Time allowed: 25 Minutes　　　　　| Version Number | 3 | 0 | 9 | 4 |

Note: Section – A is compulsory. All parts of this section are to be answered on the separately provided OMR Answer Sheet which should be completed in the first 25 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q. 1 Choose the correct answer A / B / C / D by filling the relevant bubble for each question on the OMR Answer Sheet according to the instructions given there. Each part carries one mark.

1) Enthalpy of combustion can be determined by:
   - A. Bomb calorimeter
   - B. Copper calorimeter
   - C. Coffee-cup calorimeter
   - D. Glass calorimeter

2) Born – Haber cycle is applied to determine:
   - A. Lattice energy
   - B. Bond energy
   - C. Hydration energy
   - D. Potential energy

3) What is added with S in order to balance the following equation? $S \rightarrow H_2S$
   - A. $2H^+, 1e^-$
   - B. $2H^+, 3e^-$
   - C. $2H^+, 4e^-$
   - D. $2H^+, 2e^-$

4) Which of the following has highest number of molecules in it?
   - A. $10g$ of NO
   - B. $10g$ of NO_2
   - C. $10g$ of N_2O_4
   - D. $10g$ of N_2O

5) How many moles of O_2 are needed for the complete combustion of one mole of Butane (C_4H_{10})?
   - A. 8
   - B. 6.5
   - C. 13
   - D. 4.5

6) Which of the following orbital is of greater energy?
   - A. $4d$
   - B. $6s$
   - C. $4f$
   - D. $5p$

7) When fast neutrons are bombarded on nitrogen atoms, what radiations are emitted?
   - A. β -rays
   - B. γ -rays
   - C. X -rays
   - D. α -rays

8) The C – H bond length will be greater when the hybridization of carbon is:
   - A. sp^2
   - B. sp^3
   - C. dsp^3
   - D. sp

9) One atmosphere pressure is equal to:
   - A. $101.325\,Pa$
   - B. $101.325\,Bars$
   - C. $101325\,N/m^2$
   - D. $101325\,Kpa$

10) In which of the following pairs, both gases will diffuse at the same rate?
   - A. $H_2\,\&\,He$
   - B. $N_2\,\&\,CO$
   - C. $CO\,\&\,CO_2$
   - D. $O_2\,\&\,SO_2$

11) Which of the following, requires least energy for vaporization?
   - A. Cl_2
   - B. Br_2
   - C. I_2
   - D. F_2

12) Sodium chloride exists in cubic and octahedral forms. This phenomena is called:
   - A. Polymorphism
   - B. Allotropy
   - C. Anisotropy
   - D. Isomerism

13) A reaction will proceed in forward direction in order to attain equilibrium when ($Q =$ reaction quotient, $K_c =$ equilibrium constant)
   - A. $Q < K_c$
   - B. $Q = K_c$
   - C. $Q = \frac{1}{2}K_c$
   - D. $Q > K_c$

14) pH of 0.001 M $NaOH$ solution is:
   - A. 10^{-3}
   - B. 11
   - C. 10^{-11}
   - D. 3

15) Which of the following compounds will produce acidic solution on hydrolysis?
   - A. KNO_3
   - B. $NaCl$
   - C. NH_4NO_3
   - D. $NaCN$

16) The units of rate constant and the rate of reaction will be the same when order of reaction is:
   - A. 2
   - B. 3
   - C. Zero
   - D. 1

17) Which of the following is **NOT** a pair of partially miscible liquids?
   - A. Aniline – water
   - B. Nicotine – water
   - C. Benzene – water
   - D. Phenol – water

CHEMISTRY HSSC–I

Time allowed: 2:35 Hours   **Total Marks Sections B, C and D: 68**

NOTE: The Questions of sections B, C and D are to be answered on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 21)

(Chapters 1 to 6)

Q. 2   **Answer any SEVEN parts. All parts carry equal marks.**   **(7 x3 = 21)**

(i)   Calculate the number of molecules of O_2 produced by thermal decomposition of 490 g $KClO_3$. (Atomic masses $K = 39\ g/mol$, $Cl = 35.5\ g/mol$, $O = 16\ g/mol$)

(ii)   Define limiting reactant. Why is the concept of limiting reactant not applicable to the reversible reactions?

