

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



**FORM SIX PRE-NATIONAL EXAMINATIONS 2026  
CHEMISTRY 1**

**132/1**

**Time: 3:00 Hours**

**Monday, 23<sup>rd</sup> February 2026 p.m**

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**Instruction**

1. This paper consists of **two (2)** sections **A** and **B** with a total of **ten (10)** questions.
2. Answer all questions in section A and Any **two (02)** questions in section B.
3. Each question carries **ten (10)** marks in section A and **fifteen (15)** marks in section B.
4. Cellular phones and any unauthorized materials are **not** allowed in the examination room.
5. Write your **Examination number** on every page of your answer booklet(s).
6. Write your examination number of every page of your answer booklet or Answer sheets
7. For calculation you may use the following:-
  - Rydberg constant  $R_H = 1.09678 \times 10^7 \text{ m}^{-1}$
  - GMV =  $22.4 \text{ dm}^3$
  - Freezing point of water =  $0^\circ\text{C}$
  - Standard temperature =  $273\text{K}$
  - Density of water =  $1 \text{ g/cm}^3$
  - 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,  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$  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

## SECTION A(70 MARKS)

(Answer **all** questions in this section)

1. (a) (i) You are given the following species  $K^+$ ,  $Cl$ ,  $Ca^{2+}$ , and  $S^{2-}$  which are collectively known as isoelectronic species. What do you understand by the term isoelectronic?  
(ii) Briefly explain the physical significance of the following states:  $n=\infty$  and  $E=0$  on the hydrogen atom.  
(iii) In a compound possessing both sigma and pi bonds, it is said that "Sigma bonds are stronger than pi bonds." State one reason to support the truth of that statement. **(03 Marks)**
- (b) Briefly explain why the following sets of quantum numbers are not allowed in the hydrogen atom:  
(i)  $n=1, l=1, m_l=0$   
(ii)  $n=1, l=0, m_l=2$   
(iii)  $n=2, l=-2, m_l=1$   
(iv)  $n=0, l=0, m_l=0$  **(04Marks)**
- (c) Show that the circumference of the Bohr orbit for the hydrogen atom is an integral multiple of the De Broglie wavelength associated with the electron revolving around the orbit, i.e.,  $2\pi r = n\lambda$  **(03 Marks)**
2. (a) Explain the following:  
(i) Water ( $H_2O$ ) has a molar mass of 18g/mol with a boiling point of  $100^\circ C$ , while  $H_2S$  has a molar mass of 34 g/mol with a boiling point of  $25^\circ C$ . Why is water a liquid while  $H_2S$  is a gas?  
(ii) Why does oxygen ( $O_2$ ) have a lower boiling point than ozone( $O_3$ )?  
(iii) In molten Aluminium fluoride ( $AlF_3$ ), it conducts electricity, while Aluminium chloride ( $AlCl_3$ ) does not conduct electricity. Why is this the case?  
(iv) Why is Sulphur dioxide( $SO_2$ ) a polar molecule? **(04Marks)**
- (b) With examples, explain how each of the following is formed:  
(i)  $sp$  orbital overlapping.  
(ii) Two  $p$  orbitals overlapping.  
(iii) Formation of the Oxygen molecule ( $O_2$ )  
(iv) Formation of the Nitrogen molecule ( $N_2$ ) **(04Marks)**
- (c) (i) What is hybridization?  
(ii) State **three (3)** assumptions of the valency shell electron pair repulsion(VSEPR) theory. **(02Marks)**
3. (a) (i) What is effusion?  
(ii) Calculate the ratio of the rate of diffusion of hydrogen to the rate of diffusion of oxygen where the density of  $O_2$  is 1.43 g/L and that of  $H_2$  is 0.0899 g/L. **(03 Marks)**
- (b) A 15.5-litre sample of 0.75 mole oxygen gas at a pressure of 1 atm and temperature of  $25^\circ C$  was completely converted to ozone ( $O_3$ ) at the same temperature and pressure. What was the volume of ozone ( $O_3$ ) produced? **(03 Marks)**
- (c) A  $1000\text{cm}^3$  bulb contains 1.19g of a gas at standard pressure and a temperature of  $20^\circ C$ . Assuming the gas behaves ideally, calculate its:  
(i) Relative density.  
(ii) Normal density. **(04Marks)**
4. (a)(i) Briefly explain the effect of the degree of dissociation of solute on the boiling point of a solution.  
(ii) Derive an expression relating the Van't Hoff factor ( $i$ ) and degree of dissociation ( $\alpha$ ). **(03Marks)**
- (b) A 1% solution of sodium chloride freezes at  $-0.604^\circ C$ . Calculate the degree of dissociation of the sodium chloride if the molal freezing point depression constant of water is  $1.86^\circ C\text{kg/mol}$ . **(04Marks)**
- (c) Explain how colligative properties are applied in our real life. **(03Marks)**
5. (a) (i) What is ionization energy  
(ii) Explain **four (04)** application of Hess law. **(03 Marks)**

