Roll No.

S. No. of Question Paper : 39

Unique Paper Code : 32171101   I

Name of the Paper : **Inorganic Chemistry—I**

Name of the Course : **B.Sc. (H) Chemistry**

Semester : I

Duration : 3 Hours   Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *six* questions in all.

Question No. 1 is compulsory.

1.   Explain any *five* of the following with suitable reason :   5×3

     (a)   Which is more covalent : NaCl *or* NaI ?

     (b)   Which has the greater bond dissociation energy : O_2 *or* O_2^+ ?

     (c)   All the three N-O bonds in NO_3^- are equal.

     (d)   Shape of dz^2 orbital is different from other *d*-orbitals.

     (e) $BeCl_2$ has zero dipole moment while H_2S has some value.

     (f)   Which has greater melting point : *o*-nitrophenol *or* *p*-nitrophenol ?

2. (a) Calculate the lattice energy of MgO (in $kJ mol^{-1}$) :

Given : $A = 1.7475$; $r(Mg^{2+}) = 0.65$ Å; $r(O^{2-}) = 1.40$ Å; $n = 7$; $e = 4.8 \times 10^{-10}$ e.s.u.; $N = 6.02 \times 10^{23}$.

(b) Define resonance energy and draw the resonating structures of NO_3^- and N_3^-.

(c) Are 5g and 6h sub-shells possible ? Give reasons. If they are possible, show how many orbitals can be present in each sub-shells ?   4,4,4

3. (a) Give Allred and Rochow's scale of electronegativity. Calculate the electronegativity of silicon atom using this scale. The covalent radius of Si atom is 1.175 Å.

(b) What are isoelectronic ions ? How effective nuclear charge affects the radii of isoelectronic ions : N^{3-}, O^{2-}, F^-, Na^+, Mg^{2+} ?

(c) The dipole moment of LiH is 1.964×10^{-29} Cm and bond length for LiH is 1.596 Å. What is the percent ionic character in LiH ? (Charge on one electron = 1.6×10^{-19} C).   4,4,4
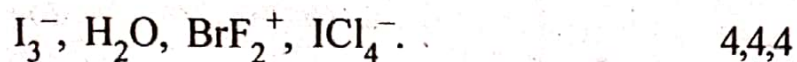
4. (a) How do you arrive at Schrodinger wave equation for H-atom starting with simple sine wave equation ?

(b) Using Slater's rule, calculate Z^* for :

(i) 3d

(ii) 4s electron in Co atom (Z = 27).

(c) Explain the shapes of the following molecules/ions according to VSEPR theory :

$$I_3^-, H_2O, BrF_2^+, ICl_4^-.$$
4,4,4

5. (a) Draw the MO energy level diagram for N_2^+. Discuss its bond order and magnetic behaviour. Why is the bond order in N_2^+ less than in N_2 molecule ?

(b) What are the four special properties which an acceptable wave function must have ? Why these restrictions are reasonable ?

(c) Using Pauling's method, calculate the radii of Na^+ and F^- ions. The observed internuclear distance in NaF crystal is 213 pm.
4,4,4

6. (a) Taking Z-axis as nuclear axis, explain whether the following orbitals will overlap to form molecular orbitals or not ?

(i) $s + p_x$

(ii) $p_x + d_{xy}$

(iii) $p_y + d_{x^2 - y^2}.$
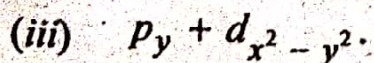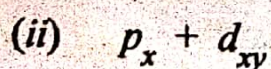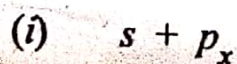
P.T.O.

(b)   Calculate the limiting radius ratio for the ionic compoun, when the coordination number of the cation is 4.

(c)   What is a radial distribution function ? Draw th, function for 1s, 2p and 3s orbitals.   4,4,

7.   (a)   Draw the Born-Haber cycle for the formation of $CaCl_2$ an, explain the various terms involved.

(b)   State Pauli's exclusion principle. Using this principle calculate the number of electrons in L shell.

(c)   Define electronegativity. How the electronegativit varies with s-character in different hybridisation o organic compounds ?   4,4,4

8.   Write short notes on any three of the following :

(i)   Bent's Rule

(ii)   Band theory of metallic bonding   1

(iii)   Hund's rule of maximum multiplicity

(iv)   Polarisation and polarisabilty.   3×4

Roll No. ☐☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : **40**

Unique Paper Code : **32171102**

I

Name of the Paper : **Physical Chemistry–I**

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : **I**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *six* questions in all.

Question No. **1** is compulsory.

Use of scientific calculator and log tables is allowed.

Physical constants : R = 8.314 JK^{-1} mol^{-1}, N_A = 6.023 × 10^{23} mol^{-1}, k = 1.38 × 10^{-23} JK^{-1}.

1. Attempt any *five* of the following : 5×3=15

Explain why :

(a) The end-centred bravais lattice is not possible for a cubic unit cell ?

(b)   The pH of water is *not* 7.0 at 60°C ? Will it remain

neutral at this temperature ?

(c)   Irrespective of their nature, drops of all the liquids falling

freely in air are spherical in shape ?

(d)   Addition of KNO_3 increases the surface tension of water

but addition of detergent decreases it ?

(e)   CO and N_2 have the same speed distribution at the same

temperature ?

(f)   The viscosity of gas increases with temperature but that

of liquid decreases with temperature ?

(g)   The initial slope of the graph of compressibility factor,

Z *versus* the pressure, p, at constant temperature is

positive for some gases and negative for others ?

2.   (a)   Write the mathematical expression for the Maxwell

distribution of molecular speeds of a gas, explain briefly

the terms involved. How does the change in temperature

influence the distribution of molecular speeds ?   4

(b)   Calculate the temperature at which average velocity of

SO_2 equals to that of O_2 at 20 K.   4

(c)   Derive the relations using van der Waals gas equation : $P_c = a/27b^2$ and $T_c = 8a/27Rb$.   4

3.   (a)   Explain the terms σ, λ, Z_1 and Z_{11}. Discuss the effect of temperature and pressure on these terms.   5

   (b)   Calculate λ, Z_1 and Z_{11} for oxygen at 298 K and 10^{-3} mmHg. Given $\sigma = 3.61 \times 10^{-8}$ cm.   4

   (c)   Write a note on continuity of state.   3

4.   (a)   Starting from the postulates of the kinetic theory of gases, derive the kinetic gas equation.   5

   (b)   Calculate the pressure exerted by 3.023×10^{23} molecules of CH_4 in 0.5 dm^3 at 298 K using van der Waals equation. (Given : $a = 2.253$ L^2 atm mol^{-2}, $b = 0.0428$ L mol^{-1} and $R = 0.0821$ L atm mol^{-1} K^{-1}).   4

   (c)   What are the units of van der Waals constants a and b ? Do these constants depend upon temperature of the gas ?   3

5.   (a)   Define the surface tension of liquid. Describe drop number method for the determination of surface tension of a liquid.   4

(b) With the given viscometer, the times of flow at 20°C for water and an unknown liquid ($d = 1.22$ g cm^{-3}) were found to be 155 sec and 80 sec respectively. Calculate the absolute viscosity of the unknown liquid at 20°C if viscosity and density of water are 1.005 centipoise and 1 g cm^{-3} respectively.   4

(c) What is capillary action ? Derive : $\gamma = \pm \frac{1}{2}h\rho gr$, where the symbols have their usual meanings.   4

6. (a) What are the differences between crystalline and amorphous solids ?   4

(b) When a certain crystal was studied by the Bragg's method using X-rays of wavelength 229 pm, first order X-ray reflection was observed at an angle of 23°20' :

(i) What is corresponding inter-planar spacing ?

(ii) When another X-ray source was used, a reflection was observed at 15°26' ? What was the wavelength of these X-rays ?   4

(c)   Give the Miller indices of the plane which intercepts the three crystallographic axes at the multiple of unit distance at :

(i)   3/2, 2, 1

(ii)   1/2, 2/3, ∞. 4

7.   (a)   Show that the concentration of H_3O^+ in an aqueous solution of an acid HA can be computed from the expression :

$$K_a = \frac{[H_3O^+]^3 - [H_3O^+]K_w}{[H_3O^+][HA]_0 - [H_3O^+]^2 + K_w}.$$

Under what conditions can the following expressions be used :

(i) $K_a = \dfrac{[H_3O^+]^2}{[HA]_0 - [H_3O^+]}$

(ii) $K_a = \dfrac{[H_3O^+]^2}{[HA]_0}.$ 5

(b)   What is the pH of a solution containing 10^{-8} M hydronium ion and compare it with the pH value of 10^{-8} M HCl solution ? 4

P.T.O.

