PHYSICAL CHEMISTRY – 37 MARKS

[A] SOME BASIC CONCEPT OF CHEMISTRY

1. Define limiting reagent.

2. One atom of element weighs $9.75 \times 10^{-23} g$.Calculate its atomic mass.

3. Commercially available sulphuric acid contain 93% acid by mass and has density $1.84\ g\ mL^{-1}$. Calculate

   (i) Molarity of solution

   (ii) Volume of concentrated acid required to prepare $2.5\ L$ of $0.50\ M\ H_2SO_4$?

4. (i) How many atom of He are present in $52\ U$ of He

   (ii) What is meant by empirical formula & molecular formula? How are they related to each other?

5. In three moles of ethane (C_2H_6), calculate the following

   (i) No. of moles of carbon atoms.

   (ii) No. of moles of hydrogen atoms.

   (iii) No. of molecules of ethane.

6. What will the mass of one ^{12}C in gram?

7. Hydrogen catches fire easily and oxygen helps in combustion. Why is water used for extinguishing fire?

8. Are the molar volume of CO_2 and SO_2 different? Support your answer.

[B] STRUCTURE OF ATOM

1. Write the electronic configuration of

   (i) Cu^{2+} (ii) Cr^{+} (iii) Fe^{3+} (iv) Mn^{2+} (v) Cl^{-}

2. What is energy of a photon of light having frequency $3.0 \times 10^{15}\ s^{-1}$ (plank's constant $= 6.6 \times 10^{-34} js$)

3. (i) What are the permitted value of n, l and m for and electron in a $4f$ orbital?

   (ii) What is an orbital? Compare the shape of $1\ s$ and $2\ s$ orbital.

4. (i) How many electron in an atom may have $n = 4$ and $m_s = +\frac{1}{2}$?

(ii) How many neutron and proton are present in U_{92}^{235}?

(iii) An electron has a speed of 600 ms^{-1} with uncertainty of 0.025%. What is the uncertainty in position?

5. Write short notes on

(i) Heisenberg Uncertainity Principle.

(ii) Aufbau Principle.

(iii) Hund's Rule of Maximum Muliplicity.

6. (i) The energy associated with first orbit in hydrogen atom is-2.17×10^{-18} J $atom^{-1}$. What is the energy associated with the $5th$ orbit of Hydrogen?

(ii) Calculate the radius of Bohr's $5th$ orbit for Hydrogen atom.

[C] CLASSIFICATION OF ELEMENTS & PERIODICITY IN PROPERTIES

1. Which among N, O and F has lowest ionization enthalpy?

2. To which block do the elements with atomic number 28 and 32 belong?

3. Explain following

(i) oxygen has lower ΔiH than N and F.

(ii) Elements in same group have similar physical and chemical properties.

(iii) Size of anion is larger than the corresponding atom but the size of cation is smaller than the corresponding atom.

4. (i) Give the general electronic configuration of $p - block$ elements.

(ii) Arrange the elements: B, Al, Mg and k in the decreasing order of Metallic Character.

(iii) What is the basic difference in approach between the Mendellev's Periodic law and Modern periodic law?

5. On the basis of quantum number explain why $6th$ period is considered as the longest period of P.T.

6. Atoms of 18 group elements have larger Atomic size why?

[D] CHEMICAL BONDING

1. Write M.O. electronic configuration of O_2 Molecules.

2. Discuss the shape of following molecules using V.S.E.R. model:

   (i) PH_3 (ii) HNO_3 (iii) SF_6 (iv) SF_6

   (v) IF_7 (vi) ICl_3^-

3. (a) State the type of hybrid orbital associated with

   (i) P in PF_5 (ii) S in SF_6

   (b) Is there any change in hybridization of B and N atom as a result of following reaction:

   $$BF_3 + NH_3 \longrightarrow F_2B - NH_3$$

   (c) Explain why ionic compound have higher melting and boiling points.

