

ST. MARYS' KITENDE
Uganda Advanced Certificate of Education
RESOURCEFUL MOCK EXAMINATIONS 2020
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 $C = 12$, $O = 16$, $H = 1$
- Molar gas volume is 22.4dm^3 at s.t.p
- $1 \text{ atmosphere} = 101325\text{Nm}^{-2}$

Question						Total
Marks						

SECTION A

Attempt only **three** questions.

1. (a) Write the electronic configuration of manganese
(Atomic number = 25) (01mark)
- (b) Explain why manganese is
- (i) a transition element. (01mark)
 - (ii) has variable oxidation states. (02marks)
 - (iii) has a high melting point (1890°C) compared to calcium with melting point (860°C) (03marks)
- (c) Describe how manganese reactions with
- (i) water (2½marks)
 - (ii) sulphuric acid (4½marks)
- (d) Aqueous sodium hydroxide solution was added to manganese(II) sulphate solution dropwise until in excess and the resultant mixture allowed to stand.
- (i) State what was observed. (1½marks)
 - (ii) Write equation (s) for the reaction(s) that took place. (03marks)
- (e) Write equation for the reaction between trimanganese tetroxide (Mn_3O_4) and aluminium (1½marks)

2. The table below shows the variation in pH when 30cm³ of 0.2M ammonia solution was titrated with hydrochloric acid .

Volume of HCl added (cm ³)	0	4	8	12	16	18	19	19.4	19.8
pH	10.8	9.9	9.4	9.1	8.7	8.3	8.0	7.8	7.3

20.2	20.6	21	22	26	28
3.9	3.5	3.2	2.9	2.5	2.4

- (a) Plot a graph of pH against volume of hydrochloric acid. (04marks)
- (b) Use the graph to determine the:
- (i) pH and volume at the end point. (02marks)
 - (ii) molarity of hydrochloric acid (02marks)
 - hydrolysis constant of ammonium chloride formed at the end point. (3½marks)
 - (iii) ratio of $[\text{NH}_4\text{Cl}]$: $[\text{NH}_3]$ when 10cm³ of hydrochloric acid has been added to ammonia solution. (2½marks)
- (K_b for ammonia = $1.78 \times 10^{-5} \text{mol dm}^{-3}$, $K_w = 1 \times 10^{-14} \text{mol}^2 \text{dm}^{-6}$)
- (c) Explain the shape of the graph. (05marks)

- (d) Which of the indicators shown below is suitable for the titration. Give a reason for your answer.

Indicator	pH range
Thymol blue	1.2 – 2.8
Methyl orange	3.1 – 4.4
Methyl red	4.2 – 6.3
Phenolphthalein	8.3 – 10.0

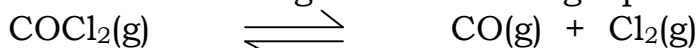
3. When 7.5g of an organic compound **Q** was burnt completely in excess oxygen, 11.2dm³ of carbon dioxide and 4.5g of water were formed at s.t.p.

- (a) (i) Calculate the empirical formula of **Q**. (3½marks)
(ii) Determine the molecular formula of **Q** (02mark)
(Density of **Q** is 5.357gdm⁻³ at s.t.p)
- (b) **Q** burns with a sooty flame and forms a yellow precipitate with 2,4-dinitrophenylhydrazine and also forms a pale yellow precipitate with iodine solution in sodium hydroxide solution. Identify **Q**. (0½mark)
- (c) Write equation and suggest a mechanism for the reaction between **Q** and
(i) 2,4- dinitrophenylhydrazine in acidic medium. (4½marks)
(ii) sodium hydrogen sulphite solution (03marks)
- (d) Using equations only show how **Q**
(i) can be synthesized from benzaldehyde (04marks)
(ii) can be converted to an alkene (2½marks)

4. (a) (i) State Le Chatelier's principle. (01mark)
(ii) State **two** factors that affect equilibrium reactions apart from catalyst. (02marks)
(iii) Briefly describe how each of the factors you have named in(a)(i) affect the equilibrium constant and equilibrium position. (05marks)

- (b) Given the reaction
- $$\text{Ni(CO)}_4(\text{g}) \rightleftharpoons \text{Ni(s)} + 4\text{CO(g)}$$
- (i) Write the expression for the equilibrium constants K_c and K_p giving units in each case. (03marks)
(ii) What is the effect on position of equilibrium of adding a catalyst. (01mark)

- (c) COCl_2 dissociates according to the following equation.