(c)   What is pH of a solution obtained by mixing 50 mL, 0.1 M CH_3COOH and 50 mL, 0.1 M NaOH. Given $pK_a (CH_3COOH) = 4.74$.   3

8.   (a)   Show that the pH of an aqueous solution of salt formed from a weak acid and strong base is given by

$$pH = 7 + \frac{1}{2}(pK_a + \log c).$$ 4

(b)   Define different types of buffer solutions. Derive Henderson-Hasselbalch equation for pH of acidic and basic buffer.   4

(c)   What is the solubility of $Ag_2(CrO_4)$ in water if the value of solubility product is $K_{sp} = 1.3 \times 10^{-11}$ M^3 ?   4

9.   (a)   What is an indicator and how does it work ?   3

(b)   Define solubility and solubility product. Determine solubility of $Mg(OH)_2$ in pure water and 0.01 M NaOH solution. K_{sp} of $Mg(OH)_2 = 1.2 \times 10^{-11}$ M^3.   5

(c)   Will a precipitate form if 20 cm^3 of 0.01 M AgNO and 20 cm^3 of 0.0004 M NaCl are mixed ? Give K_{sp} of AgCl $= 1.7 \times 10^{-10}$ M^2.

Your Roll No...............

Sr. No. of Question Paper : **837**   I

Unique Paper Code   : 32175901

Name of the Paper   : Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons

Name of the Course   : **Chemistry : G.E. for Honours**

Semester   : I

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Use of Calculator is permitted.

Section – A   (37½)
(Inorganic Chemistry)
Attempt any **three** *questions.*
(Question No. **1** *is Compulsory.)*

1. (a) Electronic Configuration of Cu is $3d^{10}$ $4s^1$ and not $3d^9$ $4s^2$. Explain.

   (b) What are some special properties which must be fulfilled by the acceptable solution of the wave equation?

P.T.O.

(c) Though the radii of Ag^+ is comparable with the radii of K^+, but the melting point of AgCl is much lower than that of KCl. Explain.

(d) How Born Haber's Cycle is used for calculating proton affinities of Bronsted bases?

(e) Explain why PCl_5 is more reactive than SF_6 molecule.

$$(5×2½=12½)$$

2. (a) Derive time independent Schrodinger wave equation for an electron in Hydrogen atom. Name the three quantum numbers obtained from this equation.

(b) What are Polar Coordinates? Derive a relationship between the Cartesian coordinates and polar coordinates?

(c) Write a short note on the following : $(4½+4+4=12½)$

     (i) Radial probability Distribution Curves

     (ii) Physical Significance of ψ and ψ^2.

3. (a) Calculate the Heat of formation, of MgF_2 from its elements using the Born Haber's Cycle from the following thermo-chemical data: Sublimation energy of $Mg(s) = 146.4$ kJmol^{-1}, Dissociation energy of $F_2(g)= 158.9$ kJmol^{-1}, Ionization energy of $Mg(g)/Mg(g)^{2+} = 2184$ kJmol^{-1}, Electron affinity of $F(g)/F^-(g)=-334.7$ kJmol^{-1}, lattice energy of $MgF_2(s) = -2922.5$ kJmol^{-1}.

(b) Explain Fajan's Rule and on the basis of this rule compare the covalent character in following compounds.

     (i) NaCl and CuCl

     (ii) AgCl and AgI

(c) Define Lattice and Solvation energy. What is the role of these terms in deciding the solubility of ionic solids?

                                          (4½+4+4=12½)

4. (a) How does Molecular Orbital Theory account for the following?

     (i) Monoatomic nature of Helium

     (ii) Paramagnetic character in O_2 molecule

(b) Using VSEPR Theory justify that ClF_3 is T-shaped while XeF_4 is a square planar molecule.

(c) Give the hybridization of the central atom and shape of the following molecules :
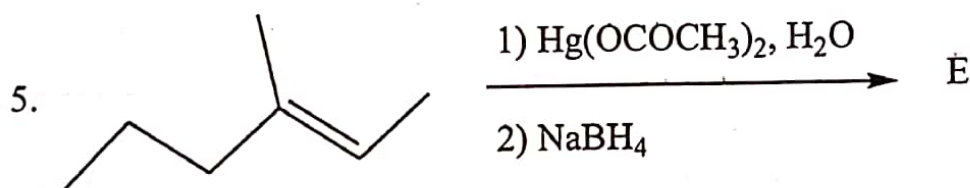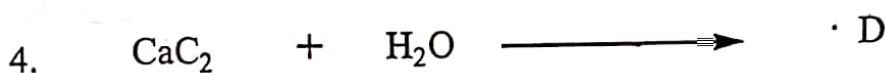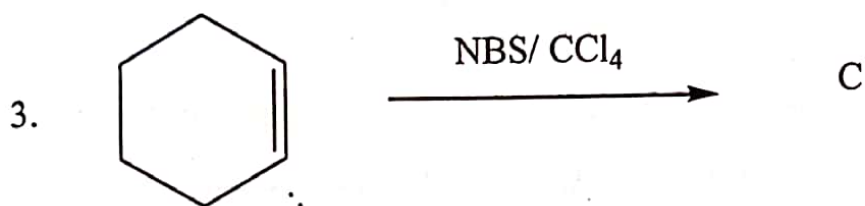
     NO_3^-, $XeOF_4$, BrF_5 and ClO_3^- (4½+4+4=12½)

5. Give reason for the following : (2,2,2,2,2,2,1½=13½)

   (a) Alkynes are less reactive than alkenes towards electrophilic addition reactions.

   (b) Ethyl carbocation is more stable than n-propyl carbocation.

   (c) 1,3-Pentadiene is more stable than 1,4-pentadiene.

   (d) Anti-conformation of n-butane is more stable than gauche conformation.

   (e) Different products are formed when propene is treated with HBr in the presence and absence of peroxide.

   (f) Ethene does not exhibit geometrical isomerism.

   (g) Cycloheptatrienyl cation is aromatic whereas cyclopentadienyl anion is not an aromatic compound.

6. (a) Explain the mechanism of HBr addition on 3-methyl but-1-ene.

   (b) Write the structures of A, B, C, D and E in the following reactions :
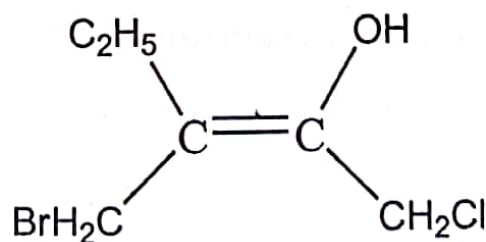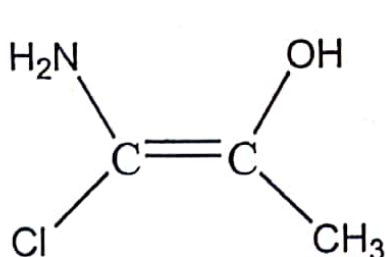
(c) How will you convert **(any two)** :

