Roll No. .....

Total No. of Questions : **9**] [Total No. of Printed Pages : **7**

(2032)

UG (CBCS) IIIrd Year (Annual) Examination

3221

B.Sc. CHEMISTRY

(Chemistry of Transition and Inner Transition Elements, Coordination Chemistry, Organometallics, Acids and Bases)

(DSE–2B)

Paper : CHEM 304 TH

Time : 3 Hours] **[Maximum Marks : 50**

Note :– (i) Attempt *five* questions in all, selecting *one* question from each Section.

(ii) All questions carry equal marks. Section E is compulsory.

Section–A

1. (a) Explain oxidizing properties of $KMnO_4$ in acidic and basic medium with suitable example.

(b) How do sodium nitroprusside react with sodium sulphide and silver nitrate ?

(c) What do you mean by Latimer diagram ? Explain Latimer Diagram for Manganese System. 4,2,4

2. (a) How do magnetic properties of Lanthanides differ from transition elements ? Assign reason.

(b) (i) Why Actinides have greater tendency to form complexes compared to lanthanides ?

(ii) Out of $La(OH)_3$ and $Lu(OH)_3$, which is more basic and why ?

(c) How is the separation of Lanthanides done using ion exchange method ? 3,3,4

Section–B

3. (a) Explain ionization and geometrical isomerism in co-ordination compounds taking suitable examples.

(b) Write down IUPAC names of the following :

(i) $[Co(en)_2Cl_2]Br$

(ii) $K[PtCl_3(C_2H_4)]$

(iii) $[(NH_3)_5Fe–OH–Fe(NH_3)_5]Cl_3$

(iv) $[Mn_3(CO)_{12}]$

(c) Using VBT, explain the formation of $[Cu(NH_3)_4]^{2+}$ ion. 3,4,3

4. (a) What is Hapticity ? Explain how cyclo-octatetraene can act both as octahepto and tetrahepto ligand.

(b) Find out effective atomic number of :

(i) $[Fe(CO)_3(C_4H_6)]$

(ii) $[Fe(\pi\text{-}C_5H_5)(CO)_3]$

(c) What is Zeise Salt ? Discuss its structure 4,3,3

Section–C

5. (a) What is Crystal field splitting ? Explain taking example of tetrahedral complex.

(b) How Crystal field splitting can explain colours in octahedral complexes ?

(c) Calculate CFSE for the following :

(i) d^8 (Strong field octahedral)

(ii) d^5 (Tetrahedral) 4,3,3

6. (a) How do oxidation state and type of transition series (*d*-orbital) affect the crystal field splitting ? Explain with suitable example.

(b) Which out of Mn(II) and Fe(III) will form low spin complex and why ?

(c) What is Jahn-Teller Distortion ? Under what condition this distortion will cause tetragonal distortion ?

4,3,3

Section–D

7. (a) What is Symbiosis ? Explain taking suitable example.

(b) What are levelling and differentiating solvents ? Discuss using at least *one* example in each case.

(c) Hard–hard interactions are generally ionic, soft-soft interactions are generally covalent, why ? 3,4,3

8. (a) Which out of pyridine and 2-methyl pyridine act as stronger base towards trimethyl boron ? Explain.

(b) How does solvent affect the strength of acids and bases ?

(c) Arrange $HClO$, $HClO_3$, $HClO_4$ and $HClO_2$ in the increasing order of their acidic strengths, giving suitable explanation. 3,3,4

Section–E

9. (i) CuI_2 is hard-hard substance. (True/False)

(ii) Which out of Ca^{2+}, Cu^{1+}, Cd^{2+} or Ag^{1+} will prefer to exist as oxide ?

(iii) Formula of Zeise's salt is ..... .

(iv) Write down formula of Potassium Hexacynoferrate (II)

(v) Which out of Lanthanides and actinides form oxocations ?

(vi) Cu^{2+} salts are coloured but Cu^{1+} salts are white. Why ?

(vii) How many water molecules are co-ordinated in $CuSO_4.5H_2O$?

(viii) How many unpaired electrons are present in d^7 tetrahedral configuration ?

(ix) CFSE for d^3 octahedral complex will be ..... .

(x) Which out of $Mn(CO)_{10}$ and $Co(CO)_8$ have all the CO as terminal groups ? $1\times10=10$

Roll No. .....

