+3 Sem-II(NEP)
CHE-C-1(P-3)

April,2025

States of matter and Ionic Equlibrium(Major)

Full Marks : 100 Time : 3 hrs

ANSWER ALL THE GROUPS
Figures in the right hand margin indicate marks

PART-I

1. Answer all the all questions: - **(10x1)**

a. The value of $\frac{RT_c}{P_cV_c}$ is :-

i) 1 ii) $\frac{8}{3}$ iii) $\frac{3}{8}$ iv) None of these

b. Compressibility factor Z of an ideal gas is :

i) Zero ii)1 iii) >1 iv) <1

c. The internal resistance to flow possessed by liquid is called its : :

i) Surface tension ii) Fluidity iii) Viscosity iv) boiling point

d. NaCl crystal shows which type of cubic lattice?

a) Simple cubic b) FCC (face-centered cubic)

c) BCC (body-centered cubic) d) Hexagonal

e. The total number of Symmetry elements in a Cubic Crystal are :

i) 13 ii) 23 iii)30 iv) 33

f. The number of atoms present per unit cell of a simple Cubic Crystal is _____?

i) 0 ii)1 iii)1/2 iv) 8

g. The P^H value of 1 M HCl Solution at room temperature is _____?

h. The PH of a Solution is 4, its POH value will be _____ ?

i. The value of ionic product of Water at 25^0C is ____ ?

j. Which Substance on mixing with CH_3COOH forms a buffer Solution ?

PART-II

2. Answer all the questions: **(9x2)**

a. What is meant by mean free path?

b. What is Collision cross-section?

c. Why do real gases deviate from ideal behaviour?

d. Shapes of small drops water are Spherical in shape- Explain.

e. A Crystal plane has intercepts on the three axes of crystal in the ratio of $\frac{3}{2}$:2:1. What are Miller indices of the Plane ?

f. What do you mean by axis of Symmetry ?

g. Explain-aqueous solution of Sodium Carbonate is alkaline in nature ?

h. What do you mean by strong electrolytes ? Give an example.

i. Calculate the P^H value of Centi normal HCl Solution at 25 ^{0}C ?

PART-III

3. **Answer any Eight of the following questions : (8x5)**

a. What is rms velocity ? At what temperature is the r.m.s. velocity of CO_2 gas will be same as that of Cl_2 at 20^0C ? **[2+3]**

b .Explain the term compressibility factor (Z) and what does it indicate? **[5]**

c. Explain the Law of Equipartition of Energy.

d. Define the term Vapour pressure and explain - Evaporation causes cooling. **[2+3]**

e. What is capillary action? Explain- how does it depend on cohesive and adhesive forces? **[2+3]**

f. Explain - how does Viscosity vary with temperature and by addition of various solutes? **[$2\frac{1}{2}+2\frac{1}{2}$]**

g. What is surface tension? Explain the cleaning action of detergents. **[2+3]**

h. State and explain the law of constancy of interfacial angles.

i. What are crystal defects? Differentiate stoichiometric and non-stoichiometric defects. **[2+3]**

j. Write a short note on – Solubility Product. **[5]**

PART-IV

4. **Answer any Four of the following questions: (4x8= 32)**

a. Discuss Maxwell's distribution of molecular velocities. Define average and most probable velocities. **[4+2+2]**

b. What are real gases ? Derive Vander Waals equation for 'n' moles of a real gas . **[2+ 6]**

c. What is Viscosity of a liquid? Describe a method for determining the coefficient of viscosity of a liquid. **[2+ 6]**

d. State Bragg's law. Derive Bragg's equation for the determination of crystal structure. **[2+6]**

e. Write notes on-

i) Buffer Solution ii) Common ion effect

******

+3 Sem-II(NEP)
CHE-C-1(P-4)

April,2025

Chemical Thermos Dynamics, Equilibrium and Colligative Property(Major)

Full Marks : 100 **Time : 3 hrs**

ANSWER ALL THE PARTS

Figures in the right hand margin indicate marks

PART-I

1. Answer all questions or fill in blanks as required. (10x1)

a. Temperature is an _____ property. (extensive / intensive)

b. For which of the reaction, $\Delta H=\Delta E$?

i) $N_2+ 3H_2 \rightarrow 2NH_3$ ii) $PCl_5 \rightarrow PCl_3 + Cl_2$

iii) $2Na + Cl_2 \rightarrow 2NaCl$ iv) $N_2 + O_2 \rightarrow 2NO$

c. In an adiabatic process, _____ of the system remains constant.

d. The dissociation energy of CH_4 is 360 Kcal/mole. What is the energy associated with C-H bond ?

e. When ice melts into water its entropy _____ . (increases, decreases, remains same)

f. At equilibrium, the value of change in free energy (ΔG) is always _____ .(+Ve, - Ve, Zero)

g. The relation between ΔG, ΔH and ΔS is:

i) $\Delta G = \Delta H+T\ \Delta S$ ii) $\Delta G = \Delta H - T\ \Delta S$ iii) $\Delta H = \frac{\Delta G}{T\ \Delta S}$ iv) $\Delta S = \Delta G+T\ \Delta H$

h. When a small amount of non-volatile solute is added to a pure solvent, the vapour pressure of resulting dilute solution _____ ?

i) decreases ii) Increases iii) remains the same iv) None of these

i. What is the name of the term $\left(\frac{\partial G}{\partial n_i}\right)_{T,P,n,.....}$ is _____ .

j. What is the relationship between Kp & Kc for the reversible reaction :

H_2 (g) + I_2 (g) ⇄ 2 HI (g)

PART-II

2. Answer all the questions : (9x2)

a. What is the Zeroth Law of Thermodynamics?

b. Calculate the enthalpy of formation of PC_5(S) from the following data:

$2P(S) + 3Cl_2$ (g) $\rightarrow 2PCl_3$ (g), $\Delta H = -15.8\ KCal$

$PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$,$\Delta H = -33.8\ KCal$

c. Justify the statement- " Entropy of the Universe is increasing".

d. What is inversion temperature ?

e. What are spontaneous processes? Give an example.

f. What is Raoult's Law.

g. Differentiate between ideal and non-ideal solutions.

h. What is partial molar quantity ?

i. Explain- Boiling point of Solvent is elevated by the addition of a non-volatile solute.

