

P525/2

CHEMISTRY

Paper 2

Jul/Aug 2019

2 ½ Hours



MUKONO EXAMINATION COUNCIL

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 2

2 Hours 30 Minutes

INSTRUCTIONS TO CANDIDATES

- Answer **five** questions including **three** questions from section **A** and any **two** from section **B**.
- Begin each question on a fresh page.
- Use equations where necessary to illustrate your answer.

SECTION A

Attempt only **three** questions from this section

1. a) Define the following terms;

(i) electrolytic conductivity (01 mark)

(ii) molar conductivity (01 mark)

b) Draw a sketch graph to show how molar conductivity varies with concentration for

(i) ethanoic acid

(ii) sodiummethanoate

Explain the shapes of the curves in each case. (09 marks)

c) The molarity of approximately 0.2M sodium hydroxide solution was determined accurately by measuring the conductivity of a solution as sodium hydroxide solution was added to 25cm³ of 0.1M hydrochloric acid. The results were as follows;

Conductivity / $\Omega^{-1} \text{cm}^{-1}$	6.7	5.7	4.5	2.4	3.3	4.9
Volume of NaOH/cm ³	2	4	6	10	18	22

(i) Plot a graph of conductivity against volume of sodium hydroxide. (03 marks)

(ii) Determine from the graph the volume of sodium hydroxide used to reach the end point. (01 mark)

(iii) Calculate the molarity of sodium hydroxide. (02 marks)

(iv) Explain the shape of the graph. (03 marks)

2. a) (i) Write the electronic configuration of chromium (Atomic number of chromium is 24)

(½ mark)

(ii) State the common oxidation states of chromium. (01 mark)

b) Explain why chromium has a high melting point. (1 ½ marks)

c) Describe the reactions of chromium with

(i) water (02 marks)

(ii) sulphuric acid (04 marks)

d) Explain the reactions that take place when the following solutions are added to an aqueous solution of potassium chromium (III) sulphate.

(i) sodium hydrogen carbonate. (4 ½ marks)

(ii) Sodium hydroxide drop wise until in excess. (04 marks)

e) Hydrogen peroxide solution was added to the solution formed in (d) (ii) above.

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

(ii) Write the equation for the reaction that took place. (1 ½ marks)

3. a) (i) State Raoult's law. (01 mark)

(ii) What is an ideal solution. (02 marks)

b) Benzene (bp 80°C) and methylbenzene (bp 110°C) for a liquid mixture that obey Raoult's law. A liquid mixture was made by dissolving 7.8g of benzene and 27.6g of methylbenzene at 25°C. At this temperature the vapour pressures of benzene and methylbenzene are atmospheres and 0.75 atmospheres respectively.
Calculate;

(i) vapour pressure of the mixture. (03 marks)

(ii) mole fraction of each in the vapour. (02 marks)

c) (i) Sketch a boiling point- composition diagram for the mixture of benzene and methylbenzene. (02 marks)

(ii) Using the diagram, describe what will happen when a liquid mixture containing 0.5 mole fraction of each is distilled. (03 marks)

d) Nitric acid and water for a liquid mixture that deviates from Raoult's law. The azeotropic mixture of nitric acid and water boils at 120°C and has a density of 1.42gcm⁻³.

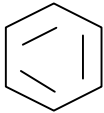
(i) Explain why the mixture deviates from Raoult's law. (2 ½ marks)

(ii) Draw a labeled boiling point – composition diagram for the mixture (2 ½ marks)

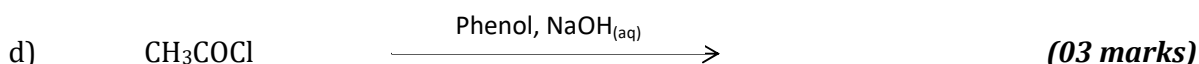
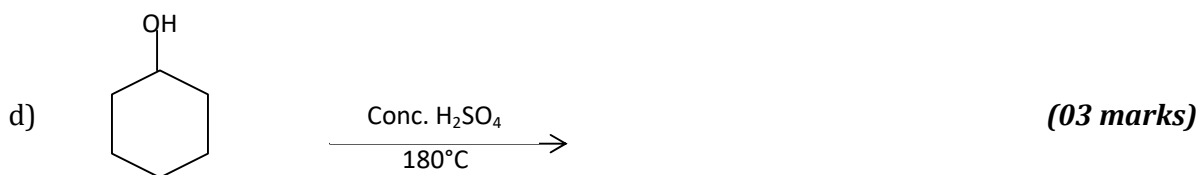
(iii) Calculate the molarity of the acid in the azeotropic mixture. (02 marks)

