1. (A) Select the correct option and complete the following sentences. (any **twelve**)   **12**

(i)   The Bragg's equation for diffraction of X-rays is _____ .
       (a) $n\lambda= d\sin\theta$ *(b) nλ= 2dsinθ*   (c) $2n\lambda= d\sin\theta$

(ii)   The total number of effective atoms in _____ system is 4.
       (a) *face centred cubic*   (b) body centred cubic   (c) simple cubic.

(iii)   _____ deaccelerates a reaction by increasing the energy of activation of the reaction.
       (a) Catalyst   *(b) An inhibitor*   (c) Temperature.

(iv)   The enzyme which can catalyse the conversion of maltose into glucose is _____.
       (a) *maltase*   (b) invertase   (c) zymase.

(v)   There are seven crystal system and _____ Bravais lattices.
       (a) *14*   (b) 7   (c) 9

(vi)   Tetraethyl lead, when added to petrol, acts as _____.
       (a) promoter   (b) an inhibitor   *(c) suppressor*

(vii)   In aqueous solution of **(c) Sn^{4+}** ions, concentration of H_3O^+ ions is maximum.
       (a) Na^+ (b) Cs^+ (c) Sn^{4+}

(viii)   Acidity of aqueous solution of cation **(b) increases** with increase in its hydration energy.
       (a) decreases   (b) increases   (c) remains same

(ix)   During hydration of anion in aqueous solution **(a) energy is released**.
       (a) energy is released   (b) energy is absorbed
       (c) energy is neither absorbed nor released

(x)   Phosphoric acid has formula **(c) H_3PO_4**.
       (a) H_2PO_3(b) H_2PO_4(c) H_3PO_4

(xi)   Phenomenon of photochemical smog leads to **(a) eye irritation** .
       (a) eye irritation   (b) decrease in acid strength   (c) increase in visibility

(xii)   **(b) Phosphoric acid** is used in soft drinks.
       (a) Sulphuric acid   (b) Phosphoric acid   (c) Nitric acid.

(xiii)   When pyridine is treated with sodamide in liquid ammonia it gives a mixture of _____ aminopyridines.
       (a) 2- and 3-   *(b) 2- and 4-*   (c) 2- and 5-

(xiv)   Electrophilic substitution reaction in thiophene takes place at position ____ .
       (a) 3 and 4   *(b) 2 and 5*   (c) 2 and 4

(xv) Two moles of _____ diketone are required in Hantzsch synthesis of pyridine.
 _(a) 1,3-_ (b) 1,4- (c) 1,5-

(xvi) Primary amine reacts with nitrous acid to form **alcohol** and nitrogen gas.
 (a) N-nitrosoamine (b) alcohol (c) ammonium salt

(xvii) Coupling of phenol with diazonium salt is usually carried out in **slightly alkaline** medium.
 (a) slightly alkaline (b) slightly acidic (c) neutral

(xviii) **Dimethyl aniline** is the strongest base.
 (a) Aniline (b) p-Nitroaniline (c) Dimethyl aniline

(B) State whether the following statements are true or false. (any **three**) **3**
(i) Temperature accelerates the rate of a catalysed reaction. **TRUE**
(ii) Sodium chloride crystallises in the body centred cubic lattice form. **FALSE**
(iii) In aqueous solution of Na^+ ions, H_3O^+ ions do not exist. **FALSE**
(iv) Sulphuric acid is used in the production of fertilisers. **TRUE**
(v) Pyrrole is a stronger base than pyrrolidine. **FALSE**
(vi) Sulphonation of the furan can be carried out by the action of H_2SO_4. **FALSE**

(C) Match the column. (any **five**) **5**

(i)	Decreases activity of catalyst - **c**	(a)	pK_b between 11.5 and 14
(ii)	Nano catalyst - **e**	(b)	pK_b between 6 and 11.5
(iii)	Strongly basic anion - **f**	(c)	Inhibitor
(iv)	Feebly basic anion - **a**	(d)	Temperature
(v)	Azocoupling reaction-**g**	(e)	Gold supported on metal oxide.
(vi)	Aldehyde & Ketones to Amines-**i**	(f)	pK_b between -4 and 1
		(g)	Synthesis of azo dyes
		(h)	Reaction with nitrous acid
		(i)	Reductive amination

2. Attempt any **four** of the following. **20**
(A) Explain three laws of crystallography.
Ans
 i) **Statemen -02 mark**
 ii) **Digramatically explanation-03 marks**

(B) State Bragg's equation. Derive and explain $n\lambda = 2d\sin\theta$.