Total No. of Questions : **9**] [Total No. of Printed Pages : 7

(2032)

UG (CBCS) IIIrd Year (Annual) Examination

3218

B.Sc. CHEMISTRY

(Polynuclear Hydrocarbons, Dyes, Heterocyclic Compounds and Spectroscopy)

(UV, IR, NMR)

(DSE–2A)

Paper : CHEM 301 TH

Time : 3 Hours] **[Maximum Marks : 50**

Note :– Attempt *five* questions in all, selecting *one* question from each of the Sections A, B, C and D. Section E is compulsory.

Section–A

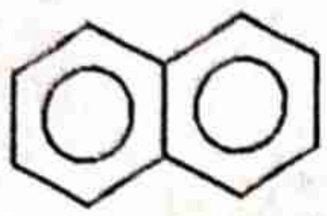
1. (a) How we can synthesize Napthalene by :

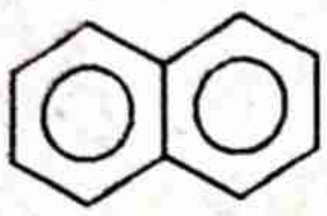
(i) Haworth synthesis

(ii) Diels-Alder reaction

(b) Why Electrophilic substitution reactions of Napthalene occurs at α-position than β-position ?

(c) Complete the following :

(i)  + $\xrightarrow[423K]{H_2|Pt}$ A

(ii)  + $O_3 \xrightarrow[196K]{CH_2Cl_2}$ A

2. (a) Discuss orbital structure of Anthracene.

(b) How Anthracene is prepared by :

(i) Diels-Alder Reaction

(ii) Elbs Reaction

(c) Why substitution and addition reactions of phenanthrene occurs at position 9 and 10 ?

Section–B

3. (a) Discuss orbital structure of Pyrrole ? Why pyrrole is more reactive than benzene ?

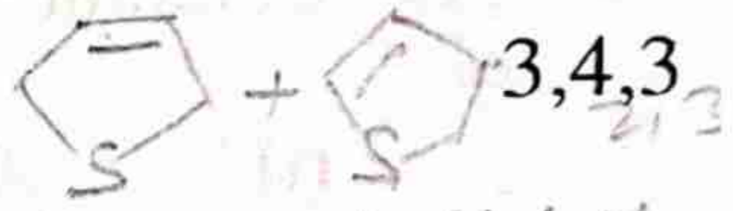
(b) Write the mechanism of Electrophilic substitutions reactions of Pyrrole ?

(c) Complete the following reactions :

(i) $2\ \underset{\underset{CH}{|||}}{\overset{CH}{}} + NH_3 \xrightarrow{\Delta} A$

(ii) Pyrrole + $\xrightarrow[\text{red P}]{HI}$ B

(iii) Thiophene $\xrightarrow[NH_3(liq.)]{Na}$ C



3,4,3

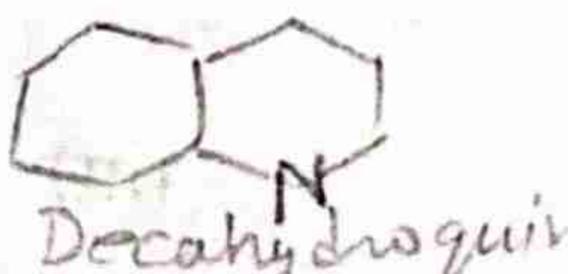
4. (a) Compare the basic strength of pyrrole, pyridine and piperidine.

(b) Why Pyridine is weaker base than aliphatic 3° amines ?

(c) Complete the following :

(i) Furan + $NH_3 \xrightarrow[753 - 763K]{\text{Steam } Al_2O_3}$ A

(ii) Quinoline + $\xrightarrow[CH_3COOH]{H_2 - Pt}$ B



(iii) Indole + $SO_3 \xrightarrow[393K]{\text{(Pyridine)}}$ C

4,3,3

Section–C

5. (a) What is Beer-Lambert's Law ? Give two limitations of it.

(b) What are the different types of Electronic transitions in case of UV visible regions ?

(c) Calculate the number of degrees of freedom in :

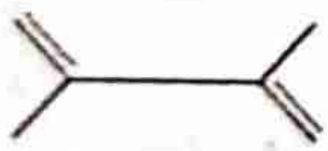
(i) N_2O

(ii) CH_4

(iii) O_2 3,4,3

6. (a) Discuss the types of fundamental vibrations ? What are the different types of Bending vibrations ?