- (b) For Ca, the heat of sublimation is +193 kJ/mol, and the first and second ionization enthalpies are +590 kJ/mol and +1145 kJ/mol, respectively. For Cl<sub>2</sub>, the heat of dissociation is +242 kJ/mol, and the electron affinity of the Cl atom is -348 kJ/mol. The standard heat of formation of CaCl<sub>2</sub> is -763 kJ/mol.
- Draw the Born-Haber cycle of CaCl<sub>2</sub>, then calculate the lattice energy of CaCl<sub>2</sub>. **(03 Marks)**
  - If Ca<sup>+</sup> and Cl<sup>-</sup> ions formed a hypothetical crystal CaCl, the lattice energy of hypothetical CaCl would be -155 kJ/mol. Use this value to calculate the heat of formation of CaCl. **(02 Marks)**
  - Which one has a more stable crystal lattice between CaCl<sub>2</sub> and CaCl? Give a reason. **(02 Marks)**
6. (a) With the aid of chemical equations, explain how the oxide of Zinc is prepared. **(03 Marks)**
- (b) Write a balanced chemical equation and the expected observation of the following:
- Sodium carbonate is strongly heated in air.
  - Aluminium hydroxide is amphoteric.
  - Magnesium nitride is dissolved in water.
  - Concentrated HCl acid is added to a white precipitate of Lead (II) chloride. **(04 Marks)**
- (c) Explain **four (04)** uses of metal carbonate in daily life. **(03 Marks)**
7. (a) Use K<sub>p</sub> or K<sub>c</sub> depending on the states of the chemicals, write down the expression of the equilibrium constant for each of the following reactions:
- $\text{CaCO}_3(\text{s}) \rightleftharpoons \text{CaO}(\text{s}) + \text{CO}_2(\text{g})$
  - $\text{AgCl}(\text{s}) \rightleftharpoons \text{Ag}^+(\text{aq}) + \text{Cl}^-(\text{aq})$
  - $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$  **(03 Marks)**
- (b) Sulphur dioxide and oxygen exist in the following equilibrium:
- $$2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$$
- When 10.0 mol of SO<sub>2</sub> were reacted with 5.0 mol of O<sub>2</sub> at 450°C, 90% of SO<sub>2</sub> was converted into SO<sub>3</sub> at equilibrium under a pressure of 200 kPa. Calculate the equilibrium constant K<sub>p</sub>. **(04 Marks)**
- (c) Hydrogen gas can be obtained from natural gas by partial oxidation with steam. This involves the following endothermic reaction:
- $$\text{CH}_4(\text{g}) + 3\text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + 3\text{H}_2(\text{g})$$
- How will the value of K<sub>p</sub> be affected by:
- Increasing the pressure
  - Increasing the temperature
  - Using a catalyst **(03 Marks)**