Ans
 i) **Statement- 01 mark**
 ii) **Diagram X-ray diffraction-01 mark**
 iii) **Explanation of diagram-01 mark**
 iv) **Derivation $n\lambda = 2d\sin\theta$-02 marks**

(C) What is homogenous and heterogenous catalysis? Explain with suitable examples.
Ans
 i) **Heterogeneous catalysis-01 mark**
 ii) **Explanation with 4 examples-04 marks**

(D)   What are the characteristic features of a catalyst?

Ans   i)   **Catalyst lowers the energy of activation -01 mark**

     ii)   **The catalyst does not change either the position or the magnitude of the equilibrium constant-01 mark**

     iii) **A catalyst remains unchanged in mass and chemical composition at the end of the reaction-01 mark**

     iv)   **A small quantity of catalyst is sufficient -01 mark**

     v)   **The catalyst does not initiate the reaction-01 mark**

(E)   What is acid base catalysis? Explain with suitable examples.

Ans   i)   **Acid-Base catalysis explanation – 03 marks**

     ii)   **Two examples – 02 marks.**

(F)   CsCl crystallises in the bodycentred cubic lattice form its unit cell edge is 4.59×10^{-10} m. The density of CsCl is 3.75×10^3 Kg m^{-3} and its molecular weight is 168.4. Calculate Avogadro's number from this data.

Ans   i)   **Given terms-0.5 mark**

     ii)   **Formula -0.5 mark**

     iii) **Correct value substitution -01 mark**

     iv)   **Calculation   -02 marks**

     v)   **Avogadro's number = 6.023×10^{23} :- correct answer with unit – 01 mark**

3.   Attempt any **four** of the following.   **20**

(A)   'The aqueous solution containing monoatomic cations becomes acidic'. Explain with a suitable example.

ANS   (i)   **Diagram of hydration and or diagram to furnish H$^+$ - 1 mark**

     (ii) **General Chemical equation - 1 mark**

     (iii) **Explanation of diagram and equation – 1 mark**

     (iv) **With chemical equation example of chromium or any general metal ion M^{+n} - 2 mark**

(B)   Write Latimer equation to calculate hydration energy of cation and explain the terms involved in it. Using this equation, calculate ΔH_{hyd} for Sc^{3+} ion. The radius of Sc^{3+} ion is 88pm.

ANS   (i)   **Latimer equation   - 1 mark**

     (ii) **Terms   - 1mark**

     (iii) **Substitution   - 1 mark**

     (iv) **Calculation, answer and unit   - 2 mark**

             Answer for numerical is 3972 kJ/mol

(C)   How cations are classified on the basis of their acidity? Explain any one category with the help of suitable predominance diagram.

ANS   (i)   **Classification of cations   - 2 mark**

     (ii) **Any one category with suitable pKa range, example, predominance diagram with explanation   - 3 mark**

(D)   With suitable predominance diagram and example, explain the following
     (i) non basic anion (ii) weakly basic anion.

ANS   (i)   **Non basic anion – example – ½ mark, predominance diagram – 1**

          mark, explanation with pKb range – 1 mark
- (ii)   **Weakly basic anion – example – ½ mark, predominance diagram – 1 mark, explanation with pKb range – 1 mark**
- (E)   Write physical properties of sulphuric acid.
  Five physical properties – 1mark each
- (F)   Write a note on uses of nitric acid.
  Five uses – 1 mark each

