Name:…….. Index No. ……

P525/1
CHEMISTRY
Paper 1
June/July 2022
2¾ hours

MWALIMU EXAMINATIONS BUREAU

UACE RESOURCE MOCK EXAMINATIONS – 2022

CHEMISTRY

PAPER 1

TIME: 2Hours 45 minutes

INSTRUCTIONS TO CANDIDATES;

- Answer **all** questions in section **A** and **six** from section **B**.
- All questions must be answered in the spaces provided.
- The Periodic Table, with relative atomic masses, is attached at the end of the paper.
- Where necessary, use the following;
  Molar gas constant $R=8.314JK^{-1}mol^{-1}$
  Molar volume of a gas at s.t.p is 22.4 litres.
  Standard temperature = 273 K
  Standard pressure = 101325 Nm^2

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

SECTION A (46 MARKS)
Answer all questions from this section

1. (a) The following equations shows part of the radioactive decay thorium.

$$^{234}_{90}Th \longrightarrow {}^{234}_{91}Th \xrightarrow{\alpha} X$$

(i) Name the particle emitted in the first stage of the decay process. (0½ mk)

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(ii) Identify X. (0½ mk)

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(b) The activity of $^{234}_{90}Th$ reduced to 25% in 50 days. Determine the half-life of $^{234}_{90}Th$. (2 mks)

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2. State what is observed and write equation(s) for the reaction(s) that would take place when

(a) aqueous ammonia was added drop wise until in excess to nicked(II) nitrate solution. (03mks)

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(b) dilute sulphuric acid was added to copper(I) oxide. ($2^1/_2$mks)

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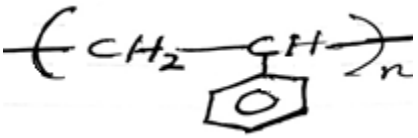
3. Polystyrene is an addition polymer with the following structure:



(a) What is meant by the term **addition polymer**. (01 mk)

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(b) Write the IUPAC name and structural formula of the monomer in polystyrene. (01 mk)

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(c) The osmotic pressure of a solution containing 1.24% polystyrene is $2.356\times\ 10^{-2}\ mmHg$ at 25℃.
Calculate the

(i) relative molecular mass of polystyrene. ($2^1/_2$mks)

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(ii) number of monomer units in polystyrene. (1½ mks)

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(d) State **one** use of polystyrene. (0½ mk)

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4. Name **one** reagent that can be used to distinguish between members of the following pairs of compounds. In each case state what would be observed if each member of the pair is separately treated with the reagent you have named.

(a) HCOOH and CH_3COOH. (03mks)

Reagent:

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Observation

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(b) CH_3OH and CH_3CH_2OH. (03mks)

Reagent:

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Observation

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5. (a) State **two** factors that can affect the magnitude of lattice energy. (01 mk)

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(b) The standard enthalpy changes for some processes are given below:

Process	$\Delta \boldsymbol{H^{\theta}(kJ\ mol^{-1})}$
Ca(s) ⟶ Ca(g)	+193
½F_2(g) ⟶ F(g)	+79
F(g)+e^- ⟶ $F^-(g)$	-348
Ca(g)+ F_2(g) ⟶ CaF_2(s)	-1214
Ca(g)⟶ Ca^+(g)+ e^-	+590
Ca^+(g)⟶ Ca^{2+}(g)+ e^-	+1150

(i) Draw a Born Haber cycle for the formation of calcium fluoride using the above given values. (03mks)

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(ii) Use the cycle in (b)(i) to determine the lattice energy of calcium fluoride. (1½ mks)

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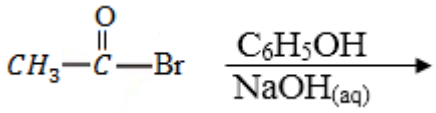
6. Complete the following equations and in each case, write a mechanism for the reactions. (03mks@)

(a)



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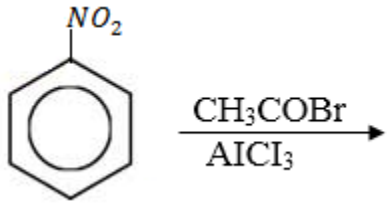
(b)



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7. The melting points of chlorides of some of the elements in Period 3 in the Periodic Table are given in the table below.

Formula of chloride	NaCl	$AlCl_3$	PCl_5	S_2Cl_2
Melting point (°C)	801	180	162	-76

(a) State the trend in melting points of the chlorides. (01 mk)

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(b) Explain your answer in (a). (03mks)

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8. (a)Using equations only, show how ammonia can be converted into nitric acid. Name the catalyst used in the process. (3½ mks)

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(b) State **one** large scale use of nitric acid. (0½ mk)

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9. (a) What is meant by **steam distillation**. (01 mk)

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(b) State **three** properties of a substance which enable it to be separated from impurities by steam distillation.

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(c) A mixture of naphthalene ($C_{10}H_8$) and water distils at 98.3℃ and 753 mmHg. Calculate the percentage by mass of naphthalene in the distillate. (The vapour pressure of water at 98.3℃ is 715 mmHg) (03 mks)

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(d) State **one** advantage of isolating substances by steam distillation.(0½ mk)

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SECTION B (54 MARKS)

Answer **six** questions from this section.

