INTERNAL MOCK EXAMINATIONS, 2022

Uganda Advanced Certificate of Education

CHEMISTRY

PAPER 2

2 hours 30 minutes

INSTRUCTIONS TO THE CANDIDATES

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

Write the answers in the answer booklet provided.

Mathematical tables and graph papers are provided.

Begin each question on a fresh page.

Non-programmable scientific electronic calculators may be used.

Illustrate your answers with equations where applicable.

Indicate the questions in the grid below.

Where necessary use $C = 12$, $O = 16$, $H = 1$, $Ca = 40$, $Ag = 108$, $P = 31$

Question						Total
Marks						

1. An organic compound T on complete combustion yielded 13.2g of carbon dio
and 2.7g of water. When 4.7g of T was vaporized at $273°C$ and at 760mmHg , it
occupied a volume of $2.7 \times 10^{-3} m^3$.

(a) (i) Calculate empirical formula of T (02marks)

(ii) Determine the molecular formula of T (2½marks)

(b) T burns with a sooty flame. Identify T. (0½mark)

(c) Discuss the reactions of T with

(i) Bromine (4½marks)

(ii) Propene (4½marks)

(iii) Ethanoyl bromide (4½marks)

(You answer should include conditions for the reactions and mechanism
for the reactions where possible)

(d) Write equation to show how T can be synthesized from benzaldehyde
(1½marks)

2. (a) What is meant by the terms.

(i) order of reaction (01mark)

(ii) half –life of a reaction (01mark)

(b) The rate equation for the reaction.

$S_2O_3^{2-}$ (aq) $+2H^+$ (aq) $\longrightarrow$ SO_2 (g) $+S$ (s) $+ H_2O$(l) is

Rate $= k [S_2O_3^{2-}][H^+]^2$

(i) State how the rate will be affected if the concentrations of the
reactants are both doubled. (02mark)

(ii) Describe an experiment to determine the order of the reaction wi
respect to $S_2O_3^{2-}$ in the laboratory. (06marks)

(c) The table below shows the kinetic data for the reaction between hot aqueous potassium hydroxide and alkylbromide(C_4H_9Br)

$$C_4H_9Br \ (l) \ + \ KOH \ (aq) \longrightarrow C_4H_9OH \ (aq) + KBr(aq)$$
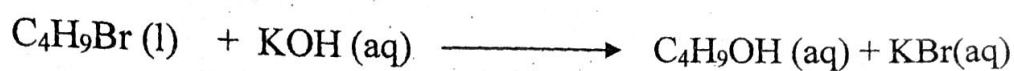
Experiment	[C_4H_9Br] (moldm^{-3})	[KOH(aq)] (moldm^{-3})	Initial rate (moldm^{-3}s^{-1})
1	1.0×10^{-3}	1.0×10^{-3}	5.0×10^{-8}
2	2.0×10^{-3}	1.0×10^{-3}	1.0×10^{-7}
3	2.0×10^{-3}	2.0×10^{-3}	2.0×10^{-7}

   (i)   determine the overall order of reaction.   (01mark)

   (ii)   determine the rate constant for the reaction and state its units.

                                                                      (02marks)

   (iii) identify the aklybromide.   (0½marks)

(d) Write the mechanism for the reaction in (c) above.   (3½marks)

(e) Draw a well labelled energy level diagram for the reaction mechanism illustrated in (d) above.   (03marks)

3. Carbon ,silicon , germanium , tin and lead are elements of Group (IV) of the Periodic Table .

   (a) Write the electronic configuration of the outer most energy level of group(IV) elements.   (01marks)

   (b) Describe how :

       (i)   carbon , silicon and lead react with water.   (06marks)

       (ii) oxides of the elements in b(i)react with sodium hydroxide.
                                                                      (08marks)

(c) Dilute nitric acid was added to trileadtetraoxide (Pb_3O_4) and the mixt...
warmed.

(i) State what would be observed. (01mark)

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

(d) The resultant mixture in (c) above was filtered and the residue was added to a solution of manganese(II) sulphate followed by few drops of concentrated nitric acid and the mixture warmed.

(i) State what would be observed. (01mark)

(ii) Write equation for the reaction. (1½marks)

4. (a) What is meant by the term **standard electrode potential**?
(01mark)

(b) (i) State and explain **two** factors that affect electrode potential of a metal. (03marks)

(ii) Describe how the standard electrode potential of iron can be determined in the laboratory. (07marks)

(c) The standard reduction potentials of some half- cells are given in the table below.