4. (i) Define hydrogen bond. Is it weaker or stronger than the vander waals force?

   (ii) Define electronegativity. How does it differ from electron gain enthalpy?

   (iii) All the $C - O$ bonds in carbonate ion (CO_3^{2-}) are equal in length. Explain.

   (iv) H_2O is liquid but H_2S is gas why?

   (v) $NaCl$ is ionic but $CuCl$ is covalent why?

[E] STATE OF MATTER

1. (a) What is the effect of temperature on:

   (i) viscocity (ii) surface tension

   (b) Density of gas is found to be 5.46 $g\ dm^{-3}$ at 27°C and 2 bar pressure. What will be the density at $N.T.P.$

   (c) Calculate the number of unit cell in 8.1 g of aluminium. If it crystallizes in F.C.C. structure (Atomic mass of $Al = 27\ g\ mol^{-1}$)

2. Calculate the total pressure of a mixture of 8 g of oxygen and 4 g of hydrogen confined in a vessel of 1 dm^3 at 27°C. ($R = 0.083\ bar\ dm^3\ k^{-1}\ mol^{-1}$)

3. (i) What is meant by compressibility factor of a gas?

(ii) Write the difference between $n - type$ and $p - type$ semiconductor.

(iii) An element with density $11.2\ g\ cm^{-3}$ form a FCC lattic with edge length of $4 \times 10^{-8}\ cm$. Calculate the atomic mass of the elements. ($N_A = 6.022 \times 10^{23}\ mol^{-1}$)

4. Write the difference between Amorphous & crystalline solid.

5. Calculate the number of particle in simple cubic, FCC, bcc unit cell.

[F] THERMODYNAMICS

1. Explain:

(i) Reversible and irreversible process

(ii) isothermal and adiabatic process

2. Explain following:-

(i) Energy of universe remains constant but entropy of universe always increases.

(ii) Most of the reaction which are spontaneous at room temperature are exothermic while the endothermic reaction are favorable at very high temperature.

3. (i) Write the difference between extensive and intensive properties.

(ii) A system absorbe 701 J of heat and does work equibalent to 394 J on its surrounding. Calculate the change in internal energy for the process.

4. (i) Heat capacity is an extensive property but specific heat is intensive property. Comment on the statements.

(ii) The C_p and C_v of a gas are 20.834 and 12.520 $Jk^{-1}mol^{-1}$ respectively. What is the atomicity of the gas.

(iii) $N_2(g) + 3H_2(g) \longrightarrow 2NH_3(g) \quad \Delta fH° = -92.4\ kJ$

What is the standard enthalpy of formation of NH_3?

5. Calculate the enthalpy change for the process

$$CCl_4(g) \longrightarrow C(g) + 4\,Cl\,(g)$$

Calculate bond enthalpy of $C - Cl$ in $CCl_4\ (g)$

Given $\Delta_{vap}H°(CCl_4) = 30.5\ kJ\ mol^{-1}$

$\Delta_f H°(CCl_4) = -135.5\ kJ\ mol^{-1}$

$\Delta_a H°(C) = 715.0\ kJ\ mol^{-1}$ where $\Delta_a H°$ is

Enthalpy of atomisation. $\Delta_a H°(Cl_2) = 242\ kJ\ mol^{-1}$

[G] REDOX REACTION

1. (a) Find the oxidation number of:

   (i) Mn in MnO_4^- (ii) O in H_2O_2

   (b) Balance the following equation by ion-electron method in acidic

   Medium $MnO_4^- + I^- \longrightarrow Mn^{2+} + I_2$

2. (i) $Zn\ (s) + Cu^{2+}\ (Aq) \longrightarrow Zn^{2+}\ (Aq) + Cu\ (s)$

   Is this reaction is redox reaction? If yes name the oxidizing agent as well as reducing agent.

   (ii) Give an example of disproportionation reaction.

