

**CHRISTIAN SOCIAL SERVICES COMMISSION (CSSC)
NORTHERN ZONE JOINT EXAMINATIONS SYNDICATE (NZ-JES)**



**FORM SIX PRE-NATIONAL EXAMINATIONS 2026
CHEMISTRY 2**

132/2

Time: 3:00 Hours

Monday, 2nd March 2026 p.m

Instructions

1. This paper consists of **Six (06)** questions
2. Answer **five (05)** questions
3. Each question carries **twenty (20)** marks.
4. Programmable calculators, phones are not allowed in the examination room.
5. Write your **examination number** on every page of your answers booklet.
6. For calculation you may use the following; -
 - Rydberg constant $R_H = 1.09678 \times 10^7 \text{ m}^{-1}$
 - GMV = 22.4 dm^3
 - Freezing point of water = 0°C
 - Standard temperature = 273K
 - Density of water = 1 g/cm^3
 - 1 moles = 1000 millimoles
 - $1 \text{ dm}^3 = 1 \text{ litre} = 1000 \text{ cm}^3 = 10^{-3} \text{ m}^3$
 - Standard pressure = $1 \text{ atm} = 760 \text{ mmHg}$
 - Gas constant, $R = 8.31 \text{ Jmol}^{-1} \text{ K}^{-1}$ or $0.0821 \text{ atm mol}^{-1} \text{ K}^{-1} \text{ dm}^3$
 - Atomic masses;
N=14, H=1, C=12, O=16, Na=23, Cl=35.5, Ca=40, Cu=63.5, K=39, I=127, S=32

1. (a) (i) What is meant by Steam distillation?
(ii) Mention **three** applications of steam distillation. (01½ marks) **(04 Marks)**
- (b) A mixture of water and Bromo benzene distills at 95°C and the distillate contains 1.6 times as much as Bromo benzene as water by mass. At 95°C the vapour pressure of water and bromo benzene are 640 mmHg and 120 mmHg respectively. Calculate the molecular weight of bromobenzene. **(05 Marks)**
- (c) Ethanol and water form an azeotropic mixture which boils at 78°C, containing 95.6% ethanol at constant pressure. Boiling points of pure ethanol and water are 78.4°C and 100°C respectively.
 - (i) Draw a labeled temperature against mole fraction diagram of ethanol and water.
 - (ii) Draw a vapour pressure composition against mole fraction diagram of ethanol and water solution.
 - (iii) How can you separate an azeotropic mixture of ethanol and water? **(06 Marks)**
- (d) (i) How is the distribution law modified when the solute undergoes dissociation in one of the solvents?
(ii) What would happen if the solute is completely dissociated in one of the solvents? **(05 Marks)**
2. (a) Explain the meaning of the following terms:
 - (i) Activation energy
 - (ii) Rate constant
 - (iii) Half-life
 - (iv) Order of reaction **(02 Marks)**
- (b) The initial concentration of sample A and the rate constant of the reaction at 60°C is 0.8 mol/dm³ and 2.0 x 10⁻³ sec⁻¹ respectively.
 - (i) How long will it take for the concentration of A to be reduced to 0.355 mol/dm³?
 - (ii) What will be the concentration of A after 40 seconds of the reaction?
 - (iii) Calculate the percentage of A that will react after 70 seconds of the reaction. **(07 Marks)**
- (c) (i) For the electrochemical cell Zn(s)/ZnSO₄(aq) // CuSO₄(aq)/Cu(s), sketch a labeled diagram of such a cell.
(ii) Write an expression for the emf of the cell above when it operates under standard conditions.
(iii) Calculate the emf of the cell above if [Cu²⁺] = 1M and [Zn²⁺] = 0.01M at standard conditions.
Given that E° Cu²⁺/Cu = 0.34 V and E° Zn²⁺/Zn = -0.76 V. **(07 Marks)**
- (d) A solution of a weak monobasic acid of concentration 0.025 mol/dm³ has a conductivity of 2.64 x 10⁻² Ω⁻¹ m⁻¹ at 25°C and a molar conductivity at infinite dilution of 3.91 x 10⁻² Ω⁻¹ m² mol⁻¹. Calculate:
 - (i) The concentration of hydrogen ion in the solution.
 - (ii) The dissociation constant of the acid. **(04 Marks)**
3. (a) Using the cell notation, write down the cells made from the following combination of half-cells. In each case, work out the e.m.f of the cell.
 - (i) S.H.E and Copper
 - (ii) Zinc and Silver
 - (iii) Mercury and Copper
 Given:

$$E^0 \text{ H}^+ / \text{H}_2 = 0\text{V}$$

$$E^0 \text{ Cu}^{2+} / \text{Cu} = 0.34\text{V} \quad E^0 \text{ Zn}^{2+} / \text{Zn} = -0.76\text{V} \quad E^0 \text{ Ag}^+ / \text{Ag} = 0.8\text{V}$$

$$E^0 \text{ Hg}^{2+} / \text{Hg} = 0.79\text{V}$$
(06 Marks)
- (b) 10g of an impure Iron (II) salt were dissolved in water and made up to 200 cm³ of solution. 20 cm³ of this solution was acidified with dilute sulphuric acid and required 25cm³ of 0.04 mol/dm³ KMnO₄ solution before a faint pink colour appeared.
 - (i) Write a balanced ionic equation for acidified KMnO₄ and Fe²⁺.
 - (ii) Calculate the percentage purity of the Iron salt. **(05 Marks)**
- (c) The standard electrode potential for Cu²⁺ /Cu is +0.34V. Calculate the reduction potential at pH = 14 given that K_{sp} of Cu(OH)₂ is 1 × 10⁻¹⁹. **(03 Marks)**