(b) Calculate λ_{max} for :

(i) 

(ii) 

(iii) 

(c) Give 3 applications of UV spectroscopy. 4,3,3

Section–D

7. (a) Write short notes on :

(i) Origin of signals

(ii) Chemical shift

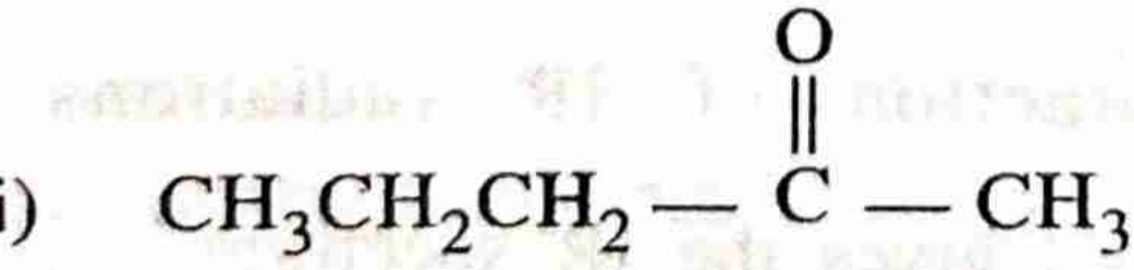
(iii) Homotopic protons

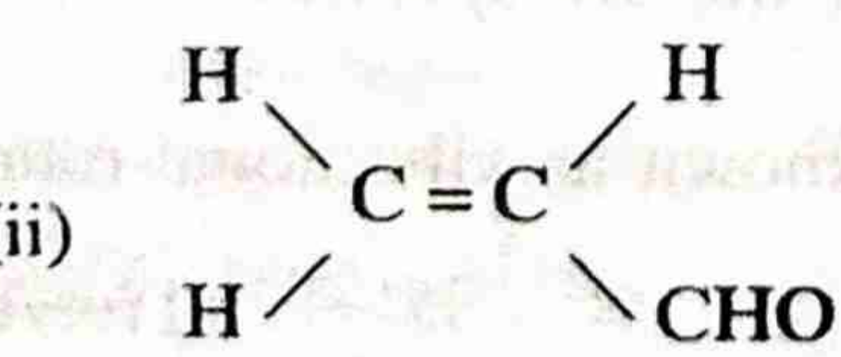
(b) What is spin-spin splitting ? What are the rules of spin-spin splitting of proton signals ?

(c) What are the factors that affect the value of chemical shift ? 3,5,2

8. (a) What is TMS ? Why TMS is used as the most common reference compound in ^1H NMR (PMR) spectroscopy ?

(b) How many proton (NMR) signals will be obtained in ^1H NMR spectrum of :

(i) 

(ii) 

(c) What is chemical shift ? What are the scales to express the chemical shift ? 4,3,3

Section–E

(Compulsory Question)

9. Do as directed :

(i) Number of π electrons in Napthalene is ..... .

(ii) Name of oldest Vat dye is ..... .

(iii) Out of pyrrole, pyridine and piperidine the least basic is ..... .

(iv) Red shift is also known as ..... shift whereas blue shift is known as ..... shift.

(v) ..... gives the IR spectrum.

(vi) IR spectra is also known as vibrational-rotational spectroscopy. (True/False)

(vii) All the hydrogen nuclei have same value of chemical shift.

(True/False)

(viii) Introduction of Conjugation in alkenes causes blue shift.

(True/False)

(ix) All heterocyclic compounds are aromatic.

(True/False)

(x) Both Napthalene and Anthracene obey Huckel's Rule.

(True/False)

1×10=10

Section A

1. (a) Write the assumptions of kinetic theory of gases and derive the kinetic gas equation.

   (b) How is the law of corresponding states derived from the van der Waals' equation ? Discuss the significance of this law. 5+5

2. (a) What are critical constants ? Deduce the values of critical constants from van der Waals' equation of state.

   (b) What do you mean by viscosity of a liquid and give its units. Describe a method to determine the viscosity of a liquid. How does viscosity vary with temperature ? 5+5

Section B

3. (a) Differentiate between the Schottky and Frankel defects.

(b) Discuss the structure of NaCl and calculate total symmetry elements present in the NaCl crystal.