1. $CH_3C \equiv CC_2H_5$ $\xrightarrow[\text{Pd/ CaCO}_3]{H_2}$ A

2. CH_3MgI + B $\longrightarrow$ $CH_4 + Mg(OH)I$

3. $\xrightarrow{\text{NBS/ CCl}_4}$ C

4. CaC_2 + H_2O $\longrightarrow$ · D

5. $\xrightarrow[\text{2) NaBH}_4]{\text{1) Hg(OCOCH}_3)_2, H_2O}$ Ė
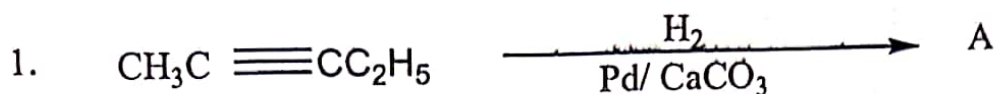
(i) Propyne to 1,2-dibromopropane
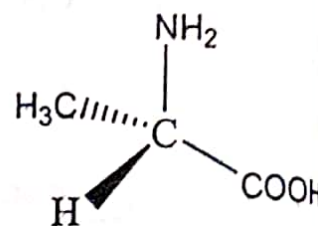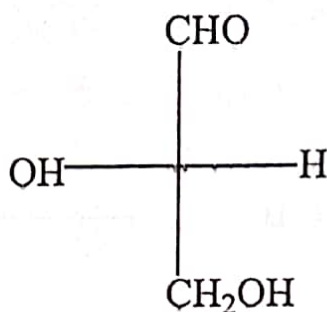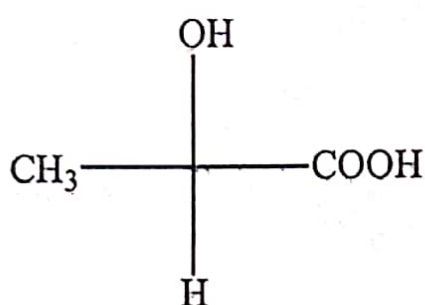
(ii) Propane to 2,3-dimethylbutane

(iii) 2-Bromobutane to Butanone   (4+5+3=12)

7.   (a) Assign E or Z notations to the following compounds:

(b) Assign R or S configuration to any two of the following compounds :

$$CH_3-\overset{\displaystyle OH}{\underset{\displaystyle H}{|}}-COOH$$

$$OH-\overset{\displaystyle CHO}{\underset{\displaystyle CH_2OH}{|}}-H$$

$$H_3C_{\prime\prime\prime\prime\prime}\overset{\displaystyle NH_2}{\underset{\displaystyle H}{C}}{}^{COOH}$$

(c) Convert the following Fischer projection to corresponding Sawhorse and Newmann projections.

$$\begin{array}{c} CH_3 \\ H-\!\!\!-\!\!\!-\!\!\!-Cl \\ Cl-\!\!\!-\!\!\!-\!\!\!-H \\ CH_3 \end{array} \quad,\quad \begin{array}{c} COOH \\ H-\!\!\!-\!\!\!-\!\!\!-OH \\ H-\!\!\!-\!\!\!-\!\!\!-OH \\ COOH \end{array}$$
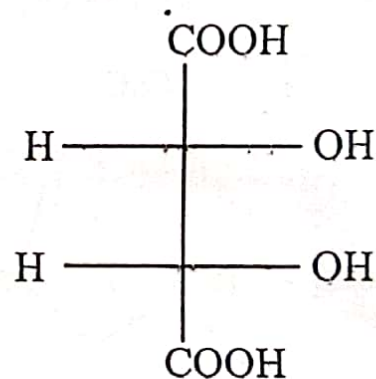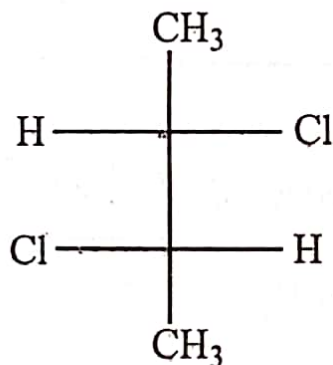
(d) Distinguish between following :

    (i) Configuration and Conformation

    (ii) Inductive and Electromeric effect

                                    (2+2+4+4=12)

8.   Write short note on any **four** of the following :

  (a) Hydroboration-Oxidation

  (b) Wurtz reaction

  (c) Kolbe's electrolytic method

  (d) Resonance

  (e) Conformations of ethane   (3×4=12)

                                               (2500)

Sr. No. of Question Paper : 41   I

Unique Paper Code   : 32171301

Name of the Paper   : C-5; Inorganic Chemistry-II; s and p block elements

Name of the Course   : **B.Sc. (Hons) Chemistry**

Semester   : III

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **five** questions.

3. **All** questions carry equal marks.

1. Explain any **five** giving suitable reasons :

    (a) Phosphorus forms pentahalides whereas nitrogen and bismuth do not.

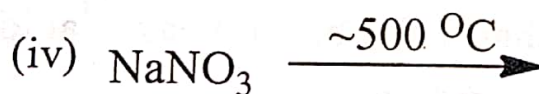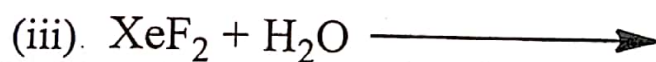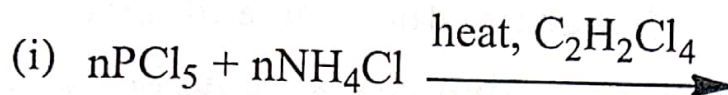   (b) The boiling points of hydrides of group 16 follow the given trend :

    $$H_2O > H_2S < H_2Se < H_2Te$$
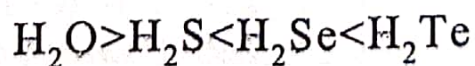
P.T.O.

(c) Ionization enthalpy of Li is very high and formation of N^{3-} requires ~2165 KJ/mole, still it forms Li_3N.

(d) Dilute solutions of alkali metals in liquid ammonia are paramagnetic and highly conducting.

(e) IF_7 is known while ICl_7 is not.

(f) $BeCO_3$ decomposes at about 100°C while the other group 2 carbonates require higher temperatures for decomposition.

(3×5)

2. (a) Draw and explain the structure of diborane with special reference to molecular orbital energy level diagram for the formation of B-H-B bonds.

(b) Magnesium metal burns in air to give an ash containing A and B. The ash on reaction with water gives an alkaline solution with smell of ammonia. Identify A and B with equations for the reactions.

(c) Explain the trend in solubility of hydroxides of alkali metals.

(d) The alkene and alkyne analogues of silicon are not known. Why?

(5,4,3,3)

3. (a) Complete and balance any **four** of the following reactions :

(i) $nPCl_5 + nNH_4Cl \xrightarrow{heat, C_2H_2Cl_4}$

(ii) $SiCl_4 + Li[AlH_4] \xrightarrow{ether}$

(iii). $XeF_2 + H_2O \longrightarrow$

(iv) $NaNO_3 \xrightarrow{\sim 500\ ^oC}$

(v) $BrF_5 + H_2O \longrightarrow$

(b) Which is stronger oxidizing agent in aqueous solution, fluorine or chlorine? Give suitable reasons.

(c) $SO_2(g)$ and $SO_3(g)$ have same hybridization but different structures. Explain.

(d) Mention the oxidation state of thallium in TlI_3 and name the compound. Justify the same.   (6,3,3,3)

4. (a) Carbon monoxide is a better reducing agent for metal oxides than carbon below 983K but above this temperature, the reverse is true. Discuss with the help of Ellingham diagram and also mention the drawbacks of carbon as a reducing agent at high temperatures.

(b) Though ClO_2 is an odd electron molecule, it shows little tendency to dimerize. Why?

(c) Why do clay minerals cleave easily into thin sheets?

(d) HF is more ionic than HCl, but a weaker acid than HCl in aqueous solution. Why?   (6,3,3,3)

5. (a) Write any one method of preparation of borazine. Though it is called inorganic benzene, it readily undergoes addition reactions unlike benzene. Explain with examples.

(b) $SnCl_2$ is a high melting solid whereas $SnCl_4$ is a liquid. Comment.

(c) Why does the first member of each group show anomalous behavior? Explain by taking Lithium as an example.

(d) Arrange the following oxoacids in the increasing order of their oxidizing power and justify the order :

$HClO$, $HClO_2$, $HClO_3$, $HClO_4$ (6,3,3,3)
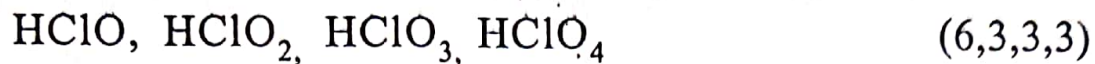
6. (a) Draw and discuss structures of any **three** :

(i) Basic beryllium acteate.

(ii) Dibenzo-18-crown-6.

(iii) P_4O_{10}

(iv) $[Li\ (acac)_2]$

(b) Select the correct answer in each category with appropriate justification :

(i) Highest solubility in water: He, Ne, Xe

(ii) No flame coloration: Rb, Be, Cs

(iii) Paramagnetic species: O^{2-}, O_2^{2-}, O_2^{-}

(c) SiF_4 is readily hydrolyzed while CF_4 is not. Why?