PART-III

3. Answer any Eight of the following questions (8x5)

a. Differentiate between extensive and intensive properties with examples.

b. Explain - isolated and open systems by giving examples..

c. Define enthalpy of formation and enthalpy of combustion.? Give an example from each.

d. State and explain Carnot's theorem.

e. State the Second Law of Thermodynamics in different forms.

f. State the Third Law of Thermodynamics and explain residual entropy.

g. What do you mean by efficiency a heat engine ? Calculate the efficiency of a heat engine which operates between 400 K & 300 K ?

h. State and explain Henry's law? Give one of its application.

i. Explain the difference between reversible and irreversible processes with examples.

j. Define osmotic pressure and derive Van't Hoff's equation.

PART-IV

Answer any Four of the following questions [4x8]

4. a. What do you mean by isothermal process ? Derive an expression for work done in a reversible isothermal expansion of an ideal gas. **[2+6]**

b. What do you mean by heat capacity of a system? Derive the relationship between heat capacities at constant pressure (Cp) and constant volume (Cv). **[2+6]**

c. Explain the term free energy and derive the Gibbs-Helmholtz equation and write the significances of Gibbs-Helmholtz equation **[2+4+2]**

d. State Le Chatelier's Principle. Discuss the effect of change of temperature, Pressure and Concentration on the following system at equilibrium:

N_2 (g) + $3H_2$ (g) ⇄ 2 NH_3 (g) + 22.4 Kcal . **[8]**

e. What do you mean by depression in Freezing Point in dilute solution and derive an expression for elevation in boiling point thermodynamically. **[2+6]**

*****

April,2025

Atomic structure, Periodicity of Elements and Chemical Bonding(Minor)

Full Marks : 100 Time : 3 hrs

ANSWER ALL THE GROUPS

Figures in the right hand margin indicate marks

PART-I

1.Answer the all questions: **(10x1)**

a. Which quantum number determines the shape of an orbital ?

b. The ion which is iso-electronic with CO is :-

i) CN^- ii) O_2^- iii) N_2^+ iv) O_2^+

c. The designation of an orbital with n = 4 and l = 3 is :

i) 4s ii) 4p iii) 4d iv) 4f

d. How many unpaired electrons are present in Cr (Z=24).

e. Which of the following has the smallest size?

i) F^- ii) Ne iii) Mg^{+2} iv) Al^{+3}

f. What type of hybridization exists in the Central atom of NH_3 molecule?

g. The bond order of O_2 molecule is _____ .

h. Which of the following molecule is linear in shape?

i) H_2O ii) CH_4 iii) C_2H_6 iv) CO_2

i. A Species which is formed by co-ordinate covalency is : ?

i)NH_4^+ ii) BF_3 iii) NH_3 iv) PCl_5

j. Filling of 4P sub- shell begins in atomic number :-

i) 19 ii) 29 iii) 31 iv) 35

PART-II

2. Answer all the questions: **(9x2)**

a. Write the values of n, l, m and s for the 4S electron.

b. Why 4S orbital is filled earlier than a 3d-orbital ?

c. Write the electronic configuration of the following:

i) Cu ii) Fe^{3+}

d. Electron affinity of Be is zero, why ?

e. What is ionization potential?

f. Why sigma bond is stronger than pi bond?

g. Write the molecular electronic Configuration of N_2 .and O_2.

h. Why does He_2 not exit ?

i. Why sigma bond is stronger than pi bond?

PART-III

3. Answer any **Eight** of the following questions : **(8x5)**

a. Explain –Aufbau's principle. [5]

b. Derive the de - Broglie equation and discuss its significance in atomic structure. [3+2]

c. Derive Schrödinger's wave equation for the hydrogen atom. [5]

d. Define electron affinity and describe its variation across periods and groups. [2+3]

e. What is hybridization? Explain about the hybridization involved and shape of NH_4^+ ion. [2+3]

f. Explain about the shapes of the following species -

i) BCl_3 ii) H_2O [$2\frac{1}{2} + 2\frac{1}{2}$]

g. Explain the magnetic nature of the following with reason :

i) O_2 ii) N_2 [$2\frac{1}{2} + 2\frac{1}{2}$]

h. Write a note on - Fajan's rules . [5]

i. Draw molecular orbital diagram of O_2. Explain the concept of bond order and magnetic nature. [2+$1\frac{1}{2}$ +$1\frac{1}{2}$]

j. Write a note on Hydrogen Bond. [5]

PART-IV

4. **Answer any Four of the following questions:** **(4x8= 32)**

a. Write notes on – [4+4]

a) Heisenberg's Uncertainty Principle b) Hund's rule

b. Describe all the four Quantum numbers with their significance? [2 × 4]

c. What is electron affinity. Discuss the various factors that affects and explain the trends in their variation along a period and down a group. [3+3+2]

d. What is lattice energy ? How lattice energy of NaCl can be determined by Born-Haber Cyclic Process? [2 + 6]

e. Explain VSEPR theory and also explain about the shape of NH_3 molecule with the help of this theory. [4+4]

*****