# TANZANIA HEADS OF ISLAMIC SCHOOLS COUNCIL

# FORM SIX INTER ISLAMIC MOCK EXAMINATION

# CHEMISTRY 2

**(For Both School and Private Candidates)**

**132/2**

**TIME: 3 HOURS** **Thursday, 6th March 2025 p.m.**

**Instructions**

1. This paper consists of **six (6)** questions.
2. Answer **five (5)** questions.
3. Each question carries twenty (20) marks.
4. Non-programmable calculators may be used.
5. Cellular phones and any other unauthorized materials are **not** allowed in the examination room.
6. Write your **Examination Number** on every page of your answer booklet(s).
7. For calculations the following constants may be used:
   - Atomic masses, Fe=56, S=32, O=16, Na=23, H=1, Cl=35.5, Mg = 24, Al=27, P=31, Pb=207, Mn=54.9
   - Standard pressure = 760mmHg=1atm=$105x10^5$Pa
   - Standard temperature = 273K
   - Avogadro's number = $6.02\ x10^{23}$
   - 1 litre = $1dm^3$=$1000cm^3$
   - GMV=$22.4dm^3$
   - Universal gas constant, R= $8.31Jmol^{-1}k^{-1}$ Or $0.0821atmol\text{-}1k\text{-}1dm^{-3}$
   - 1 Faraday = 96500 coulombs

1. (a) Explain the following chemical phenomena by using chemical equation where necessary.
   (i) Solid carbonates of Iron (III) and Aluminium have never been isolated
   (ii) Lime water is used to test the presence of $CO_2$ gas
   (iii) When $NaHCO_3$ is added to copper (II) sulphate effervescence is observed.
   (iv) Lead hydroxide precipitates dissolve in exess NaOH solution.

   (b) By using chemical equation where necessary describe;

   (i) Two methods of preparing Copper (II) chloride in the laboratory

   (ii) How zinc oxide reacts with both acid and base.

   (iii) Show how you can prepare a metal oxide by direct and indirect method.

   (c) Comment with the help of chemical equation where necessary in the following:

   (i) Iron (II) chloride cannot be prepared by heating iron fillings in a stem of chlorine gas.

   (ii) Hydrochloric acid cannot be used as an acid medium during redox titration of $KMnO_4$ solution against $FeSO_4$ solution.

2. (a) Briefly explain the following terms below and give one example for each
   (i) Thermoplastic polymers
   (ii) Thermosetting polymers
   (iii) Condensation polymers

   (b) Write the monomers used in the synthesis of the following polymers below

   (i) Polyvinyl chloride (PVC)

   (ii) Teflon

   (iii) Nylon 6, 6

   (c) Draw a short hand representation of the polymer produced from each of the following monomers

   (i) $CH_2=CHCN$

   (ii) $CF_2=CF_2$

   (iii) $C_6H_5CH=CH_2$

   (d) How will you synthesize the following polymers?

   (i) Polyvinylchloride from acetylene

   (ii) Orlon from acetylene

   (iii) Polystyrene from Benzene

3. (a) (i) Periodic table is the table displaying the arrangement of elements. Between group II and group III there are transition elements. In four points describe the properties of the elements.

(ii) Briefly explain the process of colour formation as explained by Crystal Field Theory.

(b) (i) For each of the two octahedral complex ions $[Fe(H_2O)_6]^{2+}$ and $[Fe(CN)_6]^{4-}$ draw orbital splitting diagrams and predict the number of unpaired electrons.

(ii) What are the charges and coordination numbers of the central ions in each of the following complex compounds $[Ni(H_2O)_6]Cl_2$ and $[Cr(en)](ClO_4)_3$

(c) Name the following coordination compounds

(i) $Pt((H_2NCH_2NH_2)_2Cl_2)Cl_2$

(ii) $[Ag(NH_3)_2][Ag(CN)_2]$

(d) Give molecular formula of the following coordination compounds.

(i) Ammonium tetrachlorocuprate (II)
(ii) Pentaaminechloroplatinum (IV) bromide
(iii) Ammonium diaqua bis oxalate nickelate (II)
(iv) Sodium tetrachloronickelate
(v) Tris-othylenediamine cobalt (III) sulphate

4. (a) During scientific investigation a chemist deduced a compound from the mass spectrum and found that pure liquid M has a relative molecular mass of 72. From combustion analysis its empirical formulas is $C_4H_8O$.

