

**P525/2**  
**CHEMISTRY**  
**Paper 2**  
**July / Aug: 2022**  
2 ½ hours



**MATIGO MOCK EXAMINATIONS 2022**

**Uganda Advanced Certificate of Education**

**CHEMISTRY**

**Paper 2**

2 hours 30 minutes

**INSTRUCTIONS TO CANDIDATES:**

*Answer **five** questions including **three** questions from Section A any **two** from Section B.*

*Write the answers in the answer booklet(s) provided.*

**Begin each question on a fresh page.**

*Mathematical tables and graph paper are provided.*

*Non- programmable scientific electronic calculators may be used.*

*Use equations where necessary to illustrate your answers.*

*(H=1; C=12; O=16)*

### SECTION A: (60 MARKS)

Answer **three** questions in this section

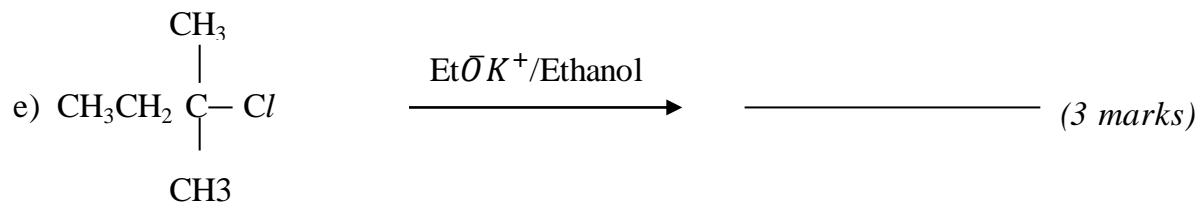
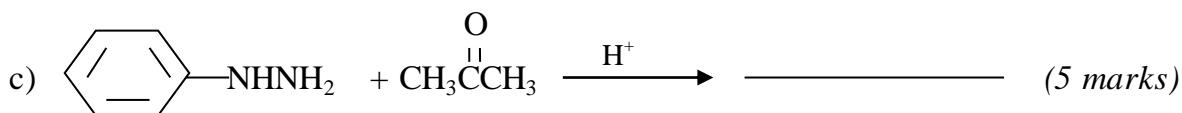
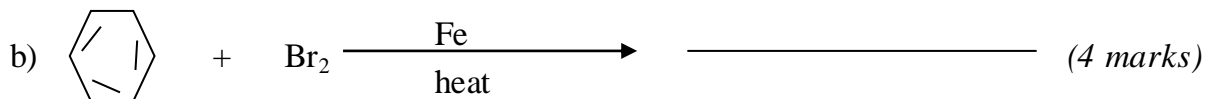
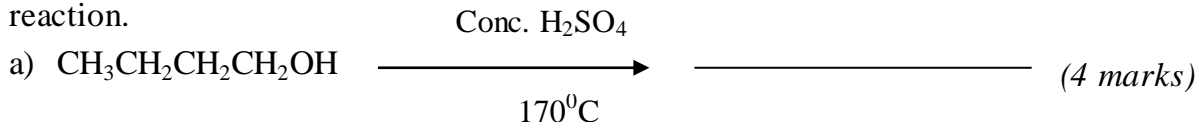
1. a) A mixture of benzene and methylbenzene behaves as an ideal solution. The saturated vapour pressure of benzene and methylbenzene at 20<sup>0</sup>C are 10,000 and 2920Nm<sup>-2</sup> respectively.
- i) Explain what is meant by an ideal solution. (2 marks)
  - ii) Calculate the composition of the vapour containing 0.5 mole fraction of each component. (3 marks)
- b) The boiling point of water is 100<sup>0</sup>C and that of ethanol is 80<sup>0</sup>C. A mixture of the two liquids, when distilled gives a constant boiling mixture at 78<sup>0</sup>C containing 95% ethanol.
- i) Draw a well labeled diagram of the boiling point against composition for the water – ethanol mixture. (4 marks)
  - ii) Describe what would happen if a mixture containing less than 95% ethanol is fractionally distilled. (3 marks)
  - iii) Give **two** examples of pairs of miscible liquids whose solutions behave in a similar way. (2 marks)
  - iv) Name the type of deviation from Raoult's Law exhibited by the solutions of the pairs of liquids above and give reason (s) for that type of deviation. (3 marks)
  - v) Give **two** methods for separating the mixture containing 95% ethanol in ethanol – water system. (2 marks)
- c) State **one** advantage of steam distillation over ordinary distillation. (1 mark)
2. a) Name a pair of organic compounds of different functional groups that show similar observations with the following reagents. In each case, state the observation and write equations for the reactions that take place.
- i) Bromine water (4 marks)
  - ii) Acidified potassium manganate (VII) solution. (4 marks)
  - iii) Sulphur dichloride oxide. (SOCl<sub>2</sub>). (4 marks)
- b) Name the classes of organic compound with the same functional group that can be distinguished with the following reagents. In each case, state what is observed when the named classes are separately treated with the reagent?

