P525/2

CHEMISTRY

Paper 2

July. /August.2024

2 ½ Hours

SISEB MOCK EXAMINATION 2024

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 2

2 hours 30 minutes

INSTRUCTIONS:

Answer **five** questions including three questions from section **A** and any **two** from section **B**

Write the answers in the answer booklet(s) provided.
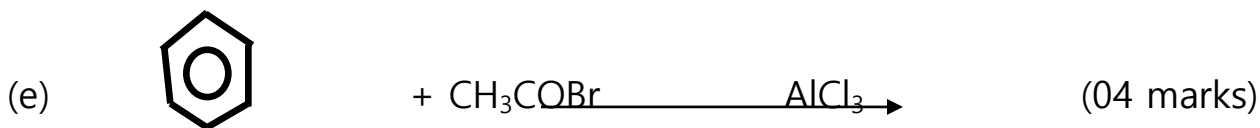
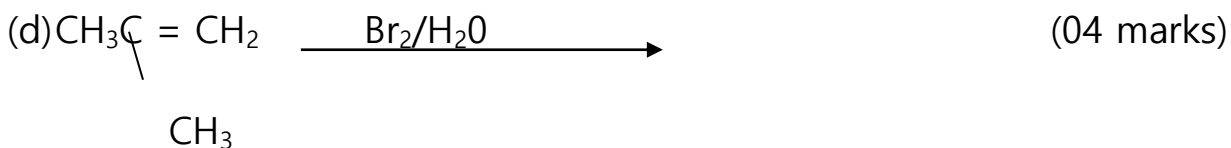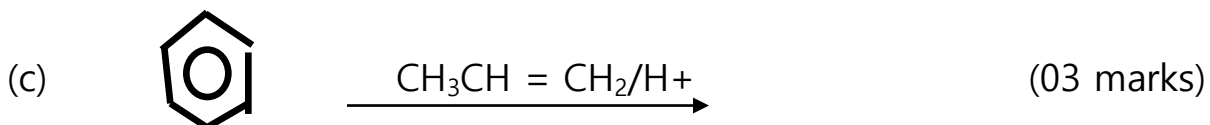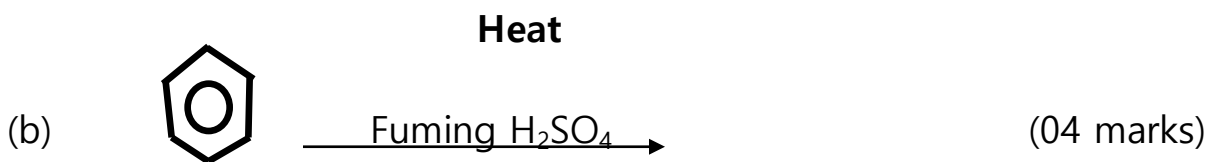Mathematical tables and graph papers are provided.

Non-programmable scientific calculators may be used.

Use equations where necessary to illustrate your answers.

SECTION A: (60 MARKS)

Answer three questions from this section.

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

(a) CH_3CH_2Br $\xrightarrow{CH_3CH_2O^-K^+ \text{ /Ethanol}}$ (02 marks)

(b) $\xrightarrow[\text{Fuming } H_2SO_4]{\text{Heat}}$ (04 marks)

(c) $\xrightarrow{CH_3CH = CH_2/H+}$ (03 marks)

(d) $CH_3\overset{|}{C} = CH_2$ $\xrightarrow{Br_2/H_2O}$ (04 marks)

       CH_3

(e) $+ CH_3COBr$ $\xrightarrow{AlCl_3}$ (04 marks)

(f) $(CH_3)_3C-Br$ $\xrightarrow{CH_3CH_2O^-/CH_3CH_2OH}$ (03 marks)
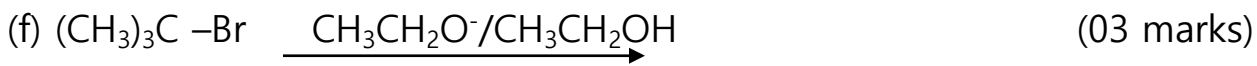
2. (a) Define the term standard enthalpy of combustion. Illustrate your answer using methane. (02 marks)

(b) Describe an experiment to determine enthalpy of combustion of liquid hexane. (Diagram not required) (05 marks)

(c) The standard enthalpies of combustion of some straight chain alkanes are shown in the table below.

