Name: ..... Centre/Index No: .....

School..... Signature.....

P525/1
CHEMISTRY
Paper 1
July/August 2024
2 ¾ hours

WAKISSHA JOINT MOCK EXAMINATIONS

Uganda Advanced Certificate of Education

CHEMISTRY

Paper 1

2 hours 45 minutes

Instructions to Candidates

- *Attempt **all** questions in section **A** and any **six** questions from section **B**.*
- *All questions are to be answered in the spaces provided.*
- *A Periodic Table with relevant atomic masses is supplied at the end of the paper.*
- *Mathematical tables (3 figures) and non-programmable silent scientific calculators may be used.*
- *Illustrate your answers with equations where applicable.*
- *Molar gas volume at s.t.p = 22.4 dm^3*

For Examiner's Use Only																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total

SECTION A (46 MARKS)

Attempt **all** questions in this section.

1. Electrode potentials for some half-cells are given below.

Table 1

Half cell	E^{θ}(V)
$Zn^{2+}(aq)/Zn(s)$	-0.76
$Cr_2O_7^{2-}(aq),\ H^+(aq), Cr^{3+}(aq)/Pt$	+1.33

(a) Write the cell notation for the cell formed when the two half-cells are connected. (01 mark)

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(b) Write an equation for the overall cell reaction. (1½ marks)

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(c) (i) Calculate the free energy change of the cell. (1F = 96500C) (02 marks)

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(ii) State whether the cell reaction is feasible or not.
Give a reason for your answer. (01 mark)

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2. 2-phenylpropane when oxidized in air at 5 atm formed liquid Q which reacts with dilute sulphuric acid to form compounds X and Y. Compound Y forms a crystalline white precipitate on addition of a saturated solution of sodium hydrogensulphite.

(a) Identify;

(i) X: .....

..... (01 mark)

(ii) Y: ..... (01 mark)

(iii) White precipitate..... (01 mark)

(b) Name the reagent that can be used to confirm compound X. (01 mark)

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(c) State what would be observed when the reagent named in (b) above is added to X. (01 mark)

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3. (a) Red lead oxide (Pb_3O_4) was shaken with dilute nitric acid and the resultant mixture filtered. Identify the;

(i) cation in the filtrate. (½ mark)

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(ii) residue (½ mark)

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(b) Write an equation for the reaction that took place. (1½ mark)

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(b) Potassium iodide solution was added to the filtrate in (a) above;

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

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(ii) Write an equation for the reaction that took place. (1½ marks)

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4. (a) Write the;

(i) equation for the hydrolysis of ammonium sulphate in water. (01 mark)

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(ii) expression for the hydrolysis constant, K_h for ammonium sulphate. (01 mark)

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(b) (i) The pH of 20 cm^3 of 0.05M ammonium sulphate solution at 25 °C was found to be 5.125

Calculate the hydrolysis constant of ammonium sulphate. (03 marks)

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(ii) State the assumptions you have made in b(i) above. (01 mark)

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Turn Over

5. State what would be observed and write equation(s) for the reaction(s) that would take place when the following pairs of substances are mixed.

(a) $HO-CH_2COOH$ and phosphorous (V) chloride.

Observation: (½ mark)

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Equation: (01 mark)

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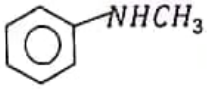
(b)  and an ice-cold mixture of sodium nitrite and concentrated hydrochloric acid.

Observation: (½ mark)

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Equation: (01 mark)

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(c) Cobalt (II) sulphate solution and excess concentrated hydrochloric acid.

Observation: (½ mark)

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Equation: (01 mark)

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6. The melting points of some fluorides of period 3 elements of the Periodic Table are shown in table 2.

Table 2:

Formula of fluoride	NaF	AlF_3	SiF_4
Melting point (°C)	993	1290	-90.2

(a) State the trend in the melting points of the fluorides. (01 mark)

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(b) Explain your answer in (a). (04 marks)

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7. The empirical formula of compound **R** is **CHO**. 20 cm^3 of **R** were mixed with 110 cm^3 of oxygen and the mixture exploded. The residual gas was cooled to room temperature and on absorption by concentrated potassium hydroxide, there was a contraction of 80 cm^3.