(c) State the law of constancy of interfacial angles. 3+5+2

4. (a) Define order of reaction, molecularity of reaction and half-life period of reaction. Show that for the first order reaction the half-life period is independent of initial concentration.

(b) Half-life period of a first order reaction is 30 min. How long will it take for 80% completion of this reaction ?

(c) Calculate the unit rate constant of a second order reaction. 5+3+2

Section C

5. (a) Discuss the mechanism and stereochemistry of SN^1 reactions.

(b) Discuss the Friedal crafts acylation of benzene and give its mechanism.

(c) Out of chloroethane and chlorobenzene which is more reactive and why ?

4+4+2

6. (a) Explain the bimolecular displacement reaction mechanism of nucleophilic substitution of aryl halides.

(b) Halogens are electron withdrawing and yet ortho, para directing. Explain. 6+4

Section D

7. (a) Explain the following reactions :

(i) Williamson's synthesis

(ii) Cumene process

(iii) Oppeneauer oxidation of diols

(b) Discuss a chemical test to distinguish between the following :

(i) Aldehyde and ketone

(ii) Primary alcohol and secondary alcohol.

6+4

8. (a) Discuss the following reactions :

(i) Pinacol-pinacolone rearrangement

(ii) Meerwein - Pondroff - Verley reduction.

(b) How acetone react with :

(i) Hydrazine

(ii) Dil. NaOH

(iii) CH_3OH in the presence of HCl gas.

(iv) Sodium bisulphite. **6+4**

Section E

9. (a) The compressibility factor for ideal gas is one. (True/False)

(b) Diaryl ethers are generally not prepared by Williamson synthesis. (True/False)

(c) With bromine water phenol gives 2-bromophenol. (True/False)

(d) With aqueous KOH, alkyl halides undergo.....reaction while with hot alcoholic KOH, they undergo.....reaction.

(e) The S. I units of van der Waals' constant 'a' are.....

(f) If the planes intercepts a, b and α, then the Miller indices will be.....

(g) Cyclohexanone on reduction with..... gives cyclohexanol.

(h) The rate law for the reaction $A + 2B \rightarrow C$ is found to be Rate $= k$ [A] [B].

Keeping the concentration of A constant and the concentration of B is doubled, then the value of rate constant will be :

(i) Same

(ii) Doubled

(iii) Quadrupled

(iv) Halved

(i) Among the following amorphous solid is :

(i) Glass

(ii) Sodium chloride

(iii) Copper metal

(iv) Zinc sulphide.

(j) Addition of HBr gives the same product in the presence or absence of peroxide when the alkene is.....

(i) 1-Butene

(ii) 2-Methylbutene

(iii) 2-Butene

(iv) Propene. **1×10=10**

Section A

1. (a) Derive the Schrödinger wave equation for hydrogen atom and give the physical significance of ψ and ψ^2.

   (b) Define and explain the Pauli's exclusion principle with suitable examples.

   (c) Write a note on angular wave function.

   5+3+2

2. (a) Discuss the Slater's rules. Using these rules calculate the effective nuclear charge of 3p electron in chlorine atom.

   (b) Differentiate between orbit and orbital.

   (c) Write the electronic configurations of Co^{3+} (At. No. 27) and Cu^{2+} (At. No. 29).

   5+3+2

Section B

3. (a) Write a note on lattice energy. Describe the Born-Haber cycle for calculating the lattice energy of sodium chloride.

(b) Discuss the Fajan's rules. Using these rules predict more covalent compound in the following :

(i) AgCl or AgI

(ii) LiCl and KCl. 6+4

4. (a) Distinguish between Bonding molecular orbital and Antibonding molecular orbital.

(b) Define hybridization and explain the shape of $SnCl_2$ on the basis of hybridization.

(c) Draw the molecular orbital energy level diagram for N_2 molecule and find out its bond order and magnetic behavior. 2+4+4

Section C

5. (a) Explain the following :

(i) Out of acetic acid and chloroacetic acid which is more acidic and why ?

(ii) Out of ethyl carbocation and benzyl carbocation which is more stable and why ?

(iii) Out of ethyl amine and diethyl amine which is more basic and why ?

(b) Discuss the conformational isomerism in n-butane. 6+4

6. (a) Discuss the geometrical isomerism in alkenes with suitable examples. Mention the necessary and sufficient conditions for geometrical isomerism in alkenes.