3. Balance the following reaction by ions electron method:

   (i) $Cr_2O_7^{2-} + SO_3^- \longrightarrow Cr^{3+} + SO_4^{2-}$

   (ii) $MnO_4 + Fe^{2+} \longrightarrow Mn^{2+} + Fe^{3+}$

4. (i) Write the anode, cathode and net cell reaction for the following cell:

   $Zn\ (s)\ |\ Zn_{2+}\ (Aq)\ ||\ B_6^-\ (Aq)\ |\ Br_2\ (g)\ PT$

   (ii) Give two main function of salt bridge.

[EQUILIBRIUM]

1. (i) Write the expression k_p for the reaction:

   $CaCO_3\ (s) \rightleftharpoons CaO\ (s) + CO_2\ (g)$

   (ii) State the conjugate dissociation. Calculate the pH of following solution:

   (i) $0.003\ M\ HCl$ (ii) $0.002\ M\ KOH$

3. Consider the reaction

$$2\,SO_2\,(g) \quad + \quad O_2\,(g) \quad \rightleftharpoons \quad 2\,SO_3\,(g) \quad + \quad 190\,kJ\,mol^{-1}$$

Indicate the direction in which the equilibrium will shift when

(i) temperature is increased

(ii) volume is increased

(iii) a catalyst is added

(iv) concentration of SO_2 increased

(v) Helium gas added at constant pressure

(vi) Helium gas added at constant volume.

4. Calculate (a) $\Delta G°$ and (b) equilibrium constant for the formation of NO_2 from NO & O_2 at $298\,K$ temp.

$$NO\,(g) \quad + \quad \frac{1}{2}O_2\,(g) \quad \rightleftharpoons \quad NO_2\,(g)$$

Where, $\Delta_f G°\,(NO_2) = 52.0\,kJ\,mol^{-1}$

$\Delta_f G°\,(NO) = 87.0\,kJ\,mol^{-1}$

HYDROGEN

1. What is Hydride? Explain various type of hydride with example.

2. What is hydride gap?

3. Distinguish between hard water and soft water. Explain any two method to remove permanent hardness of water.

4. Find the volume strength of 30 volume solution of hydrogen Peroxide.

5. Write any four method of preparation of H_2O_2

6. Ice is lighter than water. Explain briefly.

S-BLOCKS

1. Lithium shows anomalous behavior. Why?
2. Arrange the following in the order of their increasing Hydration enthalpy.

   Cs^+, K^+, Rb^+, Na^+, Li^+
3. Sodium forms peroxide but cannot form superoxide. Why?
4. Explain the formation of Na_2CO_3 by solvay process. K_2CO_3 cannot be prepared by this process why?
5. How will you prepared caustic soda from brine.
6. Be & Mg do not impart colour on heating.
7. Give the shape of B_{eCl_2} in its solid and vapour phase.
8. What happens when

   (i) sodium metal dropped in water?

   (ii) sodium metal is heated in free supply of air?

   (iii) sodium peroxide dissolve in water?
9. Write the balance chemical equation for reaction between –

   (i) Na_2O_2 & water

   (ii) KO_2 & water

   (iii) Na_2O & CO_2

P-BLOCK

1. Write the chemical formula of

   (i) Orthoboric acid (ii) Borax (iii) Kernite (iv) silicones

   (v) Diborane
2. What is inert pair effect explain briefly.
3. Boron does not show +3 oxidation state why.
4. $AlCl_3$ forms dimer explain the bonding with detail.

5. Write the structural difference between graphite and diamond.

6. Write balance equation for –

(i) $BF_3 + LiH \longrightarrow$

(ii) $B_2H_6 + H_2O \longrightarrow$

(iii) $NaH + B_2H_6 \longrightarrow$

(iv) $H_3BO_3 \xrightarrow{\Delta}$

(v) $Al + NaOH \longrightarrow$

(vi) $B_2H_6 + NH_3 \longrightarrow$

7. How would you explain lower atomic radii of gallium as compare to aluminium.

8. Write the structure of oxide of Nitrogen.

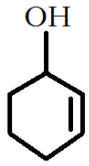
(i) NO_3 (ii) N_2O_4 (iii) N_2O_5

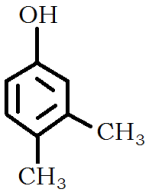
9. Write the preparation of HNO_3 by Ostwald process.