4. Attempt any **four** of the following.
   - (A) (i) Give preparation of a) 2-bromothiophene, b) 2-nitrothiophene and   **3**
      c) 2-acetyl thiophene from thiophene.
          Conditions in preparation – 1 mark each
      (ii) Why is piperidine more basic than pyridine ?   **2**
          Discussion of *s* – character- 1 mark,
          Electron pair is held by nucleus more firmly in pyridine than in piperidine - 1 mark
   - (B) (i) Explain Diel's-Alder reaction of furan.   **3**
          Explanation – 2 marks, Example – 1 mark
      (ii) Write N – alkylation of aromatic primary amine.   **2**
          Description 1mk, reaction 1mk
   - (C) (i) 'Pyridine gives nucleophilic substitution at 2,4 and 6 positions'. Explain.   **3**
          Resonance structure of Pyridine – 1 mark, Description -2 mark,
      (ii) Give carbylamine reaction of amines.   **2**
          Description 1mk, reaction 1mk
   - (D) (i) Explain two methods of preparation of aromatic amines from aromatic nitro   **3**
      compounds using reduction reactions.
          Description 1mk, reaction ½ mk X 2
      (ii) Give Paal-Knorr synthesis for the preparation of thiophene.   **2**
          Starting material, Reagent, Reaction Condition, Product - ½ X 4 mark
   - (E) (i) How is quaternary ammonium iodide obtained from aniline?   **3**
          3 steps methylation reaction of aniline with methy iodide -1 mk each step
      (ii) Discuss aromaticity of pyrrole.   **2**
          Huckel's Rule – 1 mark,
          Explanation (pyrrole satisfy Huckel's Rule)– 1 mark
   - (F) (i) How is benzene diazonium salt reduced to aryl hydrazine and hydrazobenzene?   **3**
          Reaction with description of Benzene diazonium salt with $NaHSO_3$ to Phenylhydrazine - 1 ½ mk
          Reaction with description of Benzene diazonium salt with Phenol followed with Zn dust and aqs.NaOH to Hydrazobenzene - 1 ½ mk
      (ii) What is Sandmeyer reaction?   **2**
          Description 1mk, reaction 1mk

5. Attempt any **four** of the following.
   - (A) Derive Michalis-Menten equation for enzyme catalysis with suitable graphical   **5**
      representation.
   - Ans   **i)**   **Reaction with differential equation – 01 mark**

         ii)   **Steady state approximation -01 mark**
         iii)   **Concentration of free enzyme- 01 mark**
         iv)   **Michalies-Menten equation -01 mark**
         v)   **Case i and ii – 01 mark**

(B)   The first order reflection of beam X-rays from (100) plane of KCl occurs at an   **5**
angle of 4.2^o. Calculate the wavelength of X-rays. What would be the angle of
reflection if X-rays of wavelength 201.0 pm are used?
(Given d_{100} for KCl is 258.0 pm)

Ans

         i)   **Given terms-0.5 mark**
         ii)   **Formula -0.5 mark**
         iii)   **Correct value substitution -01 mark**
         iv)   **Calculation   -02 marks**
         v)   **Correct answer with unit – 01 mark**

(C)   With the help of predominance diagram explain the behaviour of Cr^{3+} ions in   **5**
aqueous solution.
        (i)   **Predominance diagram concept**   **– 1 mark**
        (ii)   **Role of concentration of Cr^{+3}**   **- 1 mark**
        (iii)   **Predominance diagram for any one concentration – 1 mark**
        (iv)   **Explanation of predominance of various species – 2 mark**

(D)   Write a note on acid rain.   **5**
        (i)   **Acid rain cause – 1 mark**
        (ii)   **Consequenses – 2 mark**
        (iii)   **Remedies   - 2 mark**

(E)   (i) What are diazonium salts? How is benzene diazonium chloride prepared?   **3**
     Explanation of Diazonium salt 1mk, generation of HNO_2 1mk, reaction
     of aniline with HNO_2 and HCl 1mk
     (ii) Write a note on Gattermann reaction.
      Description 1mk, Reaction 1mk   **2**

(F)   (i) Write note on sulfonation of pyridine.   **3**
     Reaction conditions (with and without catalyst) 1 X 2 mark
     Product in each case - ½ X 2 mark
     (ii) Explain Vilsmeier-Haack reaction of pyrrole.   **2**
     Formation of Iminium salt – 1 mark
     Formation of 2- Formyl pyrrole – 1 mark

==   **XXXXXX**   ==