(iii) Calculate the mass of an electron with the help of its charge and e/m ratio.

(iv)   Explain the geometries of $PbCl_2$ & SO_3 on the basis of VSEPR theory.

(v)   Write down the defects of Valence bond theory.

(vi)   Draw molecular orbital diagram for N_2 molecule and calculate its bond order.

(vii) What is an isotherm? How is it affected by change in temperature? Give reason.

(viii) Write down any three uses of liquid crystals.

(ix)   Define lattice energy giving an example. Write down the factors affecting the lattice energy.

(x)   What is cleavage plane? Give an example. Why is cleavage an anisotropic property?

SECTION – C (Marks 21)

(Chapters 7 to 12)

Q. 3   **Answer any SEVEN parts. All parts carry equal marks.**   **(7 x3 = 21)**

(i)   State common ion effect and give an example.

(ii)   Justify that CaO is a basic oxide whereas Al_2O_3 is an amphoteric oxide.

(iii) Define buffer solution. Write down its types, giving one example for each.

(iv)   What is a first order reaction? Give two examples.

(v)   Differentiate between hydrophilic and hydrophobic molecules, giving one example of each.

(vi)   Define molarity, molality and mole fraction.

(vii) Write down any three properties of colloids.

(viii) What is the internal energy of a system? Justify that internal energy is a state function.

(ix)   Define enthalpy of atomization, enthalpy of solution, enthalpy of neutralization.

(x)   What is galvanizing? How does it protect iron from corrosion?

SECTION – D (Marks 26)

Note: **Attempt any TWO questions. All questions carry equal marks.**   **(13 x 2 = 26)**
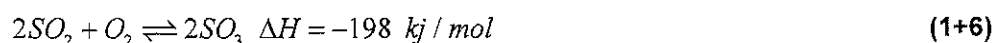
(Question 4 from Chapters 1 to 6)

Q. 4   **a.**   Derive general gas equation. How can this equation can be modified to determine the molar mass and density of a gas?   **(06)**

         b.   Define London dispersion forces. How are these forces produced in Helium gas? Also describe the factors affecting the London dispersion forces.   **(1+1.5+4.5)**

(Question 5 from Chapters 7 to 12)

Q. 5   **a.**   State Le-Chatlier's principle. Apply this principle to describe the effects of decrease in concentration of SO_3 , increase in temperature and increase in pressure on the following reactions at equilibrium. $2SO_2 + O_2 \rightleftharpoons 2SO_3\ \ \Delta H = -198\ kj/mol$ **(1+6)**

         b.   Define catalysis. How does a catalyst increase the rate of a chemical reaction? Also differentiate between homogenous and heterogeneous catalysis.   **(1+2+3)**

(Question 6 Part (a) from Chapters 1 to 6 and Part (b) from Chapters 7 to 12)

Q. 6   **a.**   Drive an expression for the radius of nth orbit of hydrogen atom.   **(06)**

         b.   What is a galvanic cells? Explain the construction and working of Zn/Cu cell. Write down the cell reaction and calculate the cell potential of this cell.   **(1+4+1+1)**

CHEMISTRY HSSC–I
SECTION – A (Marks 17)

Time allowed: 25 Minutes | **Version Number | 3 | 0 | 9 | 8**

Note: Section – A is compulsory. All parts of this section are to be answered on the separately provided OMR Answer Sheet which should be completed in the first 25 minutes and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q. 1 Choose the correct answer A / B / C / D by filling the relevant bubble for each question on the OMR Answer Sheet according to the instructions given there. Each part carries one mark.