(a) Calculate the molecular formula of **R**. (2½ marks)

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(b) **R** decolourises bromine water and reacts with sodium carbonate solution with effervescence.
Write the structural formulae and IUPAC names of two geometric isomers of **R**. (03 marks)

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8. (a) Define the term **standard enthalpy of combustion.** (01 mark)

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(b) The enthalpies of combustion of some substances are shown in table 3.

Table 3:

Substance	Enthalpy of combustion ($KJmol^{-1}$)
Carbondisulphide	-1108.8
Carbon	-393.5
Sulphur	-296.8

Calculate the enthalpy of formation of carbon disulphide. (03 marks)

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(c) Comment on the stability of carbondisulphade. Give a reason for your answer. (01 mark)

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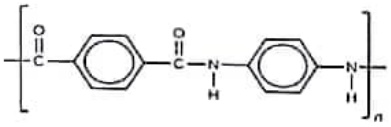
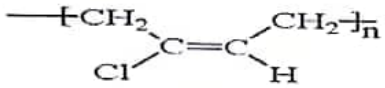
9. The molecular structures of two polymers; Kevlar and Neoprene are shown below.

Kevlar 

Neoprene 

(a) Name the type of polymer.

(i) Kevlar (½ mark)

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(ii) Neouprene (½ mark)

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(b) Write the structural formula(e) of the monomer(s) of;

(i) Kevlar (01 mark)

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(ii) Neouprene (½ mark)

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(c) State one use of each of the polymers above. (02 marks)

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SECTION B (54 MARKS)

Attempt any **six** questions from this section.

Any additional question(s) answered will **not** be marked.

10. (a) Zinc is extracted from zinc blende.

(i) State **one** method by which the ore can be concentrated. (½ mark)

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(ii) Write equation(s) to show how zinc is obtained from the concentrated ore. (02 marks)

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(b) Zinc dust was added to an alkaline aqueous solution containing nitrate ions.

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

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(ii) Write an ionic equation for the reaction that took place. (1½ marks)

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(c) 1.50 g of an ore of zinc were dissolved in excess concentrated ammonia and the resultant solution shaken with trichloromethane. The concentrations of ammonia in the aqueous layer and trichloromethane layer at equilibrium were 0.08 $moldm^{-3}$ and 0.0025 $moldm^{-3}$ respectively at 25 °C.
Calculate the percentage by mass of zinc in the ore.
(Partition coefficient, Kp of ammonia between water and trichloromethane is 25)
(04 marks)

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11. (a) Hydrogen peroxide oxidises iodide ions according to the equation.

$$H_2O_2(aq) + 2H^+(aq) + 3I^-(aq) \longrightarrow 2H_2O(s) + I_3^-(aq)$$

The rate of reaction is **independent of the concentration of hydrogen** ions and the reaction is **first order** with respect to hydrogen peroxide.
Given the kinetic data in the table 1 below obtained at 25°C.

Table 1:

$[H_2O_2]moldm^{-3}$	$[I^-]$ $moldm^{-3}$	$[H^+]$ $moldm^{-3}$	Initial rate $moldm^{-3}S^{-1}$)
0.025	0.02	0.50	5.20×10^{-3}
0.05	0.04	1.00	2.08 x 10-2

(i) State two methods by which the rate of reaction above can be determined. (02 marks)

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(ii) Determine the rate equation for the reaction. (02 marks)

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(iii) Calculate the value of the rate constant and state its units. (1½ marks)

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(b) One of the experiments in Table 1 was repeated at 40 °C using the same concentrations of all reactants.

(i) State the effect on the value of the rate constant in a(iii) above. (01 mark)

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(ii) Explain your answer in b(i) (2½ marks)

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12. Write a mechanism to show how each of the following conversions can be effected.

(a) $CH_3CH(OH)CH_3$ to $CH_3CH(I)CH_3$ (03 marks)

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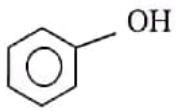
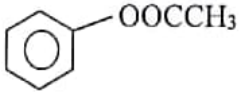
(b)  to  (03 marks)

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(c) $CH_3CH(Br)CH_2Br$ to $CH_3C \equiv CH$ (03 marks)

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13. Explain each of the following observations.