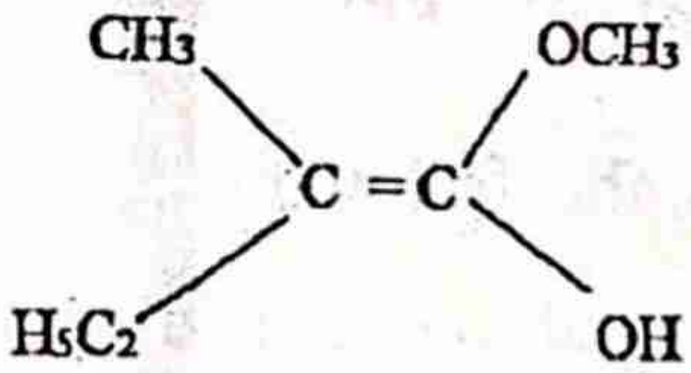
(b) Differentiate between the following :

(i) External and internal compensation

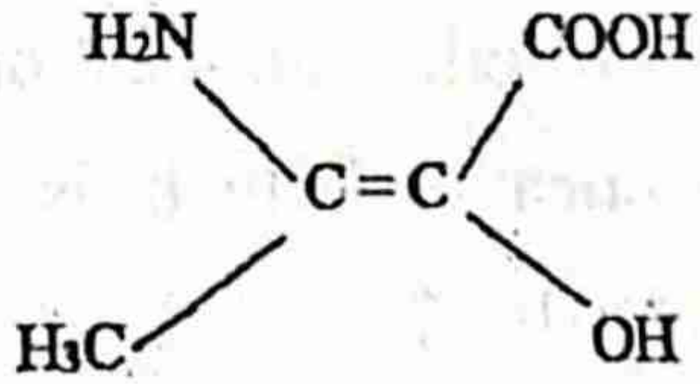
(ii) Electrophiles and nuclcophiles

(c) Give the E or Z notations for the following compounds : 4+4+2

(i)



(ii)



Section D

4. (a) How can you prepare alkanes by Wurtz reaction ? What is limitation of this reaction and how can you overcome it ?

(b) Complete the following reaction and give its mechanism :

$$CH_3\text{-}CH{=}CH_2 + HCl \rightarrow ?$$

(c) How can you prepare ethane from :

(i) Ethanol

(ii) Chloroethane ? **4+4+2**

5. (a) What is peroxide effect ? Why is it shown only with HBr but not with HCl or HI ?

(b) Discuss the ozonolysis reaction in alkenes. How can it be used to locate the position of double bond in alkenes ?

(c) What happens when ?

(i) Propyne is treated with chlorine water

(ii) Acetylene is treated with ammoniacal $AgNO_3$. **4+4+2**

Section E

9. (a) For Potassium atom's last electron, the quantum numbers values will be :

$n = 3,\ l = 1,\ m = 0,\ s = \pm\ 1/2.$

(True/False)

(b) CO and N_2 are isoelectronic molecules.

(True/False)

(c) An isobutane has a carbon branch atom extending from the second carbon atom of the chain.

(True/False)

(d) The ease of dehydration of alcohols follows the sequence :

1° alcohol < 2° alcohol < 3° alcohol

(True/False)

(e) The geometry of PF_5 molecule is .....

(f) The bond order for Li_2 molecule is.....

(g) The total number of sigma and pi bonds in Pent-1-ene-3yne are.....and..... respectively.

(h) Propyne upon treatment with dil. H_2SO_4 and $HgSO_4$ will give..... .

(i) 2-pentanone and 3-pentanone are .....isomers.

(i) Functional

(ii) Optical

(iii) Geometrical

(iv) Position

(j) In XF_4 molecule the hybridization of Xe is :

