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**Answer Sheet No._____**

**Sign. of Candidate _____**

**Sign. of Invigilator _____**

# CHEMISTRY HSSC–I

## SECTION – A (Marks 17)

**Time allowed: 25 Minutes**

Section – A is compulsory. All parts of this section are to be answered on this page and handed over to the Centre Superintendent. Deleting/overwriting is not allowed. **Do not use lead pencil.**

**Q.1 Fill the relevant bubble for each part. Each part carries one mark.**

1. Plasma is the mixture of:
   - A. Electrons and protons only. ◯
   - B. Electrons and positive ions. ◯
   - C. Electrons and beta two particles. ◯
   - D. Neutrons and protons. ◯

2. The electrode potential of metals are:

   $Mg^{2+} + 2e^- \longrightarrow Mg \quad E° = -2.71$ v

   $Ag \longrightarrow Ag^+ + 1e^- \quad E° = -0.8$ v

   Cell potential (emf) of the cell formed by these two will be:

   A. + 3.51 v ◯ B. -3.51 v ◯
   C. + 1.91 v ◯ D. – 1.91 v ◯

3. At constant Pressure what will be the change in temperature when the volume of a gas will become twice of what it is at $0^oC$?

   A. $546^oC$ ◯ B. $200^oC$ ◯
   C. 546 K ◯ D. 273 K ◯

4. Rate equation for a reaction $2A \longrightarrow$ product is Rate = $K[A]^2$. Unit of specific rate constant for this reaction is:

   A. $mol^2dm^{-6}\ S^{-1}$ ◯ B. $mol^{-1}dm^3\ S^{-1}$ ◯
   C. $moldm^{-3}$ ◯ D. $S^{-1}$ ◯

5. A substance which itself is not a catalyst but increases the activity of a catalyst is called:

   A. Enzyme ◯ B. inhibitor ◯
   C. Promoter ◯ D. Poisoner ◯

6. Diamond is a bad conductor of electricity because:

A. It has a tight structure ◯ B. It has a high density ◯
C. It has no free electrons ◯ D. It is transparent to light ◯

7. Mixture containing 0.01 mole/300cm$^3$ of $NH_4Cl$ and 0.1 mole/400cm$^3$ of $NH_4OH$ having pKb = 5 has pH of:

A. 4.00 ◯ B. 4.12 ◯
C. 9.88 ◯ D. 10.00 ◯

8. 5g of urea (M.wt = 60) is dissolved in 250 cm$^3$ of its solution. Concentration of solution will be:

A. 5 % w/w ◯ B. 5 % v/w ◯
C. 0.34 M ◯ D. 0.34m ◯

9. The gaseous element X exists in diatomic form. One volume of the element X combines with two volume of hydrogen to form two volume of gaseous hydride. What is the formula of hydride of X.?

A. $HX_2$ ◯ B. $HX_3$ ◯
C. $H_2X$ ◯ D. HX ◯

10. The number of bonds in one molecule of Nitrogen is:

A. one σ and one π ◯ B. one σ and two π ◯
C. three σ only ◯ D. two σ and one π ◯

11. Splitting of spectral lines by placing the excited atom in electric field is called:

A. Zeeman effect ◯ B. Stark effect ◯
C. Photoelectric effect ◯ D. Compton effect ◯

12. In the ground state of an atom, the electron is present:

A. in the valence shell ◯ B. in the second shell ◯
C. nearest to the nucleus ◯ D. farthest from the nucleus ◯

13. Which one of the following exists in the solid state as a giant covalent lattice?

A. ice ◯ B. iodine ◯
C. silicon (IV) oxide ◯ D. dry ice ◯

14. pH of $1 \times 10^{-4}$ M solution of Phosphoric acid is:

A. 1.10 ◯ B. 2.02 ◯
C. 3.52 ◯ D. 4.13 ◯

15. In which substance does nitrogen exhibit the highest oxidation state?

A. NO ◯ B. $N_2O$ ◯
C. $N_2O_4$ ◯ D. $NaNO_2$ ◯

16. The heat of neutralization of the given reaction is -57.3 kJ

$NaOH + HCl \longrightarrow NaCl + H_2O$

What is the heat of neutralization of the following reaction?