4. Complete the following equations and outline the mechanisms of reaction.

a) $(\text{CH}_3)_2\text{C}=\text{O} \xrightarrow{\text{NaHSO}_3(\text{aq})}$ (03 marks)

b)  $\xrightarrow[\text{Heat}]{\text{Br}_2/\text{Fe}}$ (04 marks)

c) $\text{CH}_3\text{CHO} \xrightarrow[\text{H}^+(\text{aq})]{\text{NH}_2-\text{NH}-\text{C}_6\text{H}_5}$ (05 marks)



SECTION B

*Attempt **two** questions from this section*

5. The elements; carbon, silicon, tin and lead are group (IV) of the periodic table.

a) Explain the trend in

(i) Metallic character. (03 marks)

(ii) Stability of the +2 oxidation state (02 marks)

b) Carbon differs from other members of the group in some properties.

(i) State two reasons why carbon differs from other members of the group. (01 mark)

(ii) State two properties in which carbon differs from other members of the group.

(01 mark)

c) Describe the reactions of lead (IV) oxide with;

(i) hydrochloric acid (4 ½ marks)

(ii) Sodium hydroxide (2 ½ marks)

d) Describe the reactions of the chlorides of group (IV) elements with water. (06 marks)

6. Explain the following observations.

a) Lead (IV) chloride dissolves in concentrated hydrochloric acid to give a yellow solution from which a yellow solid can be separated out on addition a saturated solution of ammoniumchloride. (4 ½ marks)

b) Boron trifluoride and phosphorus trichloride have different shapes. (04 marks)

c) Alkenes undergo electrophilic addition reactions whereas carbonyl compounds undergo nucleophilic addition. (04 marks)

d) Hydrogen fluoride is a liquid at 20°C whereas hydrogen chloride is a gas at the same temperature. **(04 marks)**

e) The acid strengths of chloroethanoic acid methanoic acid and ethanoic acid is in the order
 $\text{ClCH}_2\text{COOH} > \text{HCOOH} > \text{CH}_3\text{COOH}$ **(3 ½ marks)**

7. a) Define the following terms

(i) Eutectic point **(01 mark)**

(ii) Eutectic mixture **(01 mark)**

b) Napthalene – biphenyl system forms a eutectic mixture. The melting points of the various compositions of napthalene – biphenyl system are shown in the table below.

Percentage of napthalene	10	20	60	80	95
Melting point / °C	64	58	52	69	82

(i) Draw an accurate phase diagram for the napthalene – biphenyl system and label all the regions in the diagram. **(05 marks)**

(ii) Determine the eutectic temperature and the composition of the eutectic mixture. **(02 marks)**

c) Describe the phase changes that would take place when a mixture containing 10% naphthalene is gradually cooled from 90°C to 30°C. **(05 marks)**

d) 200g of a liquid mixture containing 10% naphthalene was cooled to 50°C. Determine the composition of the remaining liquid mixture at 50°C and calculate the mass of biphenyl remaining in the liquid mixture at this temperature. **(05 marks)**

d) State one similarity and one difference between a eutectic mixture and a compound. **(01 mark)**

8. a) (i) Write the formula and name of one ore of zinc. **(01 mark)**

(ii) Describe how pure zinc is obtained from the ore. **(06 marks)**

b) Describe the reaction of zinc with

(i) Sodium hydroxide. **(02 marks)**

(ii) Sulphuric acid **(04 marks)**

c) 6.5g of an ore zinc was dissolved in excess ammonia solution and made to 1dm³ with

water. The solution was shaken with trichloromethane and left to settle. 50cm³ of the trichloromethane layer required to 25cm³ of 0.05M hydrochloric acid for complete reaction.

25cm³ of the aqueous layer required 40cm³ of 0.5M hydrochloric acid.

Calculate the;

i) Concentration of zinc ions in the complex, $Zn(NH_3)_4^{2+}_{(aq)}$ **(3 ½ marks)**

ii) Percentage of zinc in the ore **(2 ½ marks)**

(Zn = 65, partition coefficient of ammonia between water and trichloromethane is 25).

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