P525/2
CHEMISTRY
Paper 2
Nov. / Dec. 2018
2½ hours.

UGANDA NATIONAL EXAMINATIONS BOARD

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**.

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

Begin each question on a fresh page.

Mathematical tables and graph papers are provided.

Non-programmable scientific electronic calculators may be used.

Use equations where necessary to illustrate your answers.

[*H =1; C=12; O =16; Br = 80; S= 32*]

SECTION A: (60 MARKS)

Answer **three** *questions from this section.*

1. (a) A compound **Q** contains 64.9% carbon, 13.5% hydrogen and the rest being oxygen. 1.85 g of **Q** in the vapour form occupied 969.8 cm^3 at 200 °C. *(03 marks)*

(i) Calculate the empirical formula of **Q**. *(03 marks)*

(ii) Determine the molecular formula of **Q**.

(The molar gas constant, $R = 8.31JK^{-1}\ mol^{-1}$)

(b) **Q** reacts with sodium with effervescence but has no effect on sodium carbonate. Write the names and the structures of all possible isomers of **Q**. *(04 marks)*

(c) When treated with anhydrous zinc chloride in the presence of concentrated hydrochloric acid, **Q** formed two layers after about 8 minutes. Identity **Q**. *(01 mark)*

(d) **Q** reacted with acidified chromium trioxide to give a compound **A**. Write equation for the reaction: *(01 mark)*

(i) leading to the formation of **A**.

(ii) between **A** and acidified 2, 4-dinitrophenylhydrazine and outline a mechanism for the reaction. *(4½ marks)*

(e) Write equation to show how **Q** can be prepared from an alkene and outline a mechanism for the reaction. *(3½ marks)*

2. (a) Explain the principle on which steam distillation is based. *(3½ marks)*

(b) State

(i) the conditions necessary for steam distillation. *(03 marks)*

(ii) **one** advantage of steam distillation over fractional distillation. *(01 mark)*

(c) The following data was obtained for the steam distillation of bromobenzene at 760 mmHg pressure.

Temperature (°C)	90	92	94	96	98	100
Vapour pressure of water (mmHg)	526	567	611	658	707	760
Vapour pressure of bromobenzene (mmHg)	96	106	114	123	132	141

(i) On the same axes, plot graphs of vapour pressure of the mixture and of each component against temperature. *(05 marks)*

(ii) Determine the boiling point of the mixture. *(01 mark)*

(iii) Calculate the percentage by mass of bromobenzene in the distillate. *(3½ marks)*

(d) State how a sample of dry bromobenzene can be obtained from the distillate. *(02 marks)*

(e) State **one** other application of steam distillation. *(01 mark)*

3. (a) Explain what is meant by the term.

(i) **Solubility product**. *(03 marks)*

(ii) **Common ion effect**. *(03 marks)*

(b) (i) Describe briefly how the solubility product of magnesium hydroxide in water can be determined. *(06 marks)*

(ii) State how solubility product can be used to predict precipitation or dissolution. *(03 marks)*

(c) The solubility product of calcium sulphate at 25 °C is 2.4×10^{-5} mol^2 dm^{-6}.
Calculate the solubility of calcium sulphate in mol dm^{-3} in:

(i) water. *(02 marks)*

(ii) 0.5M sulphuric acid. *(02 marks)*

(d) State **one** condition under which solubility product is valid. *(01 mark)*

4. The table below shows the melting point of some oxides of elements in Group (IV) of the Periodic Table.

Compound	CO_2	SiO_2	GeO_2	SnO_2	PbO_2
Melting point (°C)	-56.5	1700	1116	1827	752

(a) Explain the trend in the melting points of the oxides. *(5½ marks)*

(b) Compare the reactivity of the oxides with dilute acids and with dilute alkalis. (*Illustrate your answer with equations*). *(6½ marks)*

(c) State what would be observed and write equation for the reaction that would take place if lead(IV) oxide was warmed with concentrated hydrochloric acid. *(3½ marks)*

(d) When sulphur dioxide gas was passed over heated lead(IV) oxide, a white solid was formed. Explain. *(4½ marks)*