$Fe(OH)_2 + 2HCl \longrightarrow FeCl_2 + 2H_2O$

A. -57.3kJ ◯ B. -114.6kJ ◯
C. -228kJ ◯ D. -28.6kJ ◯

17. Which of these samples of gas contains the same number of atoms as 1g of hydrogen molecule? (At. Mass C = 12, O = 16, H = 1, Ne = 20)

A. 22 g of $CO_2$ ◯ B. 8 g of $CH_4$ ◯
C. 20 g of Ne ◯ D. 8 g of $O_3$ ◯

Federal Board HSSC-I Examination
Chemistry Model Question Paper
(Curriculum 2006)

Time allowed: 2.35 hours | Total Marks: 68

Note: Answer any fourteen parts from Section 'B' and attempt any two questions from Section 'C' on the separately provided answer book. Write your answers neatly and legibly.

## SECTION – B (Marks 42)

**Q.2** Attempt any **FOURTEEN** parts from the following. All parts carry equal marks. (14 × 3 = 42)

i. The bond angles of $H_2O$ and $NH_3$ are not $109.5^o$ like that of $CH_4$. Although O and N atoms are $SP^3$ hybridized like C. Give reason.

ii. As both $NF_3$ and $BF_3$ are tetra atomic molecules but have different shape and geometry. Explain according to VSEPR theory.

iii. Ionic Crystals are brittle in nature but metals are malleable in nature. Give reason of your answer.

iv. Derive the units for general gas constant 'R' in general gas equation.
   a. When the pressure is in $Nm^{-2}$ and volume in $m^3$.
   b. When energy is expressed in ergs.

v. Justify that the distance gaps between different orbits of an atom go on increasing from the lower to the higher orbits.

vi. Describe hybridization in acetylene ($C_2H_2$) molecule. Also draw diagram of hybridized orbitals in this molecule.

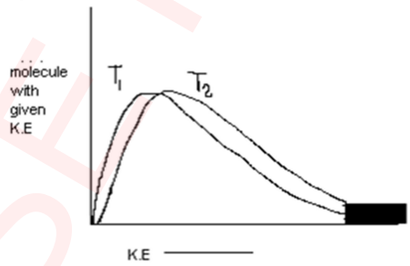
vii. Interpret why water and ethanol can mix easily in all proportions.

viii. Justify that Bohr's equation for the wave number can explain the spectral lines of Lyman, Balmer and Paschen series.

ix. State Dalton's law. Also write its two applications.

x. The melting and boiling points of hydrazine ($N_2H_4$) are much higher than those of ethane ($C_2H_4$). Suggest reasons for these differences in terms of the intermolecular forces each compound possesses.

xi. Consider this graph and explain on the basis of Maxwell Boltzmann curve of kinetic energy why does rate of reaction increase with the increase in temperature.




xii. An aqueous solution of ammonium Chloride is acidic and that of sodium acetate is basic in nature. Give reason with the help of equations.

xiii. Calculate molality of aqueous solution of sulfuric acid from the following data.

| Molar mass | Molarity | Density in g/Cm$^3$ |
|---|---|---|
| 98 | 18 | 1.84 |

xiv. Lattice energies of LiCl and KCl are 833 kJ/mol and 690 kJ/mol, respectively. Discuss why is lattice energy of LiCl greater than KCl?

xv. Benzene ($C_6H_6$) is an aromatic hydrocarbon which exists as a liquid at room temperature.
Using the following standard enthalpy changes:
Heat of formation of $CO_2$ = -393 KJ / mol
Heat of formation of $H_2O$ = -286 KJ / mol
Heat of combustion of $C_6H_6$ = -3268 KJ / mol
Calculate the enthalpy change of formation of $C_6H_6$.