(i) What is molecular formula of compound M?
(ii) Suggest three possible structures of M.

(b) A chemist further carried out the following tests of liquid M in (a) above.

| Test reagent | Observation |
|---|---|
| A. Na metal | No reaction |
| B. Bromine water | No reaction |
| C. 2,4 Dinitrophenyl nitrate | Orange precipitates were formed (positive results) |
| D. Ammoniacal silver nitrate (Tollen' s reagent) | No reaction |
| E. Iodo form test | Yellow precipitates formed (positive results) |

(i) What functional group has been tested for the structure of liquid M from

- Test A alone?
- Test B alone?
- Test C alone?
- Test D alone?
- Test E alone?

(ii) Identify the structure of liquid M.

(c) Write the product(s) of the reaction of liquid M with

(i) Hydrazine

(ii) Iodo form test

(d) (i) Explain the Aldo condensation

(ii) Explain why $(CH_3)_2CO$ and $CH_2CHO$ can undergo Aldo condensation while $(CH_3)_3C\text{-}CHO$ and $(CH_3)_3\text{-}CHO$ cannot.

5. (a) (i) Calculate the pH of a buffer solution prepared by dissolving 0.10 moles of cynic acid (HCNO) and 0.5 moles of sodium cyanide (NaCN) in enough water to make 0.50 litres of solution (Ka for HCNO = $2.0 \times 10^{-4}$ at 25°C).

(ii) Calculate the pH of the buffer solution in above after adding 0.03 moles of HCl.

(b) 6.60g of $MnF_2$ dissolved in one litre of solution at 25°C. Calculate the value of Ksp for $MnF_2$ at 25°C.

(c) Write the balanced equations to explain whether addition of $H_3O^+$ from strong acid affects the solubility of each of the following ionic compounds

(i) Lead (II) bromide

(ii) Copper (II) hydroxide

(iii) Iron (II) sulphide

6. (a) Balance the following redox reactions:

(i) $Cr_2O_7^{2-}{}_{(aq)} + HNO_{2(aq)} \rightarrow Cr^{3+}{}_{(aq)} + NO_3^-{}_{(aq)}$ (acidic)

(ii) $PbO_2 + Cl^- \rightarrow ClO^- + [Pb(OH)_3]^-$ (basic)

(b) (i) A 0.5F electric charge is passed through three electrolytic cells connected in series containing $AgNO_3$, $CuSO_4$ and $FeCl_3$ solutions. Calculate the mass of each metal that will be deposited at the cathode assuming that only cathodic reactions occurred in each cell.

(ii) The molar conductivity at infinite dilution and molar conductivity at $0.1 moldm^{-3}$ of $CH_3OOH$ are $3.88 \times 10^{-2} Sm^2mol^{-1}$ and $5.2 \times 10^{-4} Sm^2mol^{-1}$ respectively. Calculate the degree of Ionization, $\alpha$, of $CH_3COOH$.

(c) An electrochemical cell is constructed based on the following redox reaction

$Zn_{(s)} + Cu^{2+}{}_{(aq)} \rightarrow Zn^{2+}{}_{(aq)} + Cu_{(s)}$

If the concentrations of copper and zinc are 5.0 $moldm^{-3}$ and $0.05 moldm^{-3}$ respectively. Calculate the emf at 298k given that;

$E^\theta\ Cu^{2+}/Cu = 0.34V$ and $E^\theta\ Zn^{2+}/Zn = -0.76V$.

6. (d) The overall reaction $2NO_{(g)} + O_{2\,(g)} \rightarrow 2NO_{(g)}$ has an experimental rate law $R=K[NO]^2[O]$.

A proposed mechanism is;

$NO_{(g)} + O_{(g)} \underset{R\text{-}1}{\overset{R_1}{\rightleftharpoons}} NO_{3\,(g)}$ (fast) …… I

$NO_{3(g)} + NO_{(g)} \xrightarrow{R_2} 2NO_{2(g)}$ (slow) …….. II

(i) What is the intermediate species?

(ii) Is the rate law consistent with proposed mechanism?

*Wabillah Tawfiiq*