- (i) At 25°C , one mole of COCl_2 was placed in 2dm^3 vessel producing an equilibrium mixture with 20.25% chlorine. Calculate the value of the equilibrium constant K_c at this temperature. (03marks)
- (ii) At 75°C , the degree of dissociation of 2 moles of COCl_2 in the same 2dm^3 vessel was found to be 15% . Calculate the value of the equilibrium constant K_c at this temperature. (03marks)
- (iii) From your answer in (c)(i) and (c) (ii) above, state whether the reaction is exothermic or endothermic. Give a reason for your answer. (02marks)

SECTION B

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

5. Write equations to show how the following conversions can be effected.
 - (a) Bromo benzene from phenol (3½marks)
 - (b) Propanal from chloroethane (05marks)
 - (c) Phenylamine from methylbenzene (05marks)
 - (d) Hexane from propene (2½marks)
 - (e) $(\text{CH}_3)_2\text{C} = \text{NCH}_2\text{CH}_2\text{CH}_3$ from 2-iodopropane (04marks)

6. (a) Define the following terms.
 - (i) Lattice energy
 - (ii) Hydration energy. (02marks)

- (b) Given the following thermodynamic data.

Standard enthalpy of formation of aluminium fluoride	$= -1301\text{kJmol}^{-1}$
Standard enthalpy of atomization of aluminium	$= +314\text{kJmol}^{-1}$
Standard enthalpy of bond dissociation of fluorine gas	$= +158\text{kJmol}^{-1}$
First ionization energy of aluminium	$= +577\text{kJmol}^{-1}$
Second ionization energy of aluminium	$= +1820\text{kJmol}^{-1}$
Third ionization energy of aluminium	$= +2740\text{kJmol}^{-1}$
First electron affinity of fluorine	$= -348\text{kJmol}^{-1}$

 - (i) Draw an energy level diagram for the formation of aluminium fluoride and use it to determine the lattice energy of aluminium fluoride. (06marks)
 - (ii) Given that the hydration energies of aluminium ions and fluoride ions are -4690 and -364kJmol^{-1} respectively. Calculate the enthalpy of solution of aluminium fluoride and hence comment on its solubility in water. (04marks)

- (d) State and explain **two** factors that affect the lattice energy. (06marks)
- (e) Would you expect the lattice energy of aluminium chloride to be less than, greater than or equal to that of aluminium fluoride. Explain your answer. (04marks)

- 7.** The table below shows the hydrides of group(VII) elements and their boiling points .

Period number	2	3	4	5
Hydride	HF	HCl	HBr	HI
Boiling point (°C)	+20	-85	-67	-35

- (a) (i) Plot a graph of boiling point against period number. (04marks)
- (ii) Explain the shape of the graph (05marks)
- (b) Describe briefly how the following hydrides are prepared in the laboratory .(Illustrate your answer with an equation).
- (i) Hydrogen chloride (2½marks)
- (ii) hydrogen iodide (2½marks)
- (c) Discuss the reactions of the hydrides with
- (i) sodium hydroxide
- (ii) sulphuric acid
- (iii) Silicon dioxide (06marks)
- 8.** (a) Explain the following processes as used in the extraction of metals
- (i) Floatation
- (ii) Roasting
- (iii) Smelting (12marks)
- (b) Briefly describe how the ore of aluminium can be concentrated. (08marks)

END