### SECTION B (30 MARKS)

(Answer **only two (02)** questions in this section)

8. (a) Given the IUPAC names for some organic compounds below, using the principle of naming, give out the structural formula for each of the given names:
- 3,4-diethyl-2,2-dimethylheptane
  - 2-methylpent-2-ene
  - Pent-1-ene-3-yne **(03 Marks)**
- (b) Describe the observations made as a result of doing the following experiments:
- 1-bromopropane is heated with alcoholic caustic potash.
  - Ethene is treated with alkaline potassium permanganate solution (cold).
  - A few drops of bromine are added to hexane under sunlight. **(03 Marks)**
- (c) (i) After an ozonolysis experiment of a certain organic compound, the only product was ethanol (CH<sub>3</sub>CHO). The chemist who did the experiment correctly claimed that there were two different structures for the starting material. What are they? **(02 Marks)**
- (ii) Predict and explain the most likely product for the addition of hydrogen chloride to 2-methylbut-2-ene. **(02 Marks)**
- (iii) Scientifically, it is said that the preparation of Grignard reagents should be done under anhydrous conditions. Why is that so? **(02 Marks)**
- (d) The pairs of compounds listed below were found to confuse a Form Five student in the laboratory. You, as a Form VI student, help him/her to distinguish the compounds from each pair.
- CH<sub>3</sub>CH<sub>2</sub>C≡CCH<sub>3</sub> and CH<sub>3</sub>CH<sub>2</sub>CH<sub>2</sub>C≡CH
  - CH<sub>2</sub>=CH<sub>2</sub> and CH<sub>3</sub>CH<sub>3</sub>
  - CH<sub>3</sub>CH<sub>2</sub>Cl and CH<sub>3</sub>CH<sub>3</sub> **(03 Marks)**

9. (a) Briefly explain the following:-

- (i) Farm yard manure
- (ii) Organic fertilizers
- (iii) Artificial fertilizers
- (iv) Compost manure

**(04Marks)**

(b) The exchangeable hydrogen from 5g of oven dry soil was neutralized with 10cm<sup>3</sup> of 0.1 M NaOH. If the total c.e.c of the soil was 25 meq/100g of soil, calculate:

- (i) Percentage saturation
- (ii) Concentration of the H<sup>+</sup> ions in (meq) in 75g of the dry soil.

**(04Marks)**

(c) A soil sample of 20g was analyzed and found to contain 0.015g of Ca. What is the concentration of calcium in the soil in milliequivalent per 100g of soil?

**(03Marks)**

(d) (i) What are soil colloids, and why are they important in soil science?

(ii) How do soil colloids contribute to the soil's cation exchange capacity (CEC)?

(iii) Discuss the role of soil colloids in nutrient retention and availability to plants.

**(04Marks)**

10. (a) Suggest the proper structure of the following compounds:

- (i) 2-chloro-3-methylpentane
- (ii) 4-tertbutyl-3-iodoheptane
- (iii) 1,4-dibromobut-2-ene
- (iv) 1-bromo-4-sec-butyl-2-methylbenzene

**(04Marks)**

(b) An unknown compound X has molecular formula C<sub>5</sub>H<sub>6</sub>. Suggest the possible structure of X from the following data:

- (i) One mole of X takes up two moles of chlorine.
- (ii) Compound X decolourizes a solution of Br<sub>2</sub> in CCl<sub>4</sub>.
- (iii) Compound X forms no precipitates with ammoniacal silver nitrate.
- (iv) Write all the reactions involved.

**(06 Marks)**

(c) When 1,2-dibromodecane was treated with potassium hydroxide in aqueous ethanol, it yields a mixture of two isomeric compounds of molecular formula C<sub>10</sub>H<sub>19</sub>Br. Each of these compounds was converted to dec-1-yne on reaction with sodium amide. Identify the two isomers and show the chemical reactions taking place.

**(05 Marks)**