Number of carbon atoms	1	2	3	4	7
Enthalpy of combustion of alkanes (kJmol^{-1})	-890	-1560	-2220	-2877	-4800

(i) Plot a graph of enthalpies of combustion of alkanes against the number of carbon atoms. (03 marks)

(ii) Use the graph to determine the enthalpy of combustion of hydrogen and hexane. (02 marks)

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

(d) (i) The standard enthalpy of combustion of carbon is -393 kJmol^{-1}. Calculate the standard enthalpy of formation of hexane. (03 marks)

(ii) From your answer in (d) (i), state whether hexane is a stable compound or not. (½ mark)

(iii) Give a reason for your answer in (d) (ii) (01 mark)

(iv) Apart from being used as a fuel, state *one* other use of hexane. (½ mark)

3. (a) Write the formula and name of the main ore of aluminum. (01 mark)

(b) Describe how:

(i) the ore is purified. (07 marks)

(ii) pure aluminium is obtained from the purified ore. (03 marks)

(c) Describe the reaction of aluminium with;

(i) Sulphuric acid (02 marks)

(ii) sodium hydroxide (02 marks)

(d) State what you will observe and write equation(s) for the reaction(s) that take place when;

(i) sodium carbonate solution is added to an aqueous solution of aluminium sulphate. (02 marks)

(ii) sodium hydroxide solution is added to aqueous aluminium sulphate drop wise until in excess. (02 marks)

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

(ii) Explain what is meant by the term ideal solution. (02 marks)

(b) Benzene (boiling point of 80^0C) and methylbenzene (boiling point of 111^0C) from a liquid mixture that obeys Raoult's law. A liquid mixture was made by dissolving 0.2 moles of benzene in 0.6 moles of methylbenzene at 25^0C. At this temperature, the vapour pressures of benzene and methylbenzene are 1521 mmHg and 570 mmHg respectively. Calculate the;

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

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

(c Nitric acid and water form a non-ideal liquid mixture that deviates negatively from Raoult's law. The azeotropic mixture boils at 120^0C and contains 68% of nitric acid. Its density is $1.42 gdm^{-3}$

(i) Explain why the mixture shows negative deviation from Raoult's law. (03 marks)

(ii) Draw a well-labelled boiling point-composition diagram of the mixture. (03 marks)

(iii) Using the diagram, describe what happens when a liquid mixture containing 50% of each component is distilled. (03 marks)

(iv) Calculate the molar concentration of nitric acid in the azeotropic mixture. (1½ marks)

(v) Calculate the valume of the acid required to prepare $250cm^3$ of a 0.05M solution. (H = 1; O= 16;N= 14) (1½ marks)

SECTION B: (40 MARKS)

*Answer any **two** questions from this section*

5. Explain the following observations.

(a) Oxygen is a gas whereas sulphur is a solid at room temperature. (05 marks)

(b) Group II elements have a higher melting point than group I elements. (03 marks)

(c) The first ionization energy of phosphorus is higher than that of sulphur. (03 marks)

(d) Diamond melts at 4827^0C and silicon melts at 2355^0C although both have similar structures. (04 marks)

(e) When sodium hydroxide solution was added to aluminium sulphate solution, a white precipitate was formed which dissolved in excess sodium hydroxide to form a colourless solution. (05 marks)

6. The elements; beryllium, magnesium, calcium and barium belong to group II of the periodic table.

(a) Describe the reaction of the elements with;

(i)   Water (05 marks)

(ii) Sulphuric acid (07 marks)

(b) Explain the trend in;

(i)   Solubility of their hydroxides   (03 marks)

(ii)   Thermo stability of the carbonates   (03 marks)

(c) Write equation for the reaction between;

(i)   Beryllium oxide and sodium hydroxide   (01 mark)

(ii)   Magnesium chloride and water   (01 mark)

7. (a) What do you understand by the terms:

(i)   Equilibrium constant   (01 mark)

(ii)   Dynamic equilibrium   (01 mark)

(b) Describe an experiment to determine the equilibrium constant for the reaction between ethanoic acid and ethanol.   (07 marks)

(c) When 8.28g of ethanol were heated with 60g of ethanoic acid 49.74g of the acid remained at equilibrium. Calculate the;

(i) value of the equilibrium constant.   (04 marks)

(ii) mass of ester present in the equilibrium mixture formed from 13.8g of ethanol and 12g of ethanoic acid.   (04 marks)

8. (a) When a hydrocarbon company **Y** was completely burnt in air 4.41g of water were formed and the residual gas occupied 16.76dm at room temperature. When the residual gas was passed through concentrated sodium hydroxide solution, the volume decreased to 5dm^3. All volumes being measured at room temperature and pressure.

Determine the;

(i)   Empirical formula of **Y**.   (3½ marks)

(ii)   Molecular formula of **Y** if it has a vapour density of $1.161 \times 10^{-3}\,\text{gcm}^{-3}$.

(b) When $400\,\text{cm}^{-3}$ of a mixture of **Y** and ethane measured at room temperature was bubbled through excess ammoniacal silver nitrate solution, a white precipitate was formed.

(i) Write the equation for the reaction which took place and name the white precipitate.   (02 marks)

(ii) Calculate the percentage by volume of ethane in the mixture if 2.4g of the white precipitate was formed.   (03 marks)

(c) Using equations, while including reagents and conditions, show how **Y** can be converted to the following compounds.

(i) 2-phenylpropane.   (03 marks)

(ii) But-2-yne   (03 marks)

(iii)   Propan-2-ol   (03 marks)

END