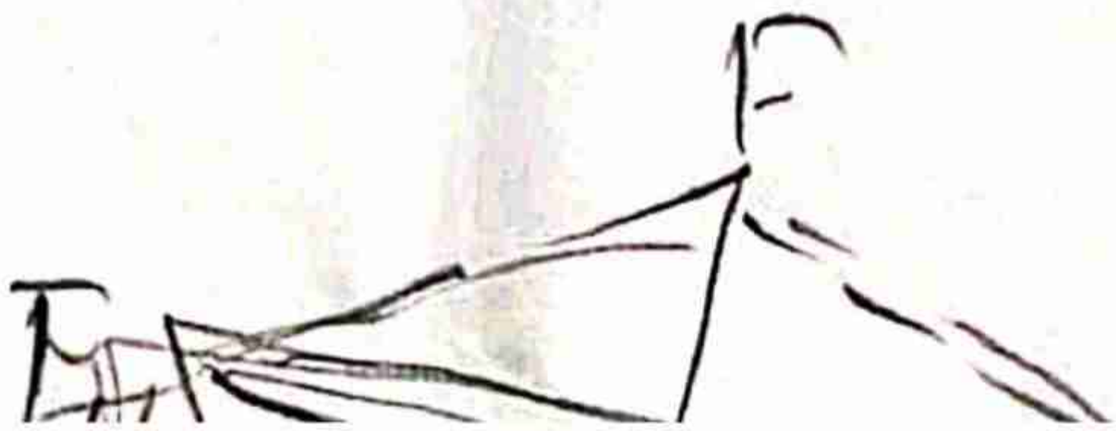
(i) sp^3

(ii) sp^3d^2

(iii) sp^3d

(iv) dsp^2

10×1=10



Roll No. .....

Total No. of Questions : **9**] [Total No. of Printed Pages : **8**

(2033)

UG (CBCS) IInd Year Annual Examination

3102

B.Sc. CHEMISTRY

(Chemistry of Main Group Elements, Chemical Energetics and Equilibria)

(Core)

Paper : CHEM 202 TH

Time : 3 Hours] **[Maximum Marks : 50**

Note :– Attempt *five* questions in all, selecting *one* question from each Section. Section E (Q. No. **9**) is compulsory. Candidates are required to answer accurate and precise.

Section–A

1. (a) Distinguish between Ortho and Para-hydrogen.

   (b) Explain why, Ca and Ba imparts characteristic flame colours but, Be and Mg do not impart ?

(c) Explain the Pauling and Mulliken scales of electronegativity.

(d) When alkali metal dissolved in liquid ammonia, it imparts blue coloured solution. Explain.

(e) NaOH is a stronger base than $Ba(OH)_2$. Explain. 2×5=10

2. (a) Can Sodide ion exist ? Explain.

(b) Alkali metals are strong reducing agents. Explain.

(c) Distinguish between Cryptates and Crown Ethers with example.

(d) Li^+ ion is more hydrated than K^+. Explain.

(e) Differentiate between Nascent Hydrogen and Atomic Hydrogen. 2×5=10

Section–B

3. (a) What do you mean by Inorganic Benzene ? Discuss its bonding and structure.

(b) What are Carbides ? Discuss and explain their classification.

(c) Discuss the Geometry and Hybridization of :

(i) SF_6

(ii) IF_7

(d) CCl_4 cannot be hydrolyzed but $SiCl_4$ can be hydrolyzed.

(e) Show that Al_2O_3 is amphoteric in nature. 2×5=10

4. (a) What are Clathrate compounds ? Discuss the essential condition for their formation.

(b) Discuss the structure of $XeOF_2$ and XeF_4.

(c) Complete the following reactions :

(i) $CaC_2 + 2H_2O \longrightarrow$

(ii) $XeF_2 + I_2 \longrightarrow$

(iii) $XeF_4 + SF_4 \longrightarrow$ 3+4+3

Section–C

5. (a) Derive :

$$PV^{\gamma} = \text{Constant}$$

(b) Derive Kirchhoff's equation. Discuss its significance.

(c) Calculate the entropy change when one mole of ethanol is evaporated at 351K. The molar heat of vaporization of ethanol is 39.840 J/mol. 3+4+3

6. (a) State and explain Nernst Heat Theorem.

(b) The enthalpy change for the following reaction is −150 kJ/mol. Calculate the bond energy of $C \equiv N$ bond. Given, bond energies of C—H = 414 kJ/mol; H—H = 435 kJ/mol; C—N = 293 kJ/mol; N—H = 396 kJ/mol :

$$HC \equiv N(g) + 2H_2(g) \longrightarrow H_3C—NH_2(g)$$

(c) Differentiate between State Function and Path Function. Illustrate with an example.

(d) Define Residual Entropy. What is its cause ? 3+3+2+2

Section–D

7. (a) Derive relationship between K_p; K_c and K_x. Discuss their units also.

(b) Explain Le-Chatelier Principle. Explain the effect of temperature, pressure and concentration on the equilibrium :

$$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g)$$

(c) Write short notes on the following :

(i) Common ion effect

(ii) Ionic product of water 4+4+2

8. (a) What is Buffer Solution ? Describe buffer action of acidic and basic buffer.