xvi. Consider the Standard electrode potentials
$Ag^+/Ag = 0.7994V$, $Fe^{3+}/Fe = 0.771V$
Write the half-cell reactions at each electrode. Also write overall reaction.

xvii. Chemical kinetics is concerned with rates of chemical reactions and factors that affects the rates of chemical reactions. Consider the following steps of reactions:
$FeCl_3(aq) + 2KI(aq) \longrightarrow FeI_2(aq) + 2KCl(aq) + Cl^-(aq)$ (slow)
$2KI(aq) + 2Cl^-(aq) \longrightarrow 2KCl(aq) + I_2(S)$ (fast)
a. Write the rate expression for the above reaction.
b. Give the order of reaction for the above reaction.

xviii. What is reverse osmosis? Give its daily life applications.

xix. How to calculate the molecular mass of the solute by using $\Delta P/P^0 = X_2$?

xx. How to calculate standard electrode potential? Explain briefly.

## SECTION – C (Marks 26)

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

**Q.3** a. Derive the equation for the radius of nth orbit of hydrogen atom using Bohr's model. **(7)**

b. Ammonia Solvay process is used to manufacture sodium carbonate. During this process ammonia is recovered by the following reaction. **(2+2+2)**
$2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$
When 100 g of ammonium chloride and 150 g calcium hydroxide are used then
(At. Mass N=14 H=1 Cl= 35.5 Ca=40)
i. Calculate the mass in kg of ammonia produce during chemical reaction.
ii. Calculate the excess mass in gram of one of the reactant left unreacted.

**Q.4** Consider the following reaction:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$
a. Derive expression of Kc for the above reaction and calculate equilibrium concentration of $N_2$. The equilibrium concentration of $H_2$ and $NH_3$ are 1.0 moldm$^3$ and 0.5 moldm$^{-3}$ respectively. Kc of above reaction at 25℃ is $1.85 \times 10^{-3}$. **(4+4)**

b. Balance the following chemical equation in an acidic medium
$Cr^{3+} + BiO_3^{1-} \longrightarrow Cr_2O_7^{2-} + Bi^{3+}$ **(5)**

**Q.5** a. Phosgene ($COCl_2$) is a toxic gas. This gas is prepared by the reaction of carbon monoxide with chlorine. **(7)**

$CO\ (g) + Cl_2\ (g) \longrightarrow COCl_2\ (g)$

The following data were obtained for kinetic study of this reaction.

| Experiment | Initial [CO] | Initial [$Cl_2$] | Initial rate (moles $dm^{-3}\ s^{-1}$) |
|---|---|---|---|
| 1 | 1.000 | 0.100 | $1.29\times10^{-29}$ |
| 2 | 0.100 | 0.100 | $1.30\times10^{-30}$ |
| 3 | 0.100 | 1.000 | $1.30\times10^{-30}$ |

Use the data in the table to deduce the order of the reaction with respect to CO and $Cl_2$.

Hence write a rate law/equation for this reaction.

b. Show the diamagnetic/paramagnetic nature of $O_2$, $O_2^{2+}$ and $O_2^{2-}$ with the help of molecular orbital theory. **(6)**

* * * * *

# CHEMISTRY HSSC-I
# SLOs

## SECTION A

**Q.1**

1. Define and explain Plasma.
2. Use the activity series of metals to predict the product of single replacement reaction.
3. Drive ideal gas equation.
4. Explain and use the term rate of reaction, rate equation, order of a reaction and rate determining steps.
5. Explain that a catalyst provides a reaction path way that has a low activation energy.
6. Describe properties of crystalline solid.
7. Make Buffer solution and explain how such a solution maintain such a PH.
8. Express solution concentration in term of molality.
9. interpret volume of the gasses at STP.
10. Describe the features of sigma and Pi bonds.
11. use Bohr atomic model for calculating energy of electron in a given orbit of Hydrogen atom.
12. summarize Bohr atomic theory.
13. Differentiate between Ionic, corater molecular and metallic crystalline solids.
14. Make Buffer solution and explain how such a solution maintain such a PH.
15. Determine the oxidation number of an atom of any element in a pure substance.
16. Relate a change in enthalpy to the heat of reaction.
17. Interpret representative particles.