1) Which enthalpy change is always positive?
   - A. Enthalpy of combustion
   - B. Enthalpy of neutralization
   - C. Enthalpy of solution
   - D. Enthalpy of atomization

2) The standard enthalpy of formation is zero for:
   - A. H_2O
   - B. $NaCl$
   - C. ZnO
   - D. N_2

3) Oxidation state of Nitrogen in $Ca(NO_3)_2$ is:
   - A. +3
   - B. +4
   - C. +5
   - D. +2

4) The mass of $11.2 dm^3$ of CO_2 enclosed in a container at STP is:
   - A. $22g$
   - B. $11g$
   - C. $33g$
   - D. $44g$

5) Which series of spectral lines is present in the visible region of electromagnetic spectrum?
   - A. Balmer series
   - B. Paschen series
   - C. Pfund series
   - D. Lymen series

6) The geometry of a molecule containing two bond pairs and one lone pair around the central atom is:
   - A. Trigonal planar
   - B. Triangular pyramid
   - C. Angular
   - D. Tetrahedral

7) According to Graham's law, the rates of diffusion of CH_4 and O_2 are in _____ ratio.
   - A. $1:\sqrt{2}$
   - B. $2:1$
   - C. $\sqrt{2}:1$
   - D. $1:2$

8) Which gas is more ideal at STP?
   - A. H_2S
   - B. NH_3
   - C. H_2
   - D. SO_2

9) Which of the followings possesses highest boiling point ?
   - A. HCl
   - B. H_2O
   - C. H_2S
   - D. HF

10) The intermolecular forces present in chloroform $CHCl_3$ are:
    - A. Dipole-dipole forces
    - B. London dispersion forces
    - C. Electrostatic forces
    - D. Hydrogen bonding

11) Which of the followings is **NOT** an anisotropic property?
    - A. Refractive index
    - B. Electrical conductivity
    - C. Cleavage
    - D. Viscosity

12) CO_2 in solid state forms:
    - A. Ionic crystal
    - B. Molecular crystals
    - C. Liquid crystals
    - D. Covalent crystals

13) For the reaction $N_2O_4 \rightleftharpoons 2NO_2$
    - A. $K_p = K_c(RT)$
    - B. $K_p = K_c(RT)^2$
    - C. $K_p = K_c(RT)^{-2}$
    - D. $K_p = K_c$

14) The value of K_c for the reaction $2SO_2 + O_2 \rightleftharpoons 2SO_3 + Heat$ is increased by:
    - A. Decreasing the temperature
    - B. Increasing the pressure
    - C. Decreasing the pressure
    - D. Increasing the temperature

15) Which of the following is an amphoteric oxide?
    - A. MgO
    - B. Cr_2O_3
    - C. NO_2
    - D. Na_2O

16) When concentration of a reactant is doubled, the rate of reaction becomes half. The order of reaction with respect to that substance is:
    - A. 0
    - B. 1/2
    - C. –1
    - D. 1

17) A colloid, containing a solid dispersed in a liquid is called:
    - A. Gel
    - B. Aerosol
    - C. Emulsion
    - D. Sol

CHEMISTRY HSSC-I

Time allowed: 2:35 Hours   **Total Marks Sections B, C and D: 68**

NOTE: The Questions of sections B, C and D are to be answered on the separately provided answer book. Use supplementary answer sheet i.e. Sheet–B if required. Write your answers neatly and legibly.

SECTION – B (Marks 21)
(Chapters 1 to 6)

Q. 2   **Answer any SEVEN parts. All parts carry equal marks.**   **(7 x3 = 21)**

(i)   Define conversion factor. Write down the conversion factor for the preparation of NH_3 from 4 moles of N_2, according to the following reaction. $N_2 + 3H_2 \rightarrow 2NH_3$

(ii)   Calculate the wave number of limiting line in Lymen series of hydrogen spectrum.

(iii)   Write down any three differences between sigma and pi bonds.