- (d) The conversion of cyclopropane to propene in the gas phase is a first-order reaction with a rate constant of $6.7 \times 10^{-4} \text{ s}^{-1}$ at 500°C .
- If the initial concentration of cyclopropane is 0.25M, what will be the concentration after 8.8 min?
 - How long will it take for the concentration of cyclopropane to decrease from 0.25M to 0.15M?
 - How long will it take to convert 74% of the starting material? **(06 Marks)**

4. (a) Explain the following:

- Common reductants are useless in the manufacture of aluminium from its ore.
- Chlorine is much more soluble in aqueous sodium hydroxide than in water.
- Unlike other halogens, fluorine liberates oxygen from cold water. **(03 Marks)**

(b) Describe the process of aluminium extraction starting with bauxite under the following stages:

- Purification of the ore from impurities
- Electrolysis of alumina **(10 Marks)**

(c) Silver nitrate may react with the compound $[\text{Pt}(\text{NH}_3)_3\text{Cl}_2]\text{Cl}$ but not with $[\text{Pt}(\text{NH}_3)_2\text{Cl}_4]$.

Explain by giving the necessary equations. **(04 Marks)**

(d) (i) The complex compounds of Cobalt have different colours, example $[\text{Co}(\text{CN})_6]^{3-}$ is yellow, $[\text{Co}(\text{NH}_3)_6]^{3+}$ is orange, and $[\text{Co}(\text{H}_2\text{O})_6]^{3+}$ is blue. Explain the difference in colour.

(ii) Briefly explain why adding alkali to the dichromate (VI) equilibrium produces a strong yellow colour.

(iii) Solution of iron(III) salts are often acidic. Explain. **(03 Marks)**

5. (a) It is deduced from the mass spectrum that a pure organic liquid Y has a relative molecular mass of 58. From combustion analysis, its empirical formula is $\text{C}_3\text{H}_6\text{O}$. If liquid Y was subjected to the following tests:

Test	Reagent	Observation
A	Sodium metal	No reaction
B	Bromine water	No reaction
C	2,4-Dinitrophenylhydrazine	Orange precipitate
D	Ammoniacal silver nitrate	No reaction

(i) What can be said about the structure of liquid Y from:

- Test B alone
- Test C alone
- Test D alone
- Test C and D taken together

(ii) What is the molecular formula of liquid Y?

(iii) Identify the structure of liquid Y. **(05 Marks)**

(b) Compound M is composed of 64.86% C, 13.5% H, and 21.64% O. M reacts with PCl_5 to form compound O and gas P, which produces dense white fumes with ammonia. M also reacts with a mixture of iodine and some hydroxide solution to form sodium salt Q and triiodomethane.

(i) Give the molecular formula of M if its molecular mass is 74.

(ii) Referring to the reaction of M suggested, write the structures of five possible isomers of M and give their names.

(iii) Give chemical reactions for all the two reactions undergone by M. **(07 Marks)**

(c) Give the structures and the IUPAC name of the organic products formed when phenylamine reacts with each of the following compounds:

- Ethanoic anhydride.
- Aqueous bromine.
- Ethanoic anhydride followed by bromine water.
- Sodium nitrite and hydrochloric acid below 10°C . **(04 Marks)**

(d) Show how n-propyl amine could be prepared from each of the following compounds:

- (i) n-Propyl bromide.
- (ii) n-Propyl alcohol.
- (iii) n-Butyl alcohol.
- (iv) n-Propanitrile.

(04 Marks)

6. (a) The air craft tyres are made from vulcanized rubber.

- (i) What do you understand by vulcanization of rubber?
- (ii) What property of vulcanized rubber makes it suitable to be used for making these air craft tyres?
- (iii) Why plasticizer is used during moulding of plastics?

(03 Marks)

(b) With specific example explain why is cationic polymerization preferred in case of vinylic monomers containing electron donating groups.

(02 Marks)

(c) cis- $[\text{MnCl}_2(\text{OH}_2)_4]$ is red crystalline solid.

- (i) Draw cis and trans - $[\text{MnCl}_2(\text{OH})_4]^-$
- (ii) What is the co ordination number for manganese in this complex?
- (iii) If the d electrons in this complex are high spin configuration, draw an energy level diagram for those d electrons.
- (iv) Briefly explain why this complex is coloured.

(08 Marks)

(d) (i) An organic compound has a relative molecular mass of 88. It was found to exist in the isomers of an aliphatic carboxylic acid and an aliphatic ester. Write the structural formulae of the three isomers of that organic compound and give their IUPAC names.

(04 Marks)

(ii) Salicylic acid (2-hydroxybenzoic acid) is an analgesic that can irritate the stomach; however, its ester (Aspirin) is easily hydrolyzed in the alkaline condition of the stomach to 2-hydroxybenzoic acid, which dissolves in the bloodstream. Write the structure of salicylic acid and aspirin.

(03 Marks)