(a) When anhydrous aluminium chloride is exposed to moist air, misty fumes are formed. (03 marks)

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(b) Aqueous solutions of Copper (I) salts are colourless while solutions of Copper (II) salts are coloured. (03 marks)

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(d) When hydrogen sulphide gas is bubbled into acidified ammonium dichromate solution, the orange solution turns green and a yellow precipitate is formed. (03 marks)

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14. (a) Fluorine and Iodine belong to group VII of the Periodic Table. Explain why;

(i) Fluorine and Iodine have different physical states at room temperature. (2½ marks)

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(ii) Fluorine reacts directly with carbon while Iodine does not. (02 marks)

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(b) Write an equation for the reaction between;

(i) Fluorine and water. (1½ marks)

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(ii) Iodine and hot concentrated sodium hydroxide solution. (1 ½ marks)

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(iii) hydride of Iodine and excess concentrated sulphuric acid. (1½ marks)

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15. Lead (II) Iodide is sparingly soluble in water.

(a) Write the;

(i) equation for the solubility of Lead (II) iodide in water. (01 mark)

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(ii) expression for the solubility product, Ksp of Lead (II) iodide. (01 mark)

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(b) The solubility product of Lead (II) iodide is 1.39×10^{-8} mol^3dm^{-3} at 25 °C. Calculate the solubility of Lead (II) iodide in gdm^{-3}. (03 marks)

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(c) Explain how the solubility of lead (II) iodide would be affected if to its saturate solution;

(i) a few drops of potassium iodide are added. (02 marks)

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(ii) magnesium ribbon is added. (02 marks)

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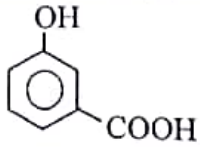
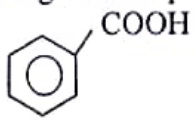
16. (a) The structural formulae of two aromatic organic compounds are



and



(i) Name the reagent(s) that can be used to distinguish between the compounds. (01 mark)

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(ii) State what would be observed when each compound is separately treated with the reagent in a(i) above. (02 marks)

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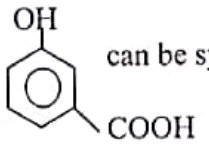
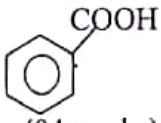
(b) Using equations only, show how 

can be synthesized from 

(04 marks)

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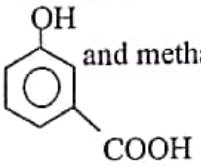
(c) A mixture of 

and methanol was heated in the presence of sulphuric acid.

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

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(ii) Write an equation for the reaction that took place. (01 mark)

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17. (a) The vapour pressures of acetone and benzene are 30 Kpa and 12.68 kPa at 25 °C respectively. A solution containing 20% acetone and 80% benzene at 25 °C exerted a vapour pressure of 18.00 Kpa.

(i) Calculate the vapour pressure above the solution assuming it is ideal. (03 marks)

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(ii) State the type of deviation from ideal behaviour shown by the solution of acetone and benzene. Give a reason for your answer. (02 marks)

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(b) Sketch a well labelled boiling point composition diagram for the mixture of acetone and benzene. (03 marks)

(d) State **one** method by which an azeotropic mixture of acetone and benzene can be separated. (01 mark)

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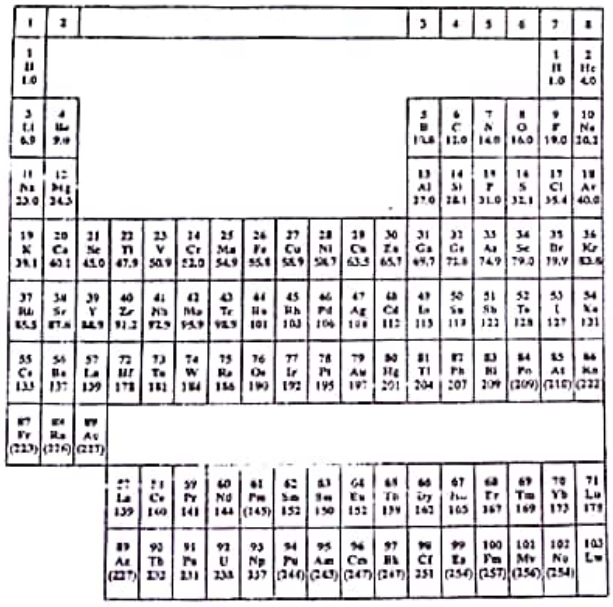
THE PERIODIC TABLE



1. I ← Indicates atomic number.
   II

2. II
   1.0 ← Indicates relative atomic mass.

END