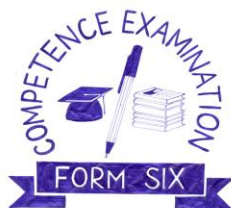


THE PRESIDENT'S OFFICE
REGIONAL ADMINISTRATION AND LOCAL GOVERNMENT
FORM SIX COMPETENCE EXAMINATIONS (FOSCE) - 2025



CODE: 132/2

CHEMISTRY 2

TIME: 3 HOURS

24TH FEBRUARY 2025, PM

INSTRUCTIONS

1. This paper consist a total of **six (6)** questions
2. Answer a total of **five (5)** questions.
3. Each question caries 20 marks.
4. NECTA's Mathematical tables and non-programmable calculator may be used.
5. Cellular phones are **not** allowed in the examination room.
6. Write your **examination number** on every page of your answer sheets provided.
7. For calculations you may use the following constants.
 - Gas constant $R = 0.0821 \text{ atm dm}^3 \text{ K}^{-1} \text{ mol}^{-1}$ or $8.314 \text{ J mol}^{-1} \text{ K}^{-1}$.
 - Velocity of light $3.0 \times 10^8 \text{ m/s}$.
 - $\text{GMV} = 22.4 \text{ dm}^3$
 - Standard pressure $= 760 \text{ mmHg} = 1 \text{ atm} = 1.05 \times 10^5 \text{ N m}^{-2} = 1.05 \times 10^5 \text{ Pa}$
 - Standard temperature 273 K
 - $1 \text{ dm}^3 = 1 \text{ litre} = 1000 \text{ cm}^3 = 10^{-3} \text{ m}^3$.
 - $1 \text{ Faraday} = 96500 \text{ C mol}^{-1}$

Atomic masses: C = 12, H = 1, N = 14, O = 16, Fe = 56, Na = 23, Cl = 35.5, Ca = 40, K = 39, Mn = 55,

1. a) i. What is buffering capacity? **(2marks)**
 ii. Briefly explain why does buffer solution resist the change in PH? **(4marks)**

 b) A form six student wishes to precipitate out PbSO_4 by adding the solid $\text{Pb}(\text{NO}_3)_2$ to Na_2SO_4 solution. How much solid $\text{Pb}(\text{NO}_3)_2$ must be added to 1.0L of 0.0010M Na_2SO_4 solution to precipitate PbSO_4 ? Given that the K_{sp} of PbSO_4 is 1.6×10^{-8} . Assume no change in volume when the solid is added.
(7marks)

 c) The PH of buffer solution containing 0.1M, CH_3COOH and 0.1M CH_3COONa is 4.74. If 0.05moles of HCl is added to one liter of this buffer solution what will be the PH of the resulting? K_a for CH_3COOH is 1.8×10^{-5} . **(7marks)**

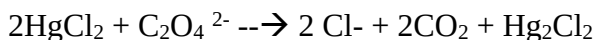
2. a) Ethanol and water form an azeotropic mixture which boil at 78.01°C when it is 95.6% ethanol at standard pressure. If the Boiling point of pure water and ethanol are 100°C and 78.4°C respectively.
 - i. Draw a well labeled Temperature versus mole fraction diagram for ethanol and water solution. **(4marks)**
 - ii. What happen when a dilute ethanol solution of less than 50% ethanol is boiled and condensed several times? **(4marks)**
 - iii. How will you obtain pure ethanol from this mixture? Give four points **(4marks)**
 b) When 500cm^3 of an aqueous solution containing 4g of solute G per Liter was shaken well with 100cm^3 of Pentan-1-ol, 1.5g of solute G was extracted. Assuming that the molecules state of the solute G remain the same in both solvents, Calculate,
 - i. The partition Coefficient of the solute G between pentan-1-ol and water. **(2marks)**
 - ii. Mass of the solute G extracted after a further shaking the aqueous solution with 100ML of Pentan-1-ol. **(4marks)**
 c) What are the practical applications of portion law in our daily life? Give two point two points **(2marks)**

3. a) While working in the Chemistry Laboratory, the technician left the bottles containing Pentan-2-one, Pentan-3-one and Pentanal labeled as A, B and C.