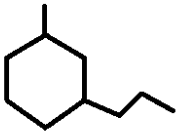
10. NCl_5 does not exist but PCl_5 exist.

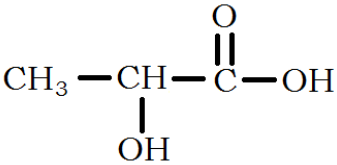
BASIC CONCEPT OF ORGANIC CHEMISTRY

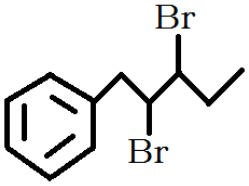
1. Write the IUPAC name of followings:-

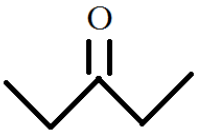
(i) 

(ii) 

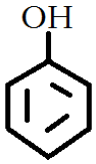
(iii) 

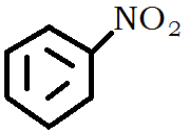
(iv) 

(v) 

(vi) 

2. Write the all possible resonating structure of –

(i) 

(ii) 

(iii) $CH_3CH{=}CH{-}CHO$

3. Define inductive effect.

4. With the help of suitable example explain + E and – E effect.

5. Define carbocation, and arrange following in increasing order of stability.

$$CH_3-\overset{+}{C}(CH_3)-CH_3 \qquad CH_3-\overset{+}{C}(H)-CH_3 \qquad CH_3-\overset{+}{C}-CH_2$$

6. Define electrophile & Nucleophile with example.
7. Explain why alkyl group act as electron donor when attached to a TT system.
8. Write all possible structural isomers of C_4H_8.

HYDROCARBON

1. Do the following conversion:-

(i) Methane to Ethane (ii) Ethane to Methane

(iii) Benzene to P-Nitrobromobenzene (iv) Benzene to Acetophenone

(v) Hexane to Benzene

2. Complete the following reaction:-

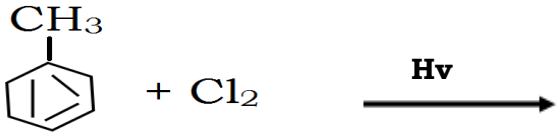
(i) $CH_3CH = CH_2 + HBr \longrightarrow$

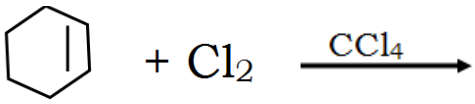
(ii) $CH_3C \equiv CH + H_2O \xrightarrow{Hg^{2+}/H^+}$

(iii) $CH_2 = CH_2 + Br_2 \xrightarrow{CCl_4}$

(iv) $CH_2 = CH_2 \xrightarrow[\text{(ii) } Zn/H_2O]{\text{(i) } O_3}$

(v)  $+ CH_3-\overset{O}{\overset{\|}{C}}-X \xrightarrow{\text{Anhyd. } Alcl_3}$

(vi) 

(vii) 

3. An alkyl halide $C_5H_{11}Br$ [A] react with ethanolic KOH to give an alkene [B] which react with Br_2 to give a compound [C] which on dehydrobromination given an alkyne [D] on treatment with sodium metal in liquid ammonia, one mole of [D] gives one mole of sodium salt of [D] and half a mole of hydrogen gas. Complete hydrogentation of [D] yields a straight chain Alkane. Identify A, B, C & D.

ENVIRONMETAL CHEMISTRY

1. What is Acid Rain.
2. Explain green house effect. Name some green house gases.
3. What is song
4. What are pesticide & Herbicide.
5. How can domestic waste used as manures.