Half –cell reaction	Standard lectrode potential (V)
A: $Fe^{2+}(aq) + e \longrightarrow Fe(s)$	-0.44
B: $Cr_2O_7^{2-}(aq) + 6e + 14H^+(aq) \longrightarrow Cr^{3+}(aq) + 7H_2O(l)$	+1.33
C: $MnO_4^-(aq) + 5e + 8H^+(aq) \longrightarrow Mn^{2+}(aq) + 4H_2O(l)$	+1.52
D: $Cl_2(g) + 2e \longrightarrow 2Cl^-(aq)$	+1.36

(i) State which species is the

- strongest reducing agent. (0½marks)
- strongest oxidizing agent. (0½marks)

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(ii) Write the cell convention for the cell formed by combining the following half – cells:

- A and B   (01marks)
- C and D   (01marks)

(iii) State what would be observed at the cathode in each of the cells in (ii) above.   (02marks)

(iv) Draw a labelled diagram for the cell formed by combining **B** and **C**.   (03marks)

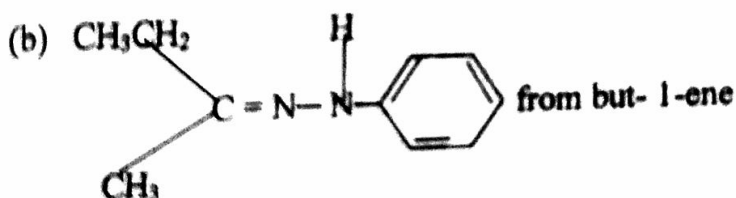(v) Calculate the standard free energy for the cell in (iv) above. (02marks)

SECTION B

Attempt any two questions from this section.

5. Write equations to show how the following conversions can be effected.
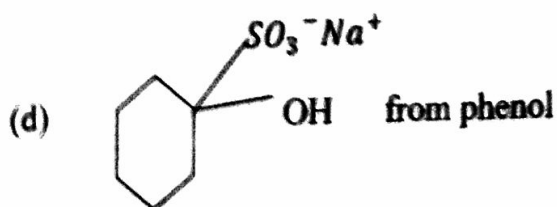
(a) bromobenzene from nitrobenzene   (05marks)

(b) CH_3CH_2

C = N— N— $\bigcirc$ from but- 1-ene   (05marks)

CH_3

(c) Aminoethane from propanal   (05marks)

$SO_3^-Na^+$

(d) $\bigcirc$ — OH   from phenol   (05marks)

6. (a) (i) What is meant by the term standard **enthalpy of combustion?** (01mark)

    (ii) Describe an experiment that can be carried out to determine the enthalpy of combustion of liquid cyclohexane.
    (Diagram **not** required) (05marks)

(b) The standard enthalpies of combustion of the first five straight chain alkanes and alcohols are shown in the table below.

Number of carbon atoms (n)	0	1	2	3	4	5
Enthalpy of combustion of alkanes , $-\Delta H_c$ (kJmol^{-1})	286	890	1560	2220	2877	3509

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

    (03marks)

    (ii) Use the graph to determine the enthalpy of combustion of hexane. (02mark)

    (ii) Explain the shape of the graph. (04marks)

(d) The enthalpies of combustion of some substances are given in the table below:

Substance	Standard enthalpy of combustion, ΔH, (kJmol^{-1})
Hydrogen	-285
Benzene	-3280
Cyclohexene	-3725
Cyclohexane	-3920

    (i) Calculate the enthalpy of hydrogenation of cyclohexene and benzene. (03marks)

    (ii) Comment on your answer in (d)(i) (02marks)

7. Explain each of the following observations

    (a)   When solid iodine crystals were added to s dilute sodium hydroxide solution , the grey solid dissolves to form a pale yellow solution which turns colourless on standing.   (04marks)

    (b)   When ammonium sulphate solution was mixed with sodium sulphite solution and the mixture warmed, there was effervescence of a colourless gas that turns moist ~~red~~ litmus paper ~~blue~~.red.   (04mark)

    (c)   When a mixture of anhydrous zinc chloride and concentrated hydrochloric acid was added to 2- methylpropan- 2- ol , immediate cloudiness was formed but there no observable change at room temperature if the same reagent was treated with propan- 1- ol.   (04marks)

    (d)   When aluminium was added to concentrated sodium hydroxide solution , the metal dissolved with effervescence of a colourless gas that burnt with a pop sound..   (04marks)

    (e)   When methanoic acid was warmed with Fehling's solution a red precipitate was formed whereas with ethanoic acid , there was no observable change.   (04marks)

8.   (a)   (i)   What is meant by the term **ore**?   (01mark)

            (ii)   Write the formula and name of **one** ore from which zinc is extracted.   (01marks)

    (b)   Describe how pure zinc can be extracted from the ore in (a)(ii) above.   (07marks)

    (c)   Discuss the reactions of zinc with
            (i)   air
            (ii)   sulphuric acid   (7½marks)
            (iii)   sodium hydroxide

    (d)   Ammonia solution was added to zinc sulphate solution drop-wise until in excess.
            (i)   State what would be observed.   (01mark)

            (ii)   Write equation(s) for the reaction.   (2½marks)

END