

P525/ 2
CHEMISTRY
Paper 2
June /July 2019
2½hours

MOCK EXAMINATIONS, 2019

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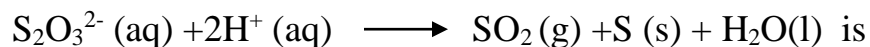
Marks						
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1. An organic compound **T** on complete combustion yielded 13.2g of carbon dioxide and 2.7g of water. When 4.7g of **T** was vaporized at 273°C and at 760mmHg, it occupied a volume of $2.7 \times 10^{-3} m^3$.

- (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 mechanisms 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)

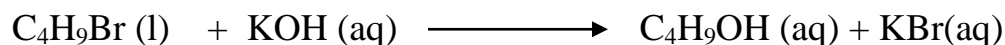
- (b) The rate equation for the reaction.



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

- (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 with 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)



Experiment	$[C_4H_9Br]$ ($mol\,dm^{-3}$)	$[KOH(aq)]$ ($mol\,dm^{-3}$)	Initial rate ($mol\,dm^{-3}\,s^{-1}$)
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 alkylbromide. (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 mixture 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: $\text{Fe}^{2+}(\text{aq}) + \text{e} \longrightarrow \text{Fe}(\text{s})$	-0.44
B: $\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 6\text{e} + 14\text{H}^+(\text{aq}) \longrightarrow \text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$	+1.33
C: $\text{MnO}_4^-(\text{aq}) + 5\text{e} + 8\text{H}^+(\text{aq}) \longrightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$	+1.52
D: $\text{Cl}_2(\text{g}) + 2\text{e} \longrightarrow 2\text{Cl}^-(\text{aq})$	+1.36

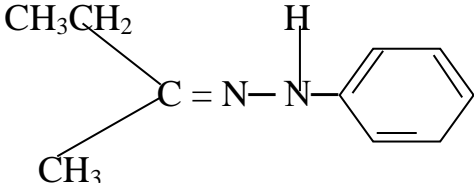
- (i) State which species is the
- strongest reducing agent. (0½marks)
 - strongest oxidizing agent. (0½marks)
- (ii) Write the cell convention for the cell formed by combining the following half – cells:
- **A** and **B** (01marks)
 - **C** and **D** (01marks)
- (iii) State what would be observed at 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

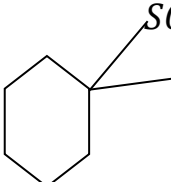
Attempt any **two** questions from this section.

5. Write equations to show how the following conversions can be effected.

(a) bromobenzene from nitrobenzene (05marks)

(b)  from but-1-ene (05marks)

(c) Aminoethane from propanal (05marks)

(d)  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	0	1	2	3	4	5
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atoms (n)						
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 a 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. (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 was 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
 - (iii) sodium hydroxide (7½marks)
- (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