(6,6,3)

7. Write short notes on any **three** :

(a) Peroxoacids of sulphur

P.T.O.

(b) Vapour phase refining

(c) Clathrate compounds of noble gases

(d) Allotropes of phosporus

(5×3

(18

[This question paper contains 4 printed pages.]

Sr. No. of Question Paper : 42   IC

Unique Paper Code   : 32171302

Name of the Paper   : C VI – Organic Chemistry – II

Name of the Course   : **B.Sc. (Hons.) Chemistry**

Semester   : III

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **five** questions.

3. **All** questions carry equal marks.

1. (a) An organic compound A (C_4H_8O) reacts with hydroxylamine to give two isomeric compounds B and C (C_4H_9ON). Compound B and C when treated with sulphuric acid separately, give compounds D and E (C_4H_9ON) respectively. Identify A, B, C, D & E and write all the reactions involved. Name the reaction by which B is converted to C along with the mechanism.

                                            (10)

                                    P.T.O.

(b) Write one test with reaction involved for distinction between the following pairs of compounds.

    (i) Benzyl alcohol and phenol

    (ii) Acetaldehyde and acetone   (2×2.5)

2. How will you prepare the compounds **a, b, & c** from ethyl acetoacetate and **d & e** from diethyl malonate?   (5×3)

    (a) 3-Methylpentan-2-one

    (b) Pentane-1,5-dioic acid

    (c) n-Butyric acid

    (d) Adipic acid

    (e) 5,5-Diethylbarbituric acid

3. Explain the following :   (5×3)

    (a) Maleic acid is stronger than fumaric acid. However the second dissociation of fumaric acid occur more readily than maleic acid.

    (b) S_N2 reactions involve complete inversion of configuration.

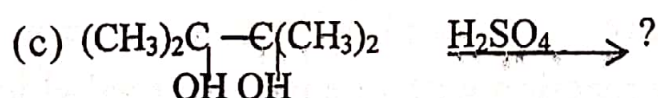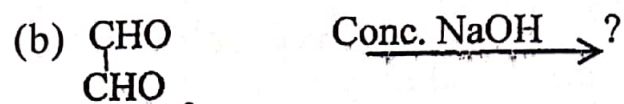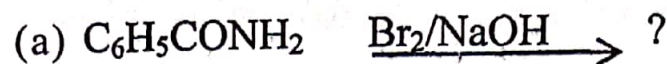   (c) Phenol is a weaker acid than p-nitrophenol.

    (d) Vinyl chloride is less reactive than ethyl chloride towards nucleophilic substitution reactions.

(e) Methoxy benzene is prepared by reaction of methyl chloride and sodium phenoxide rather than from chlorobenzene and sodium methoxide.

4. Write the products for the following along with equations :   (5×3)

(a) When α-, β-, and γ- hydroxy acids are heated separately.

(b) Ethyl acetate is treated with sodium ethoxide followed by reaction with one mole of methyl iodide in the presence of. sodium metal.

(c) Phenol is heated with chloroform in the presence of sodium hydroxide followed by reaction with alkaline $KMnO_4$.

(d) 2-Phenyl-1-ethanol is treated with dil. NaOH.

(e) Formic acid and malonic acid are hearted separately.

5. How will you carry out the following conversions?
                                                     (5×3)

(a) Propanoic acid to lactic acid

(b) Phenol to aspirin

(c) Propanal to 2-butanol

(d) Phenylacetaldehyde to phenylacetamide

(e) Aniline to iodobenzene.

P.T.O.

4

6. Complete the following reactions. Write the mechanism of the reaction involved. (3×5)

(a) $C_6H_5CONH_2$ $\xrightarrow{Br_2/NaOH}$?

(b) $\begin{array}{l} CHO \\ | \\ CHO \end{array}$ $\xrightarrow{Conc. NaOH}$?

(c) $(CH_3)_2\underset{OH}{C} - \underset{OH}{C}(CH_3)_2$ $\xrightarrow{H_2SO_4}$?

7. Write short notes on any **three** of the following with emphasis to (i) the functional group that undergoes these reactions, (ii) products formed, (iii) reaction conditions and (iv) mechanism. (3×5)

(a) Benzoin condensation

(b) Perkin reaction

(c) Wittig reaction

(d) Claisen rearrangement

(e) Dieckmann reaction

Roll No. ☐☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : 43

Unique Paper Code : 32171303   I

Name of the Paper : **Physical Chemistry-III : Phase Equlibria, Electrochemical Cell**

Name of the Course : **B.Sc. (Hons.) Chemistry**

Semester : **III**

Duration : **3 Hours**   Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. **1** is compulsory.

Attempt *six* questions in all,

selecting at least *two* questions from each Section.

Use of scientific calculator is permitted.

Graph paper may be provided.

Values of constant : R = 8.314 JK^{-1} Mol^{-1}; F = 96500 C Mol^{-1}.

P.T.O.

1. Attempt any *five* questions from the following :   5×3

    (a)   Why a saturated solution of KCl or NH_4NO_3 should be

          used in the salt bridge ?

    (b)   Polarities of cathode and anode in a galvanic cell are

          opposite to those in an electrolytic cell.

    (c)   Langmuir equation is more suitable for chemisorption than

          physisorption.

    (d)   Adsorption is an exothermic process.

    (e)   For a one component system, the maximum number of

          phases that can exist in equilibrium is three.

    (f)   Find out the number of components present in the solution

          containing Na^+, Cl^-, Ag^+, NO_3^-, $AgCl(s)$ and H_2O.

                            Section-A

2. (a)   The EMF of the following cell :

                    $Cd/CdCl_2(satd.)//AgCl(s)/Ag$
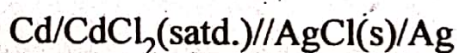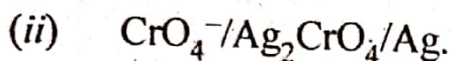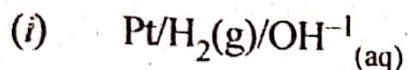
          is 0.6753 V at 25°C and 0.6915 V at 0°C.

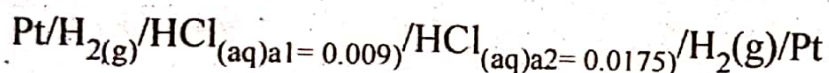   Calculate ΔG, ΔH and ΔS for the cell reaction at 25°C

                                                    (1800)

(b) Derive an expression for the electrode potential for the following half cells :

(i) $Pt/H_2(g)/OH^{-1}_{(aq)}$

(ii) $CrO_4^-/Ag_2CrO_4/Ag$.

(c) Explain with examples, the difference between reversible cell and irreversible cells. 6,3,3

(a) Given the cell,

$Pt/H_{2(g)}/HCl_{(aq)a1=0.009}/HCl_{(aq)a2=0.0175}/H_2(g)/Pt$
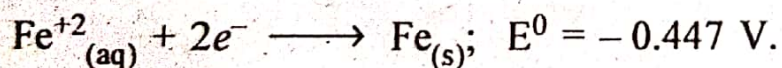
$E_{cell} = 0.028$ V at 25°C

(i) Derive an expression for EMF of cell with transference.

(ii) Calculate the liquid junction potential associated with this cell. The transference no. of H^+ ions is 0.83.

(b) You are given the following reduction reactions and E^0 values :

$Fe^{+3}_{(aq)} + e^- \longrightarrow Fe^{+2}_{(aq)}$; $E^0 = 0.771$ V

$Fe^{+2}_{(aq)} + 2e^- \longrightarrow Fe_{(s)}$; $E^0 = -0.447$ V.
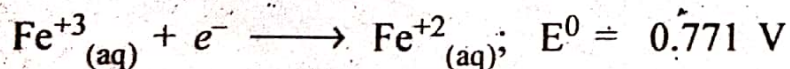
Calculate E^0 for half cell reaction :
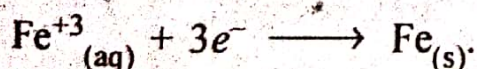
$Fe^{+3}_{(aq)} + 3e^- \longrightarrow Fe_{(s)}$. 8,4

P.T.O.

4.   (a)   Construct the appropriate cell and to determine the equilibrium constant for the reaction at 298 K :

$$Cd^{+2}_{(aq)} + 4NH_{3\,(aq)} \rightleftharpoons [Cd(NH_3)_4]^{+2}$$

$E^0_{Cd^{+2}/Cd} = -0.40$ V and $E^0_{[Cd(NH_3)_4]^{+2}/Cd} = -0.61$ V.

