marks)

(ii) 25cm^3 of a saturated solution of strontium hydroxide at 25°C were mixed with 50cm^3 of 0.2M hydrochloric acid. The resultant solution was diluted to 250cm^3.20cm^3 of this solution required 12.55cm^3 of 0.025M sodium hydroxide solution using phenolphthalein indicator. Calculate the solubility product of strontium hydroxide at 25°C. (5 marks)

(d) State two applications of solubility measurements.

8(a) Distinguish between addition polymerization and condensation polymerization (3 marks)

(b) The structural formula of a polymer P is given below;



(i) Name the type of polymerization involved during the formation of polymer P. (1 mark)

(ii) Write the names and structural formulae of the monomers which react to form polymer P. (3 marks)

(c) The osmotic pressure of a solution containing 0.09g of the polymer P in 1000cm^3 of an organic solvent is 1400Nm^{-2} at 25°C.

(i) Determine; the molar mass of polymer P (4 marks)

(ii)Give two reasons why the osmotic pressure method is preferred in the determination of molar masses of polymer to other colligative properties (3 marks)

(d) An organic compound Q has the structure shown below;

$$CH_3(CH_2)_{16}COOCH_2$$
$$|$$
$$CH_3(CH_2)_{16}COOCH$$
$$|$$
$$CH_3(CH_2)_{16}COOCH_2$$

(i) State the physical test of Q. (1mark)

(ii) Name ant two naturally occurring substances from which compound Q can be obtained. (1 mark)

(iii) The compound Q was reacted with sodium hydroxide. State the condition(s) for the reaction. (1 mark)

(iv)Write equation for the reaction that takes place in d (iii) (2 marks)

(v) State one use of one of the products formed in d (iii) (1 mark)

END