SECTION B: (40 MARKS)

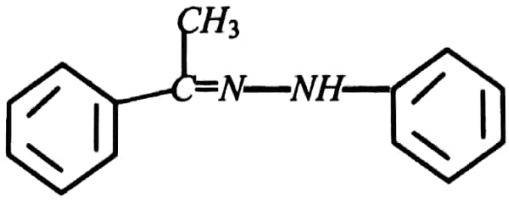
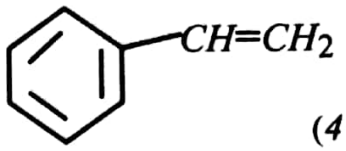
Answer any **two** *questions from this section.*

5. Using equations show how the following conversions can be made. Indicate conditions and the reagents for the reactions.

(a) Benzene from chlorobenzene. *(04marks)*

(b) But–2–yne from butan–2–ol. *(4½ marks)*

(c) $CH_3\ CO\ CH_3$ from $CH_3\ CH_2\ CH_2\ OH$. *(05 marks)*

(d)  from  *(4½ marks)*

(e) $CH_3\ CH_2\ CH_2\ CH_3$ from $CH_3\ CH_2\ OH$. *(02 marks)*

6. In the industrial preparation of sulphuric acid by contact process, sulphur dioxide reacts with oxygen according to the following equation.

$$2SO_2(g) + O_2(g) \rightleftharpoons 2\ SO_3(g) + Heat.$$

(a) Explain what would happen to the concentration of sulphur trioxide if

(i) more sulphur dioxide was added. *(1½ marks)*

(ii) the volume of the reaction vessel was increased. *(1½ marks)*

(iii) the reaction vessel was cooled. *(1½ marks)*

(b) At 700 °C and total pressure of 1.0 atm, the partial pressure at equilibrium for sulphur dioxide and oxygen are 0.27 and 0.41 atm respectively.

Calculate the equilibrium constant, K_p for the reaction. *(03 marks)*

(c) (i) Write equations to show how sulphuric acid can be obtained from sulphur trioxide. *(03 marks)*

(ii) Concentrated sulphuric acid contains 98% by mass of the acid. Calculate the volume of the concentrated sulphuric acid that will be required to make a 0.2M solution of sulphuric acid.
(H = 1; S=32; O = 16; Density of concentrated sulphuric acid $=1.84\ g\ cm^{-3}$)

(03 marks)

(d) Explain what would be observed when concentrated sulphuric acid reacts with

(i) hydrobromic acid. *(03 marks)*

(ii) hydroiodic acid. *(3½ marks)*

7. (a) (i) State the term that refers to formation of soap and write equation for the reaction that leads to the formation of soap. *(2½ marks)*

(ii) Name a locally available raw material from which soap can be prepared. *(½ mark)*

(b) (i) Describe how a sample of solid soap can be prepared in the laboratory starting from the raw material you have named in (a)(ii). *(05marks)*

(ii) Outline how a sample of a soapless detergent can be prepared. (*Your answer should include equations*) *(3½ marks)*

(iii) Explain the cleansing action of soap. *(4½ marks)*

(c) Explain

(i) **one** disadvantage of using soap for washing as opposed to the use of a soapless detergent. *(02 marks)*

(ii) **one** disadvantage of using soapless detergents. *(02 marks)*

8. (a) One of the ores from which copper can be extracted is copper pyrites. Write the formula of copper pyrites. *(01 mark)*

(b) During the extraction of copper from copper pyrites, the ore is concentrated, roasted, smelted and reduced to impure copper, which is then refined to obtain pure copper.

(i) Describe how the copper ore is concentrated. *(03 marks)*

(ii) Write equation for the reaction which takes place during roasting and reduction of the copper ore. *(03 marks)*

(iii) State why the ore is smelted. *(01 mark)*

(iv) Explain what takes place during the refinery process. (*Diagram is not required*) *(03 marks)*

(c) Explain the reaction of aqueous copper(II) sulphate with a solution of

(i) potassium iodide. *(2½ marks)*

(ii) ammonia. *(04 marks)*

(iii) sodium carbonate. *(2½ marks)*

END