(iv)   Why is the energy of σ_{2px} orbital higher than that of π_{2py} & π_{2pz} orbitals in the molecular orbital diagram of N_2?

(v)   How will you derive absolute zero from Charle's law?

(vi)   4 g of CH_4 at 27°C and 2.5 atm pressure occupies the volume of 2.46 dm^3. Calculate the value of general gas constant R.

(vii)   What is vacuum distillation? Give its one application.

(viii)   Describe the role of hydrogen bonding in cleansing action of soap and solubility of some organic compounds in water. Give an example.

(ix)   Differentiate between hexagonal close packing and cubic close packing of atoms in the metals.

(x)   Write down the three differences between ionic and covalent solids.

SECTION – C (Marks 21)
(Chapters 7 to 12)

Q. 3   **Answer any SEVEN parts. All parts carry equal marks.**   **(7 x3 = 21)**

(i)   Describe the effect of increase in temperature on the value of K_c for the given reactions at equilibrium.

$$2SO_2 + O_2 \rightleftharpoons 2SO_3 \quad \Delta H = -198 \; kj/mol$$
$$N_2O_4 \rightleftharpoons 2NO_2 \quad \Delta H = +57.2 \; kj/mol$$

(ii)   When 60 g CH_3COOH and 46 g C_2H_5OH are heated, 12 g H_2O and 58.7 g $CH_3COOC_2H_5$ are formed at equilibrium. Calculate the value of K_c.

(iii)   Calculate the concentration of H^+ ions in a solution that contains $1 \; M \; HF (K_a = 7.2 \times 10^{-4})$

(iv)   Define Lewis acid and Lewis base. Give an example to show the significance of this concept.

(v)   Define initial rate. How is it determined? (data is not required)

(vi)   Describe the effect of increase in temperature on the solubility of gases in water.

(vii)   Compare any three properties of colloids, suspensions and true solutions.

(viii)   Differentiate between constant pressure and constant volume calorimetry.

(ix)   State Hess's law and give one example.

(x)   Balance the equation by ion-electron method. $Cr_2O_7^{-2} + Cl^{-1} \rightarrow Cr^{+3} + Cl_2$

SECTION – D (Marks 26)

Note: **Attempt any TWO questions. All questions carry equal marks.**   **(13 x 2 = 26)**

(Question 4 from Chapters 1 to 6)

Q. 4   **a.**   Differentiate between limiting and non-limiting reactant. How will you identify limiting reactant in a chemical reaction? Calculate the volume of NH_3 gas produced at STP when 200 g NH_4Cl is heated with 200 g $Ca(OH)_2$ according to the following reaction.   **(2+2+3)**

$$2 \; NH_4Cl + Ca(OH)_2 \rightarrow CaCl_2 + 2NH_3 + 2H_2O$$
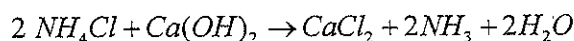
(Atomic masses $N = 14g/mol$, $Cl = 35.5g/mol$, $Ca = 40 \; g/mol$, $O = 16 \; g/mol$, $H = 1 \; g/mol$)

   b.   Explain the structure of acetylene on the basis of hybridization of central atom.   **(06)**

(Question 5 from Chapters 7 to 12)

Q. 5   **a.**   Explain collision theory of reaction rates with reference to activation energy, formation of activated complex and enthalpy changes in a chemical reaction.   **(3+3+2)**

   b.   Derive an expression for the determination of relative lowering of vapour pressure and molecular mass of a substance from Raoult's Law.   **(2+3)**

(Question 6 Part (a) from Chapters 1 to 6 and Part (b) from Chapters 7 to 12)

Q. 6   **a.**   Derive an expression for total energy of election present in nth orbit of H-atom.   **(06)**

   b.   What is a Fuel Cell? Describe the construction and working of Fuel Cell, giving the reactions taking place at cathode and at anode. What is the application of these cells?   **(1+3+2+1)**