   (b)   Explain, how the pH of a solution is determined by using the quinhydron electrode.

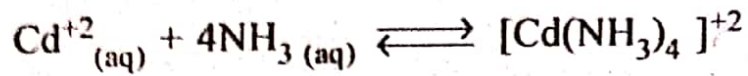   (c)   What other electrodes can also be used to determine the pH of the solution ?   6,3,3

5.   (a)   Give the postulates on which Langmuir's adsorption isotherm is based and develop an expression for the same. What form does the equation take under conditions of low pressure and high pressure ?

   (b)   At 0°C and 1 atm pressure, volume of N_2 gas required to cover a sample of silica gel assuming Langmuir monolayer adsorption is found to be 130 cm³ g⁻¹ of the gel. Calculate the surface area per gram of silica gel. Given that the area occupied by a N_2 molecule is 0.162 nm².   6,6

Section-B

6. (a) Using Clausius-Clapeyron equation, draw the labelled phase diagram for water.

    (b) A mixture of an organic liquid A and water is distilled under 1 atm pressure at 372.2 K. What mass of steam would be condensed to obtain 1 g of liquid A in the distillate ? The vapour pressure of H_2O at 372.2 K is 739 torr and molar mass of A = 123 g mol⁻.

    (c) What are the azeotrops ? Can they be purified by fractional distillation ? Justify your answer.   4,4,4

7. (a) Construct a well labelled phase diagram for zinc and magnesium system using the following data :

    (i) Melting point of magnesium, 655°C

    (ii) Melting point of zinc, 500°C

    (iii) One eutectic point at 350°C with 20 mole per cent of zinc and another at 430°C with 92 mole per cent of zinc.

(ii)   A solid compound of $MgZn_2$ is formed which melts

   congruently at 540°C.

Draw the cooling curves at 20% mole and 40% mole

of Zinc.

(b)   A solute distributes itself between two immiscible

solvents α and β. If the solute was found to be associated

in phase β while it remained unaffected in the other, find

out the distribution coefficient of the solute between

phase α and β.

(c)   Starting from Duhem-Margules equation, show that if one

component behaves ideally, the second component also

behave in the ideal manner.   6,3,3

8.   (a)   Derive an expression of phase rule for the reactive and

non-reactive system.

(b)   When a liquid, which is immisible with water, was steam

distilled at 95.2°C at a total pressure of 747.3 torr, the

distillate contained 1.27 g of the liquid per gram of water.

Calculate the molar mass of the liquid. The vapour pressure

of water is 638.6 torr at 95.2°C.

(c)   What is the effect of different types of impurities on

CST ? Explain with examples.   4,4,4

9.   Write short notes on any *three* :

(a)   Calomel electrode

(b)   Physical adsorption and Chemical adsorption

(c)   BET equation

(d)   Fractional distillation of ideal and non-ideal

solutions.   4,4,4

[This question paper contains 7 printed pages]

Your Roll No. : ....

Sl. No. of Q. Paper : **216**   I

Unique Paper Code : 42174304

Name of the Course : **B.Sc.(Prog.)**

Name of the Paper : Chemistry-2 (Solution, conductance, Electrochemistry and Functional Group)

Semester : III

Time : 3 Hours   *Maximum Marks : 75*

Instructions for Candidates :

  (a) Write your Roll No. on the top immediately on receipt of this question paper.

  (b) Use separate answer sheets for **Section - A** and **Section - B**.

  (c) Both sections carry equal marks.

  (d) Attempt **six** questions in **all, three** questions from each Section.

 (e) Log tables can be used for calculations.

P.T.O.

Section – A

1. (a) The resistance of 0.01N NaCl solution at 25°C is 200 Ω. Cell constant of conductivity cell is unity. Calculate the equivalent conductivity.   2.5

    (b) Plot the graph for conductometric titration between strong acid and strong base. Explain it also.   2.5

    (c) Give Nernst equation for Calomel electrode.   2.5

    (d) Define components and phase of system.   2

    (e) What is minimum boiling azeotrope ?   2

    (f) Define ionic mobility and transport number.   2

2. (a) Calculate the E_{red} of the following electrode.   4

    Pt/Cl_2 (1.5 atm)/ $2Cl^-$ (0.01M)
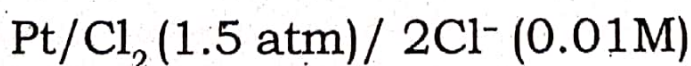
    $E°Cl_2 /2 Cl^- = 1.36$ V

(b) How will you calculate the pH of unknown solution using Hydrogen electrode ? 4

(c) Calculate the equilibrium constant for a reaction. 4

Ni (s) + Cu^{2+} (aq) → Cu(s) + Ni^{2+} (aq)
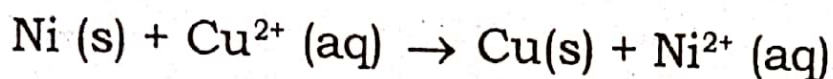
Given, $E°Ni^{2+}/Ni = -0.25$ V

$E°Cu^{2+}/Cu = +0.34$ V

3. (a) Determine the solubility product of sparingly soluble salt using conductometric measurements. 4

(b) Explain Hittorf method to calculate transport number. 4

(c) Given the following molar conductivities at 25°C 4

HCl=426 Ω^{-1} cm^2 mol^{-1}

NaCl=126 Ω^{-1} cm^2 mol^{-1}

NaC(Sodium Crotonate)=83 Ω^{-1} cm^2 mol^{-1}

Calculate the degree of dissociation and dissociation constant of crotonic acid.

The conductivity of 0.001 mol dm^{-3} acid solution in 3.83 × 10^{-5} Ω^{-1} cm^{-1}.

4. Write short note on any **three** :

4, 4, 4

(a) Gibb's Phase Rule

(b) Ideal and Non-Ideal solution

(c) Steam distillation

(d) Critical Solution Temperature (CST) and effect of impurity on CST.

Section - B

Note : Attempt **THREE** questions in **all**. Question No.1 is compulsory.

5. (i) Give the preparation of glycine using Streckers synthesis.   2

(ii) Giving suitable explanation, arrange the following in increasing order of their reactivity with phenol :

acetyl chloride, acetamide, methyl acetate

2

(iii) What is meant by isoelectric point with reference to amino acids ?   2

(iv) How will you distinguish between ethyl amine and aniline using HNO_2? Give the chemistry involved.   2.5

(v) What are polysaccharides ? What is the structural difference between starch and cellulose ?   2.5

(vi.) A tetrapeptide on partial hydrolysis gave following dipeptides. Determine the structure and name of the tetrapeptide by overlapping method.   2.5

Ala–Gly + Gly–Val + Leu–Ala

6. (i) What happens when methyl α -D- glycoside is oxidized with periodic acid and the resultant compound is treated with bromine water, followed by hydrolysis with dilute acids ? What conclusion is drawn from these reactions regarding structure of D-(+) glucose.   4

(ii) What is mutarotation ? Explain taking the example of D-(+)glucose.   4

(iii) How can D-aldopentose be converted into D-aldohexose ? Give name of reaction involved.   4

P.T.O.

7. (i) Explain the method used for determining the N & C-terminal amino acid present in a peptide.   4

(ii) Synthesize dipeptide ala-val by using t-BOC & DCC. Give the name and structure of protecting & activating groups.   4

(iii) Explain the formation of violet colour when amino acid reacts with ninhydrin.

    4

8. (i) Convert :   2.5, 1.5

    (a) Phenylacetic acid to benzylamine

    (b) Aniline into p-bromoanilne

(ii) An aliphatic amine with molecular formula C_2H_5N exists in 2 isomeric forms 'A' and 'B'. When warmed with chloroform and KOH only 'A' reacts producing a foul smell. What are the structure and name of 'A' and 'B' ? Write name of reaction and chemical equation involved in it. Also predict which would behave as stronger base- 'A' or 'B' ?   4

(iii) Give a brief description, reaction and example of any **one** of the following : 4

    (a)   Perkin condensation

    (b)   Claisen condensation

3500

Your Roll No. : ....