- i) Ammonical copper (I) chloride solution. (2 marks)
  - ii) Ice – cold sodium nitrite solution and concentrated hydrochloric acid. (3 marks)
  - iii) Acidified potassium permanganate solution. (3 marks)
3. a) i) Define the term **Standard electrode potential**. (2 marks)
- ii) Describe with the aid of a labeled diagram how the standard electrode potential for the system  $\text{Cu}^{2+}_{(\text{aq})} / \text{Cu}_{(\text{s})}$  can be determined. (6 marks)
- b) Differentiate between the terms **electrolytic conductivity** and **molar conductivity**. (3 marks)
- c) i) Sketch a graph to show variation of molar conductivity with concentration for sodium hydroxide and ammonia solutions, on the same axes. (4 marks)
- ii) Explain the graphs in c) (i). (5 marks)
4. a) Write the name and formula of the principle ore of copper. (2 marks)
- b) Describe a method by which the ore named in (a) above may be concentrated. (2 marks)
- c) i) Using equations only, state how impure copper can be obtained from concentrated copper ore. (4 ½ marks)
- ii) Describe how blister copper is purified in the industry. (3 marks)
- d) Describe the reactions of copper with;
- i) Nitric acid. (3 marks)
  - ii) Sulphuric acid. (1 ½ marks)
- e) Explain the following,
- i) When potassium iodide solution is added to an aqueous solution of copper (II) sulphate, a white precipitate stained brown is obtained. (2 marks)
  - ii) When a solution of copper (II) sulphate is mixed with concentrated hydrochloric acid, the blue solution turns yellow. (2 marks)

**SECTION B: (40 MARKS)**

Answer any **two** questions from this section

5. Complete the following equations and in each case, outline a mechanism for the reaction.



6. a) i) Describe how group (IV) elements react with chlorine. (6 marks)  
ii) Write equations for the reaction between sodium hydroxide and the products in a (i) above. (3 marks)

- b) Explain the variation of the following properties down group (IV) for the elements.

- i) Melting point. (3 marks)  
ii) Stability of the +4 oxidation state. (3 marks)  
iii) Electropositivity. (3 marks)

- c) Explain why tetrachloromethane does not undergo hydrolysis while silicon(IV) chloride is readily hydrolyzed. (2 marks)

7. a) i) State **Hess's** law of constant heat summation. (2 marks)  
ii) State **four** factors that affect enthalpies of reactions. (2 marks)

b) You are provided with following thermochemical data

Process	$\Delta H^\theta \text{ (KJmol)}^{-1}$
Atomization energy of chlorine	+122
Atomization energy of barium	+128
First ionization energy of barium	+698
Second ionization energy of barium	+1320
Lattice energy of barium chloride	-2526
Enthalpy of formation of barium chloride	-641

- Construct a Born – Haber cycle for barium chloride. (4 marks)
- Calculate the electron affinity of the chlorine atom. (3 marks)
- If the hydration energies of barium ion and chloride ion are -2360 and -371 KJmol<sup>-1</sup> respectively, determine the enthalpy of solution for barium chloride, and hence comment on the solubility of barium chloride.

(3 marks)

c) The table below provides some information about the sulphates of selected alkaline earth metals.

Sulphate	Solubility (mol dm <sup>-3</sup> )	Lattice energy (KJmol <sup>-1</sup> )	Hydration energy of M <sup>2+</sup> ion (KJ mol <sup>-1</sup> )
CaSO <sub>4</sub>	$4.6 \times 10^{-2}$	-2480	-1650
SrSO <sub>4</sub>	$7.1 \times 10^{-4}$	-2084	-1480
BaSO <sub>4</sub>	$9.4 \times 10^{-6}$	-2374	-1360

- Explain the trend of the hydration energies of the M<sup>2+</sup> cations shown in the table above. (2 marks)
- Comment on the trend of the solubilities of the sulphates. (2 marks)

d) A sample of barium was burnt in plenty of air for a long time and the product reacted with dilute hydrochloric acid. Write equations for the reactions that took place. (2 marks)

8. Explain the following observations

- Ammonium chloride solution produces effervescence with magnesium ribbon while sodium methanoate solution forms a white precipitate with magnesium chloride solution. (5 marks)

- b) A solution of sodium thiosulphate turns cloudy when exposed to air for some time. (4 marks)
- c) With excess sodium hydroxide, copper (II) ions form a blue precipitate insoluble in excess but with excess ammonia solution, a blue precipitate soluble in excess is produced with copper (II) ions. (4 marks)
- d) Nitrite ion ( $\text{NO}_2^-$ ) adopts a V-shape geometry while the nitronium ion ( $\text{NO}_2^+$ ) is linear. (4 marks)
- e) Chloroethanoic acid has a higher  $K_a$  than ethanoic acid. (3 marks)

**END**