- i. What chemical test should he carry out to identify the compound in the bottle A, B, C? **(3marks)**.
 - ii. Describe how would the technician used the product of the results in(i) above to distinguish Pentan-2-one and Pentan-3-one. **(4marks)**.
- b) Briefly explain the following observations
- i. lower member of carboxylic acid are soluble in water while higher are insoluble. **(2marks)**
 - ii. Carboxylic acid shows higher boiling point than corresponding alcohol. **(2marks)**
- c) With suitable balanced chemical equation show how Benz aldehyde (C_7H_6O) react with the following.
- i. Acidified potassium permanganate.
 - ii. 2,4-dinitrophenyl hydrazine.
 - iii. Zinc amalgam and concentrated HCl acid. **(3marks)**
- d) By giving examples differentiate thermoplastic from thermosetting polymer. **(4marks)**
4. a) Briefly explain why it's important to study rate of chemical reaction? **(2marks)**
- b) the rate of chemical reaction between $HgCl_2$ and $C_2O_4^{2-}$ were studied by measuring the number of moles of each reactants involved and the results were recoded as follows

Experiment	$[HgCl_2]M$	$[C_2O_4^{2-}]M$	Initial rates (molL/mn)
1	0.185	0.266	2.7×10^{-4}
2	0.185	0.133	1.35×10^{-4}
3	0.370	0.133	6.75×10^{-4}
4	0.370	0.266	2.70×10^{-4}

If $HgCl_2$ and $C_2O_4^{2-}$ react according to the following reaction



- i. Determine the order of reaction with respect to each reactant and an overall order of reaction **(4marks)**
- ii. Calculate the rate constant.
- iii. What will be the initial rates of reaction if $[HgCl_2] = 0.094M$ and $[C_2O_4^{2-}] = 0.19M$ are mixed. **(4marks)**

c) it was observed that 8g of radioactive took 40years to decay up to 5g

i. Calculate the rate constant for this decay. **(3marks)**

ii. How long will it take for the sample to decay to 1.2g **(3marks)**

5. (a) write the structure for the following compounds

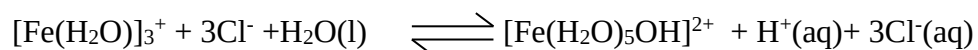
- (i) Bromopentaaquacobalt (III) chloride.
- (ii) Trichlorotriammineplatinum (IV) chloride.
- (iii) Potassium aquatetracyanochromate (III).
- (iv) Tetraaminedichlorochromium(III) dinitratoargentate(I). **(4 marks)**

(b) Account for the following

- i. By using their electronic configurations explain for why Fe^{2+} ions are readily oxidized to Fe^{3+} ions but Mn^{2+} ions are not readily oxidized to Mn^{3+} ions.
- ii. Silver nitrate solution reacts with compound $[\text{Pt}(\text{NH}_3)_3\text{Cl}_3]\text{Cl}$ but cannot react with the compound $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$
- iii. Copper (II) sulphate is coloured while copper (I) sulphate is colourless explain.

(6 marks)

(c) Given the following equation:



- (i) Name the two ligands in the complex structure on the right side of the equation.
- (ii) With aid of diagram comment whether a complex at right hand side is paramagnetic or diamagnetic. **(4 marks)**

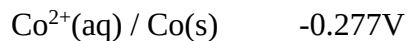
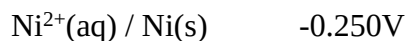
(d) Using hybridization principles, prove illustratively that the complex

- (i) $[\text{Fe}(\text{CN})_6]^{4-}$ is d^2sp^3 hybridized
- ii. $[\text{CoF}_6]^{3-}$ is sp^3d^2 hybridized **(6marks)**

6. (a) 0.95g of ethanedioic acid crystals, $\text{H}_2\text{C}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$, was dissolved in 250cm^3 of water. 25.00cm^3 sample of the solution required 33.00cm^3 of potassium permanganate solution in a titration

- (i) Write the balanced redox reaction **(5 marks)**
- (ii) Calculate the concentration (g/dm^3) of potassium permanganate solution

(b) Given the standard electrode potentials of the following at 25°C:



- (i) Write half ionic equation for each electrode and identify which electrode is oxidant or reductant
- (ii) Write the overall reaction at equilibrium
- (iii) Calculate the K_c of the reaction at equilibrium if the e.m.f of the cell is 1.50V

(7 marks)

(c) with aid of chemical equation explain the following phenomenon

- i. What happens when a solution of sodium thiosulphate is added into a beaker containing iodine solution.
- ii. Concentrated sulphuric acid should not be used in redox titration of potassium permanganate against iron (II) sulphate
- iii. Hydrochloric acid can be used as an acidic medium in redox titration of potassium dichromate (VI) against potassium iodide while same acid cannot be applied as acidic medium in redox titration of potassium permanganate (VII) against potassium iodide.
- iv. Dark brown colouration is observed when dilute hydrochloric acid is added to a beaker containing mixture of potassium iodate and potassium iodide.

(8 marks)