Sl. No. of Q. Paper : **246**   I

Unique Paper Code : 32173909

Name of the Course : **B.Sc.(Hons.)/ B.Sc. (Prog.) : Chemistry-SEC**

Name of the Paper : Pharmaceutical Chemistry

Semester : III

Time : 2 Hours   **Maximum Marks : 38**

Instructions for Candidates :

  (a) Write your Roll No. on the top immediately on receipt of this question paper.

 (b) Attempt any **three** questions in all. Question NO.1 is compulsory.

                                               3×5

1. Attempt any **five** questions :

  (i) What is a drug ?

(ii) Write the clinical uses of Dapsone and Glyceryl trinitrate.

(iii) Write down the structure of phenobarbital.

(iv) What are anti-inflammatory agents ? Give two examples.

(v) Write **two** advantages and two disadvantages of herbal medicine

(vi) What are antiviral agents ? Give **one** example.

(vii) Write down the structure of **A** and **B** :

2
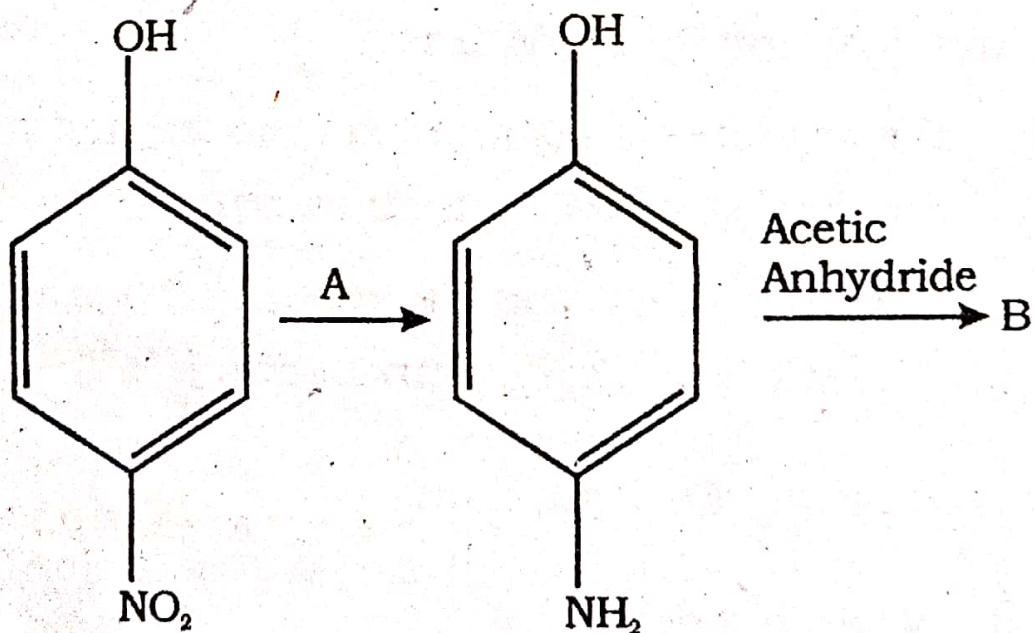
2. (i) What are bacteriostatic and bactericidal agents ? Give **one** example for each.   3

(ii) What do you understand by 'targeted drug delivery'.   3.5

(iii) Explain Retrosynthetic approach in drug discovery with a suitable example.   5

3. (a) Write down short notes on any **two** of the following :   4×2

(i) Drug Discovery

(ii) HIV- AIDS

(iii) Hypnotics

(b) Describe fermentation process for Lysine.   3.5

4. (i) Write down the laboratory preparation of Aspirin.   3

(ii) Write a short note on preparation of ethyl alcohol through anaerobic fermentation.

4.5

(iii) How fermentation could be useful for industrial production of Vitamin B12 ? 4

Your Roll No. : ....

Sl. No. of Q. Paper : 247   I

Unique Paper Code : 32173910

Name of the Course : **B.Sc.(Hons.)/B.Sc. (Prog.) : Chemistry-SEC**

Name of the Paper : Chemistry of cosmetics and perfumes

Semester : III

Time : 2Hours   *Maximum Marks : 38*

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt **three** questions in all.

(c) Question NO.1 is compulsory. Attempt any two other questions.

1. (a) Given below is the formulation of a cosmetic product. Recognize it and also write the important uses of the ingredients of this product.   4

    Beeswax, Mineral Oil, Borax, Distilled water and Perfume

P.T.O.

(b) (i) Write the structure and uses of muscone. 2

(ii) Why is hydrogen peroxide not required for the application of temporary hair dye ? 2

(iii) What are the main differences between cold cream and vanishing cream ? 2

(iv) What are the ideal properties of good nail enamel ? 2

(v) How does SPF value describe the effectiveness of a sun screen cream ? 2

2. (a) Write the essential requirements of compact face powder. How are they different from cream powders (Foundation creams) ? 4

(b) Describe the important uses of various ingredients of vanishing cream. 4

2

(c) Name the various methods for extraction of essential oils from plant materials. Describe any **one** method in detail excluding expression method. 4

3. (a) What are the main ingredients of shampoo ? Discuss the role of surfactants in them.

4

(b) Mention the constituents of talcum powder with their importance. 4

(c) How are hair dyes classified? Discuss permanent hair dyes in detail. 4

4. Write short note on any **three** of the following :

4+4+4

(i) Deodorants and antiperspirants.

(ii) Sun screen creams (or lotions)

P.T.O.

3

(iii) Lipsticks

(iv) Hair sprays

900

Roll No. ☐☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : 971

Unique Paper Code : 32175915   IC

Name of the Paper : Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional group Organic Chemistry–II

Name of the Course : Chemistry : Generic Elective

Semester : III

Duration : 3 Hours   Maximum Marks : 75

(Write your Roll No. on the top immediately on receipt of this question paper.)

Use separate sheets for Section A and Section B.

Attempt *all* parts of a question together.

Use of scientific calculator and logarithmic table is allowed.

SECTION A

(Answer any *three*)

1. (a) What are the number of phases and degree of freedom in a system containing two completely miscible liquids ?

    (b) Describe the phase diagram of water.

P.T.O.

(c)   Derive Clausius-Clapeyron equation.

(d)   Draw and explain two component phase diagram for Na-K.   2,2½,3,5

2.   (a)   Define lever rule.

(b)   What do mean by CST ? What are its different types ? Explain with examples.

(c)   Write a short note on steam distillation.

(d)   Draw the temperature-composition phase diagram for a liquid pair forming minimum boiling Azeotrope solution. Describe its Isobaric fractional distillation.   2,3,3½,4

3.   (a)   Write the cell reaction and Nernst equation for Standard Hydrogen Electrode.

(b)   What are various types of electrodes ?

(c)   What is the underlying principle of Potentiometric titrations ? What are its advantages over volumetric titrations ?

(d)   Calculate equilibrium constant for the following cell at 298 K :

$Zn(s), Zn^{2+} \parallel Cu^{2+}, Cu(s)$

Given : $E^0 (Cu^{2+}, Cu) = 0.3394$ V and

$E^0 (Zn^{2+}, Zn) = -0.763$ V   2,3,3½,4

4. (a) Define molar and equivalent conductance. What is the relation between the two ?

    (b) State and explain Kohlrausch law of independent migration of ions with suitable example.

    (c) Write any *three* applications of conductometric measurements. Explain any *one* in detail.

   (d) Describe Hitorff's method for determination of transference number.   2,3,3½,4

SECTION B

(Answer any *three*)

1. (a) Explain what happens when an aqueous solution of α-D-glucose is kept for some time. Name the phenomenon and discuss the mechanism.

    (b) How will you convert D-glucose to D-arabinose by Ruff's degradation ?

    (c) Sucrose and maltose both are disaccharides but sucrose is a non-reducing sugar while maltose is a reducing sugar. Explain on the basis of their structures.

                                                                        P.T.O.

(d) Draw Haworth projection of β-D-glucopyranose and α-D-fructofuranose.

(e) Write a short note on starch, a polysaccharide, emphasizing its monomer, linkages between monomers.