(b) What is Solubility Product ? Calculate the solubility of $BaCl_2$, if its solubility product is 2.16×10^{-4} at 298K.

(c) What is the difference between ΔG and ΔG° ? 4+4+2

Section–E

9. Do as directed. Fill in the blanks/MCQ/True-False :

(i) Definition of Temperature comes from ..... law of thermodynamics.

(a) First

(b) Second

(c) Zeroth

(d) Third

(ii) During an adiabatic expansion of 2 mol of gas the change in internal energy was found –50 J. The work done during the process is :

(a) –50 J

(b) 50 J

(c) –100 J

(d) –25 J

(iii) The efficiency (η) of a Carnot heat engine working between temperatures T_H and T_C is :

(a) $\eta = \frac{T_H - T_C}{T_H}$

(b) $\eta = \frac{T_C - T_H}{T_H}$

(c) $\eta = \frac{T_C - T_H}{T_C}$

(d) $\eta = \frac{T_H - T_H}{T_H}$

(iv) In a reversible chemical reaction at equilibrium, if the concentration of any *one* of the reactants is doubled, then the equilibrium constant K_{eqbm} will :

(a) remain same

(b) be halved

(c) become one-fourth

(d) also be doubled

(v) The Syngas is a mixture of :

(a) $CO + H_2$

(b) $CO_2 + H_2$

(c) $CO + N_2$

(d) $CO_2 + N$

(vi) The boiling point of Ortho-nitrophenol is ..... than Para-nitrophenol.

(vii) The hybridisation of ClF_3 is sp^3d and therefore its geometry will be .....

(viii) Silicon carbide (SiC) is also known as Corrundum. (True/False)

(ix) The Geometry of $XeOF_4$ is distorted octahedral. (True/False)

(x) F_3^- is known but I_3^- is not known. (True/False)

1×10=10

Total No. of Questions : 9] [Total No. of Printed Pages : 4

(1108)

UGC (CBCS) IIIrd Semester (New) Examination

1520

CHEMISTRY

(Basic Analytical Chemistry)

(SEC)

CHEM SEC–301

Time : 3 Hours] **[Maximum Marks : 70**

Note :– Attempt *five* questions in all, selecting at least *one* question from each Section A to D. Section–E is compulsory.

Section–A

15 each

1. (a) Discuss the various types of error in analytical Chemistry.

   (b) What are significant figures ? Explain their importance.

   (c) Explain the following numbers upto 4 significant figures :

   7.481765, 3.215984

(d) Calculate the proper significant numbers in $18{\cdot}6 \times 15{\cdot}98$ and 367.8/15.

2. (a) What is Soil ? Give its composition.

(b) What do you mean by Chelation ? Give any *two* Chelating agents.

(c) How will you estimate calcium and magnesium ions as calcium carbonate by complexometric titration ?

Section–B

15 each

3. (a) What do you mean by dissolved oxygen ? Explain any *two* analytical method to determine dissolved O_2.

(b) What do you mean by deoxygenation of water ? Explain any one method.

(c) Define pH of a solution. How will you determine the pH of a solution ?

4. (a) Explain the terms food processing and food preservation. Give its advantages.

(b) How will you analyse the colouring matter present in various food item as adulterants ?

(c) Why the food items are being adulterated ?

Section–C

15 each

5. (a) Explain how Ferric ion and aluminium ions are separated by paper chromatography.

   (b) Define R_f value. Explain the factors on which it depends.

   (c) Explain ascending and desending chromatography with examples.

6. (a) Define elution and explain eluotropic series.

   (b) Explain the process of packing of column before elution.

   (c) Give at least two advantages and two limitations of TLC.

Section–D

15 each

7. (a) Explain the various techniques to analyse the deodrants and antiperspirants.

   (b) What are arson accelerants ? Explain by taking various examples.

8. (a) Give the composition of talcum powder. How will complexometric titration helps in determining its composition ?

(b) Explain spectrophotometric technique to determine iron in dietery tablet.

Section–E

9. Explain in short the following : 2×5=10

(i) What do you mean by Eluotropic series ?

(ii) What is R_f value stands for ?

(iii) What are significant figures ?

(iv) Which material is added to black paper to make it adulterated ?

(v) Define pH and pH scale. How is it useful to find acidity and basicity of soil ?

Lukesh –8707025290