10. Write equation(s) to show how the following conversions can be effected.

(a) Bromoethane to ethane-1,2-diol. (2½ mks)

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(b) Nitrobenzene to iodobenzene (03 mks)

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(c) Butan-1-ol to methane CH_4 (3½ mks)

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11. The pH values of solutions obtained during the titration of sodium hydroxide solution against 25 cm^3 of 0.1M ethanoic acid are given below.

Volume of NaOH (cm^3)	0	6.0	10.0	14.0	15.0	15.4	16.0
pH	2.8	4.2	5.1	5.5	9.0	10.5	11.4

(a) Plot a graph of pH against volume of sodium hydroxide. (03mks)
(*Use the graph paper provided*)

(b) Use your graph in (a) to determine the;

(i) volume of sodium hydroxide required to neutralise ethanoic acid. (0½ mks)

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(ii) pH at equivalence point. (0½ mk)

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(c) Calculate

(i) the molar concentration of sodium hydroxide. (2½ mks)

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(ii) the ratio of $[CH_3COO^-]$: [CH_3COOH] when 5.0 cm^3 of sodium hydroxide solution has been added to 25.0 cm^3 of 0.1M ethanoic acid. (K_a of ethanoic acid at 25℃ is $1.8\ x\ 10^{-5}\ moldm^{-3}$)
($2^1/_2$mks)

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12. Magnesium, aluminium and sulphur are some of the elements in period 3 of the Periodic Table. State the conditions and write equations for the reaction(s) if any between each of the elements and

(a) water. (02 mks)

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(b) nitric acid. (07 mks)

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13. (a)State **three** characteristic of chemical equilibrium. (1½ mks)

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(b) Hydrogen iodide decomposes on heating according to the following equation.

$2HI(g) \rightleftharpoons I_2(g) + H_2(g)$

Write the equation for the equilibrium constant, Kc for the reaction. (0½ mk)

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(c) 3.4 g of hydrogen iodide were heated at 450℃ in a glass bulb of volume 800 cm^3. When equilibrium was attained, the bulb was rapidly cooled to room temperature then broken under a solution of potassium iodide. The iodine formed required 36.0 cm^3 of 0.2M sodium thiosulphate solution for the complete reaction using starch indicator.

Calculate the equilibrium constant, Kc for the reaction at 450℃.(4½ mks)

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(d) State what would happen to the position of the equilibrium if:

(i) the bulb was cooled from 450℃ to 250℃. (01 mk)

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(ii) the volume of the bulb was doubled. (01 mk)

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(iii) pressure was increased. (0½ mk)

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14.(a)An organic compound **Y** contains 68.8% carbon, 4.92% hydrogen and the rest being oxygen.

(i) Calculate the empirical formula of **Y**. (1½ mks)

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(ii) The vapor density of Y is 61. Determine the molecular formula of **Y**.

(01 mk)

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(b) **Y** burns with a sooty flame and its aqueous solution has pH <7. Identify **Y**. (0½ mks)

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(c) Write equation.

(i) for the reaction between **Y** and methanol. Indicate the conditions for the reaction. (01 mks)

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(ii) to show how **Y** can be obtained from phenylmagnesium bromide. (1½ mks)

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(c) Outline the mechanism for the reaction in (c)(i). (3½ mks)

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15.(a)State

(i) what is meant by the term **diagonal relationship**. (01 mk)

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(ii) **four** properties in which beryllium shows similarity to aluminium. (04 mks)

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(b) Give a reason why the elements exhibit diagonal relationship. (01 mk)

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(c) Write equations for the reaction between water and

(i) beryllium carbide. (1½ mks)

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(ii) calcium carbide. (1½ mks)

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16. A compound **B** decomposes according to the following equation.

$2\mathbf{B} \longrightarrow$ products

Time (minutes)	2.0	4.0	7.0	10.0	14.0	20.0
Concentration of $\boldsymbol{B}$ $(mol\ l^{-1})$, $[\boldsymbol{B}]$	0.820	0.670	0.490	0.372	0.240	0.141

(a) Draw a graph of $\log_{10}[B]$ against time. (04 mks)
(*Use the graph paper provided*)

(b) Using the graph, determine the:

(i) original concentration of B. (01 mk)

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(ii) order of the reaction. (01 mk)

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(c) Calculate

(i) the rate constant for the reaction. (02 mks)

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(ii) the half-life of the reaction. (01 mk)

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17. In the extraction of zinc from zinc blende, the ore is first concentrated and then roasted in air. The roasted material is then heated with coke and limestone to produce impure zinc.

(a) Write the formula of zinc blende. (0½ mk)

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(b) Name

(i) **two** impurities in the ore whose formula you have written in (a). (01 mk)

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(ii) the process by which the ore can be concentrated. (0½ mk)

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(b) State the purpose of adding

(i) coke. (0½ mk)

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(ii) limestone. (0½ mk)

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(c) Write equation for the reaction

(i) that takes place when the ore is roasted. (1½ mks)

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(ii) in which the ore is converted to zinc in the blast furnace. (01 mk)

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(d) Zinc dust was added to hot concentrated sodium hydroxide solution.

(i) State what was observed. (1½ mks)

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

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(e) State **one** large scale use of zinc. (0½ mk)

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END