3,2,3,2,2½

2. (a)

$\overset{-}{N}\overset{+}{K}$ + $ClCH_2CO_2C_2H_5$ ⟶
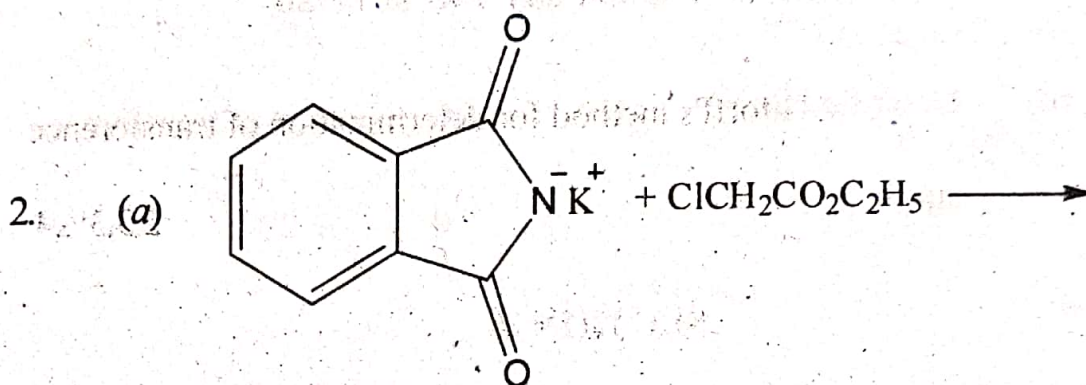
(b) Write a short note on Merrifield solid phase synthesis of polypeptide emphasizing its advantages of solution/liquid phase synthesis.
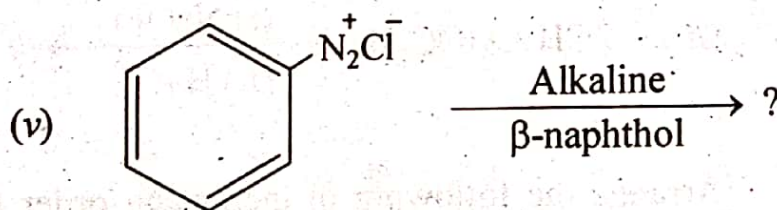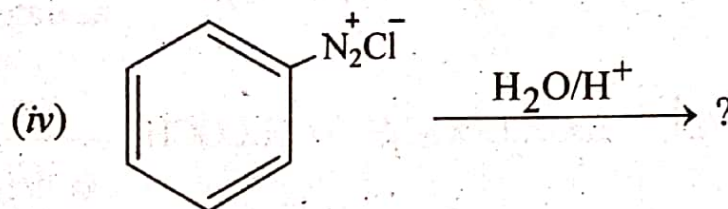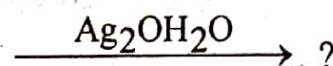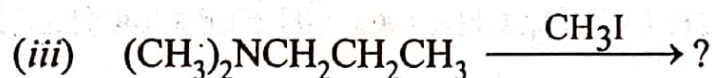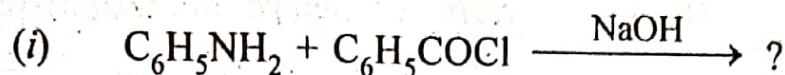
(c) Explain Edman's degradation method for determination of N-terminal amino acids of peptides.

(d) Give a method for the preparation of Gly-Ala using DCC and t-BOC.

(e) How electrophoresis is used to separate a mixture of amino acids ?

1,3,3,3,2½

3. (a) Complete the following reactions :

(i) $C_6H_5NH_2 + C_6H_5COCl \xrightarrow{\text{NaOH}}$?

(ii) $C_2H_5NH_2 + CHCl_3 + KOH \longrightarrow$?

(iii) $(CH_3)_2NCH_2CH_2CH_3 \xrightarrow{CH_3I}$?

$\xrightarrow{Ag_2OH_2O}$?

(iv)

$\xrightarrow{H_2O/H^+}$?

(v)

$\xrightarrow[\beta\text{-naphthol}]{\text{Alkaline}}$?

(b) Outline the chemistry of Hinsberg test.

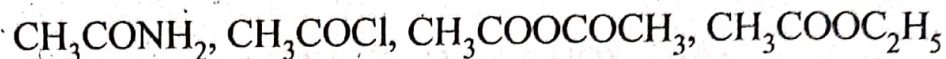(c) Compare basicity of aniline with primary aliphatic amine.

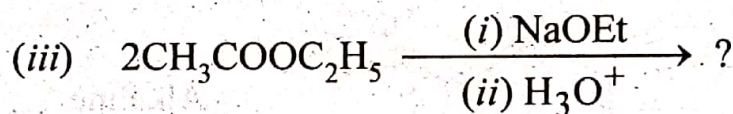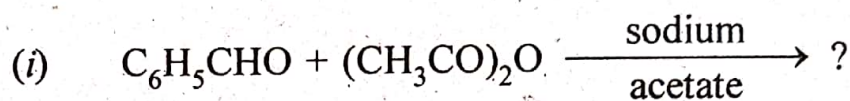(d) Explain the mechanism of Hoffmann Bromamide reaction.

6,2,2,2½

4. (a) Write down the mechanism of Hell Volhard Zielinski reaction.

P.T.O.

(b) Arrange the following acid derivatives in increasing order of their reactivity toward nucleophilic substitution (Addition elimination) and support your answer by appropriate explanation.

CH_3CONH_2, CH_3COCl, $CH_3COOCOCH_3$, $CH_3COOC_2H_5$

(c) Complete the following reactions :

(i) $C_6H_5CHO + (CH_3CO)_2O \xrightarrow[\text{acetate}]{\text{sodium}}$?

(ii) $BrCH_2COOC_2H_5 + CH_3COCH_3 \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) Zn/ether}}$?

(iii) $2CH_3COOC_2H_5 \xrightarrow[\text{(ii) } H_3O^+]{\text{(i) NaOEt}}$?

(d) Arrange the following in increasing order of acidity and justify your answer :

$BrCH_2COOH$, CH_3COOH, $HCOOH$, Br_3CCOOH

3,3,3½,3

Roll No. ☐☐☐☐☐☐☐☐☐☐

S. No. of Question Paper : **298**

Unique Paper Code : **32173911**   **IC**

Name of the Paper : **Pesticide Chemistry**

Name of the Course : **B.Sc. (Program) : SEC**

Semester : **V**

Duration : **2 Hours**   Maximum Marks : **38**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

1. Attempt any *five* of the following :   10

   (*a*) Write the structural formula of Atropine.

   (*b*) Draw the structural formula of Malaoxon.

   (*c*) Draw the structure of chloranil and write its IUPAC name.

   (*d*) Write the structural formula of acetyl choline.

P.T.O.

(e)   Describe herbicides with a suitable example.

(f)   Fill in the blanks :

(i)   Malathion is acts as an .... inhibitor.

(ii)   Gammaxene is also known as ....

2.   (a)   Write the chemical reaction for the synthesis of DDT.

(b)   What are pesticides ? Explain with a suitable example.

(c)   What are fungicides ? Explain with a suitable example.

(d)   Write the structural formula of Isomalathion.   2,2,2,1

3.   (a)   How can you differentiate between natural and synthetic

pesticides ?

(b)   Write the chemical reaction for the synthesis of Parathion.

(c)   Discuss about the mode of action of DDT.

(d)   Write the structural formula of Bendiocarb.   2,2,2,1

4.   (a)   Discuss the benefits of pesticides.

(b)   Write the chemical equation of basic (alcoholic NaOH)

hydrolysis of Lindane.

(c)   How carbaryl can be synthesized using phosgene ?

(d)   How is the toxicity of a pesticide measured ?   2,2,2,1

5.   (a)   Write the structural formula of the following :

(i)   Butachlor

(ii)   Acetyl choline

(iii)   Chloranil.

(b)   Draw the structure and write the name of the product :
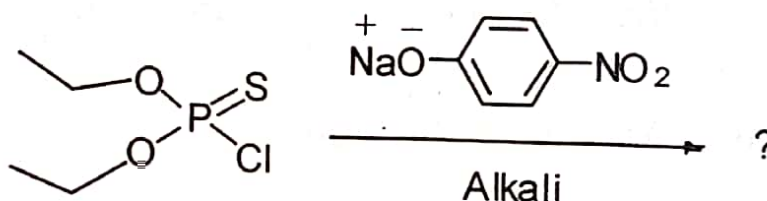
(c)   Write *two* benefits of carbamates over other classes of insecticides.

3,2,2

6.   (a)   Write the name of any *two* antidote to neutralize the toxic effect of agricultural pesticides.