## SECTION B

**Q.2**

i. Determine the shape of some molecules using orbital hybridization.
ii. Use VSEPR and VBT theories to describe the shapes of the molecules.
iii. Differentiate between ionic and covalent molecular and metallic crystal solids.
iv. Explain the significance and different units of ideal gas constants.
v. relate energy equation for electron of radiation emitted or absorbed.
vi. Determine the shape of some molecules using orbital hybridization.
vii. Use the concept of Hydrogen bonding to explain the properties of water.
viii. Relate the discreate line spectrum of Hydrogen to energy levels of electrons in the Hydrogen atom.
ix. State and use Dalton law of partial fraction.
x. Explain applications of dipole dipole force, Hydrogen bonding and London force.
xi. Explain the effect of concentration, temperature and surface area on reaction rate.
xii. Use the concepts of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.
xiii. Express solution concentration in term of molality.
xiv. Calculate lattice energy and enthalpy of formation.
xv. Use standard heat of formation to calculate the heat of reaction.

xvi. Define cell potential and describe how it is determined.
xvii. Given the order with respect to each reactant write the rate law for the reaction.
xviii. Explain on a particle bases how the addition of the solute to the pure solvent.
xix. Describe on a particle bases why a solution has lower vapour pressure than the pure solvent.
xx. Define cathode, anode, electrode potential and standard hydrogen electrode.

## SECTION C

**Q.3** a. Use Bohr atomic model for calculating radii of orbits.
b. Perform Stoichiometric calculation with balanced equation using moles.

**Q.4** a. Write the equilibrium expression for the given chemical reaction.
b. When given and unbalanced redox equation use the half reaction method to balance the equation.

**Q.5** a. Given the order with respect to each reactant write the rate law for the reaction.
b. Describe the physical and chemical properties of molecules.

# CHEMISTRY HSSC-I

TABLE OF SPECIFICATION

| Topics/ Subtopics | Stoichiometry | Atomic structure | Theories of covalent bonding | States of matter-Gases | States of matter-Liquids | States of matter-Solids | Chemical Equilibrium | Acids Bases and salts | Chemical kinetics | Solutions and colloids | Thermochemistry | Electro chemistry | Total marks for each Assessment Objective | %age |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (Knowledge based) | | 1-11(01)<br>1-12(01) | 2-vi(03)<br>2-ii(03) | 1-3(01)<br>2-iv(03)<br>2-ix(03) | 1-1(01) | 1-6(01)<br>1-13(01)<br>2-iii(03) | | 2-xii(03) | 1-5(01)<br>2-xviii(03)<br>2-xi(03) | | | 2-xvi(03) | 34 | 29.3% |
| (Understanding based) | 1-9(01)<br>1-17(01) | 2-v(03)<br>2-viii(03)<br>3a(07) | 1-10(01)<br>2-i(03)<br>5b(06) | | 2-vii(03)<br>2-x(03) | | 4a(8) | | 1-4(01)<br>1-14(01)<br>2-xvii(03) | | 1-16(01)<br>2-xiv(03) | 1-2(01)<br>1-15(01)<br>2-xx(03)<br>4b(05) | 58 | 50% |
| (Application based) | 3b(06) | | | | | | | 1-7(01) | 5a(07) | 1-8(01)<br>2-xiii(03)<br>2-xix(03) | 2-xv(03) | | 24 | 20.7% |
| Total marks for each Topic/Subtopic | 08 | 15 | 16 | 07 | 07 | 05 | 08 | 04 | 19 | 07 | 07 | 13 | 116 | 100% |

**KEY:**

1-1(01)

Question No-Part No. (Allocated Marks)