

[Time : 3 Hours]

[Total Marks : 100]

Please check whether you have got the right question paper.

N.B. : 1. All Questions are compulsory.

2. Figures to the right indicate full marks.

3. Use of log-table/nonprogrammable calculator is allowed.

4. Answers for the same question as far as possible should be written together.

1. (A) Select the correct option and complete the following sentences.

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- (i) A substance that enhances the activity of a catalyst is called _____.
(a) an auto catalyst (b) a promoter (c) an inhibitor
- (ii) A NaCl crystal consists of _____ NaCl per unit cell.
(a) 2 (b) 4 (c) 6
- (iii) The Weiss indices of (110) plane are _____.
(a) 1:1:∞ (b) 1:2:0 (c) 1:∞:1
- (iv) Acid catalysed hydrolysis of methyl acetate is an example of ----- catalysis.
(a) homogeneous (b) enzyme (c) heterogeneous
- (v) Ca^{+2} ion in water is _____.
(a) non acidic (b) feebly acidic (c) weakly acidic
- (vi) Hydration of monoatomic cation is directly proportional to _____.
(a) charge of cation (b) size of cation (c) square of charge of cation
- (vii) Photochemical smog is caused by high concentration of oxides of _____.
(a) sulphur (b) phosphorus (c) nitrogen
- (viii) _____ is used in some soft drinks.
(a) Sulphuric acid (b) Phosphoric acid (c) Nitric acid.
- (ix) Nitration of aniline gives mainly _____ nitroaniline.
(a) *p*- and *m*- (b) *p*- and *o*- (c) *o*- and *m*-
- (x) Ethyl amine when heated with acetic anhydride in presence of pyridine gives _____.
(a) ethanol (b) imine (c) N- substituted amide
- (xi) Two moles of _____ diketone are required in Hantzsch synthesis of pyridine.
(a) 1,3- (b) 1,4- (c) 1,5-
- (xii) Furan on treatment with DMF and POCl_3 gives _____.
(a) furan-3-aldehyde (b) 2-chlorofuran (c) furan-2-aldehyde

(B) State whether the following statements are true or false. 3

- (i) A catalyst becomes more effective by catalytic poison.
- (ii) Positively charged ions can furnish hydrated H^+ ion from water molecule.
- (iii) Halogenation of thiophene can be easily carried directly with halogens.

(C) Match the column. 5

- | | |
|-------------------------------------|---|
| (i) Br^- | (a) non basic anion |
| (ii) 1:0.707:0.577 | (b) very strongly basic anion |
| (iii) Gold supported on metal oxide | (c) feebly basic anion |
| (iv) Oxide ion | (d) predominantly gives least substituted alkene |
| (v) Hofmann elimination | (e) predominantly gives highly substituted alkene |
| | (f) Simple cube |
| | (g) Nano catalyst |
| | (h) BCC |
| | (i) FCC |

2. (A) (i) What do you understand by simple, face-centred and body-centred cubic lattice? Explain with the help of neat diagrams. 5

(ii) Determine the Miller indices of the following crystal planes whose intercepts on the X, Y and Z axes are as follows: (a) 1a: 2b: 3c (b) 1a: ∞ b: 1c 3

OR

(A) (i) Derive the Bragg's equation, $n\lambda = 2d \sin \theta$. 5

(ii) 'KCl and NaCl are isomorphs. But KCl exhibits a simple cubic lattice whereas NaCl shows FCC lattice'. Comment on this statement. 3

(B) (i) Explain the characteristic features of a catalytic reaction. 5

(ii) With the help of examples explain what is meant by nano catalysis. 3

OR

- (B) (i) Define the term catalyst. What are the different types of catalysts? Explain with suitable examples. 5
- (ii) How does a catalyst accelerate the rate of a reaction? 3

- (C) The first order reflection from (100), (110), and (111) planes of a cubic system occurs at 7.167° , 10.2° , and 12.5° respectively. Which type of cubic system the crystal belongs to? 4

OR

- (C) Discuss the kinetics of Acid-base catalysis. 4

3. (A) (i) How does water molecule attack the cation in aqueous medium? Explain whether the consequences of attack are same for all ions. 4
- (ii) With the example of Cr^{+3} ion, explain predominance of various species of chromium in aqueous medium. 4

OR

- (A) (i) On the basis of pK_b values, give classification of anions. 4
- (ii) Discuss environmental aspects of phosphoric acid. 4

- (B) (i) Write Latimer equation for calculation of hydration of monoatomic cation. Explain role of charge and size of cation towards hydration. 4
- (ii) On the basis of pK_a values, classify the monoatomic cations. Provide one example to each category. 4

OR

- (B) (i) With suitable predominance diagram, explain the following anions: 4
- (a) non basic (b) feebly basic
- (ii) Write uses of sulphuric acid. 4

- (C) Calculate z^2 / r ratio for W^{+6} ($r = 74\text{pm}$). What will be its acid strength in aqueous medium? Does W^{+6} exist in aqueous medium? Why? 4

OR

- (C) Discuss physical properties of concentrated phosphoric acid. 4

4. (A) (i) a) How will you obtain an aromatic amine by reduction of nitro compounds using : i) catalytic hydrogenation ii) Sn – HCl 3

b) Explain the reaction of aliphatic and aromatic secondary amines with nitrous acid. 2

- (ii) Write a note on Sandmeyer reaction. 3

OR

- (A) (i) a) How will you obtain an aromatic amine using reductive amination? 3

b) Describe N-alkylation of aryl amines. 2

- (ii) Write a note on Gomberg reaction. 3

- (B) (i) Explain : 3

a) in furan, the electrophilic substitution takes place at 2 or 5 position. 3

b) Paal-Knorr Synthesis for the preparation of pyrrole. 2

- (ii) Write a note on Chichibabin reaction of pyridine. 3

OR

- (B) (i) Explain why? 3

a) in pyridine, the electrophilic substitution takes place at 3 or 5 position. 3

b) thiophene is aromatic in nature. 2

- (ii) Discuss Vilsmeier-Haack reaction of thiophene. 3

- (C) (i) Explain azocoupling reaction of benzene diazonium chloride with phenol. 2

- (ii) Discuss Friedel-Crafts reaction of pyrrole. 2

OR

- (C) (i) Explain azocoupling reaction of benzene diazonium chloride with N,N-dimethyl aniline. 2

- (ii) Discuss sulphonation of pyrrole. 2

5. Attempt any **four** of the following.

- (A) Derive Michaelis-Menten equation for enzyme catalysis. 5

- (B) The first order reflection maxima from (100) plane of NaCl occurred at 5.9° using X-rays of wavelength 58.0 pm . If the density of NaCl is $2.17 \times 10^6 \text{ g m}^{-3}$ and gram molecular weight 58.5 gmol^{-1} , calculate the Avogadro number. 5

- (C) Represent graphically pK_a values of monoatomic cations as a function of charge, size and electronegativity. Categorise the cations on the basis of z^2/r ratios. 5

- (D) What do you mean by acid rain? How does it occur? What are its consequences? 5

- (E) i) Explain the effect of substituents on the basicity of aromatic amines. 3

- ii) How will you replace diazonium group by $-\text{H}$? 2

(F) Explain the following :

- i) Diels-Alder reaction of furan
- ii) pyridine is a weaker base compared to piperidine.

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