(b)   Write the structure of isomeric forms of HCH.

(c)   What is the chemical reaction to synthesize carbary from α-naphthol ?

2,3,2

P.T.O.

7. (a) Write the chemical reaction to synthesize Lindane.

(b) What are the advantages and disadvantages of pesticides ?

(c) Match the following with their mode of action :

(i)	Alachlor	(a)	Weeds
(ii)	Parathion	(b)	Carbophos
(iii)	Herbicide	(c)	Chloroacetanilide
(iv)	Malathion	(d)	Folidol

(d) Write the IUPAC name of DDT.   2,2,2,1

Your Roll No...............

Sr. No. of Question Paper : **388** IC

Unique Paper Code : 42177925

Name of the Paper : Chemistry of d Block Elements, Quantum Chemistry and Spectroscopy

Name of the Course : **B.Sc. (Prog.) Chemistry : DSE-2A**

Semester : V

Duration : 3 Hours   Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.

2. Attempt any **three** questions from **Section A** and any **three** from **Section B**.

3. **Section A** and **B** are to be attempted separately in the same sheet.

4. Calculators and log tables may be used.

Section A

Attempt any **three** *questions.*

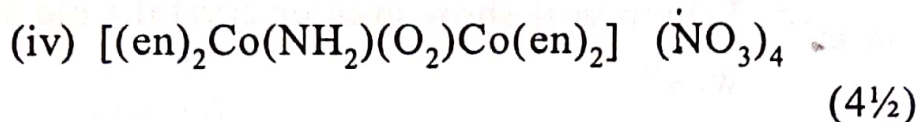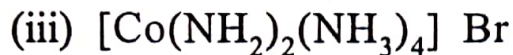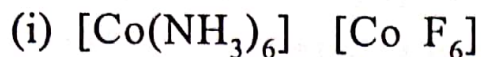1. (a) Give brief reasons for the following (**any five**) :

P.T.O.

(i) Transition metals form alloys.

(ii) Cu^{2+} ions are coloured while Zn^{2+} ions are colourless.

(iii) The atomic radii of second and third transition series elements are similar.

(iv) Many transition metals and their compounds act as catalysts.

(v) Low spin tetrahedral complexes are not known.

(vi) The oxides of first transition series elements are acidic in high oxidation state and basic in low oxidation state.   (10)

(b) Complexes with empirical formula $Pt\ (NH_3)_4$ Cl_2SO_4 exist in two isomeric forms A & B. Form A yields one mole of $BaSO_4$ when treated with a solution of $BaCl_2$ where as form B yields two moles of AgCl ppt when treated with a solution of $AgNO_3$. Write down the structural formulae of both the forms and name the type of isomerism involved.   (2½)

2. (a) Name **any three** of the following complexes according to IUPAC system of nomenclature.

(i) $[Co(NH_3)_6]$ $[Co F_6]$

(ii) Li $[Mn(CO)_5]$

(iii) $[Co(NH_2)_2(NH_3)_4]$ Br

(iv) $[(en)_2Co(NH_2)(O_2)Co(en)_2]$ $(NO_3)_4$

(4½)

(b) Calculate CFSE in terms of Δ_t of a d^7 metal ion placed in a tetrahedral field. Draw the splitting diagram.   (4)

(c) Define Jahn Teller theorem. Which of the following high spin complexes would you expect to exhibit Jahn Teller distortion? Give reasons.

$[Cr(NH_3)_6]^{3+}$ or $[MnCl_6]^{3-}$ (4)

3.   (a) The complex $[Cr(C_2O_4)_2 (NH_3)_2]$ exists in two isomeric forms A & B. A is optically active whereas B is optically inactive. Draw the structures of A & B and explain briefly.

(4½)

(b) Write the formulae of **any two** of the following :

(i) Tetraamminedichloridoplatinum(IV) tetrachloridoplatinate(II)

(ii) μ-amido-μ-peroxidobis{tetraamminecobalt (III)}phosphate

(iii) Potassium bis(thiosulphato)argentate (I)

(4)

(c) Which will show greater crystal field splitting and why?

(i) $[Co(NH_3)_6]^{2+}$ or $[Co(NH_3)_6]^{3+}$

(ii) $[Cr(NH_3)_6]^{3+}$ or $[Cr(CN)_6]^{3-}$ (4)

4. (a) Explain why the crystal field splitting in tetrahedral complexes is always less than that in octahedral complexes. Calculate Δ_t for $[NiCl_4]^{2-}$, given Δ_o for octahedral $[NiCl_6]^{4-}$ is 7300 cm^{-1}.   (4½)

(b) Although $[NiCl_4]^{2-}$ and $[Ni(CO)_4]$ have same geometry but they differ in their magnetic behavior. Explain.   (4)

(c) Given below is the Latimer diagram for copper

$$Cu^{2+} \underline{\ +\ 0.15\ } Cu^+ \underline{\ +0.50\ } Cu$$
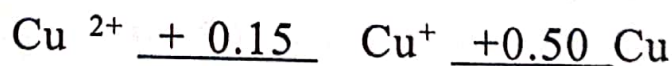
Answer the following questions :

(i) Is there any state which undergoes disproportionation? Explain by showing necessary calculations.

(ii) Calculate skip step emf for Cu^{2+} ------ Cu change.

OR

.Write short notes on any **two** of the following :

(i) Separation of lanthanides by ion exchange method

(ii) Complex formation tendency of d – block elements

(iii) Variable oxidation states in transition elements.   (4)

Section B

Physical constants

Planck's constant, $h = 6.626 \times 10^{-34} Js$

Boltzmann Constant, $k = 1.38 \times 10^{-23} JK^{-1}$

Mass of electron, $m_e = 9.31 \times 10^{-31} kg$

Velocity of light, $c = 3 \times 10^8 \ m \ s^{-1}$

Attempt any **three** *questions.*

1. (a) Write the Schrodinger wave equation and apply it to the particle in a one dimensional box. Obtain expression for energy.   (4½)

P.T.O.

(b) What do you understand by the terms singlet state and triplet state? Explain the phenomenon of fluorescence and phosphorescence using jablonskidiagram. (4)

(c) A 0.03 M solution of a substance has an absorbance of 0.75 at 600 nm using a cell of pathlength 1 cm. Calculate molar absorption coefficient and the percent absorption for 0.01 M solution in the same cell. (4)

2. (a) The pure rotational spectrum of the gaseous molecule CN has a series of equally spaced lines separated by 3.79 cm^{-1}. Calculate the internuclear distance of the molecule. The molar mass of C and N are 12.011 and 14.007 g/mol respectively. (4½)

(b) Normalise the function $\psi = a - x$ over the interval $0 \le x \le a$. (4)

(c) Explain the terms chromophore and auxochrome giving examples. (4)

3. (a) Calculate the probability of finding a particle between $x = 0.4$ nm and $x = 0.5$ nm in a one dimensional box of length 1nm. (4½)

(b) Discuss the reasons for low and high quantum yield in photochemical reactions. A system absorbs 3×10^8 quanta of light per second. On irradiation for 20 mins, 0.003 moles of reactant was found to have reacted. Calculate the quantum yield for the process. (4)

(c) Define BornOppenheimer approximation. Explain its application in spectroscopy. (4)

4. (a) Show that the function cos ax.cos by. cos cz is an eigenfunction of laplacian operator and determine the eigenvalue. (4½)

(b) What are the essential conditions for a molecule to show microwave spectrum? Which of the following will show Microwave spectrum? Give reason.

(i) CO_2 (ii) H_2O

(iii) O_2 (iv) CO   (4)

P.T.O.

(c) Write a note on any **two** of following :

   (i) Bathochromic and hypsochromic shifts

   (ii) Free electron model

   (iii) Laws of photochemistry   (4)

[This question paper contains 4 printed pages]

Your Roll No. : ....

Sl. No. of Q. Paper : 195　　I

Unique Paper Code : 42161101

Name of the Course : **B.Sc.(Prog.)**

Name of the Paper : Biodiversity (Microbes, Algae, Fungi and Archegoniatae

Semester : I

Time : 3 Hours　　　　Maximum Marks : 75

Instructions for Candidates :

　(a) Write your Roll No. on the top immediately on receipt of this question paper.

　(b) All parts of a question must be answered together.

　(c) Attempt a total of **five** questions, including Question No. **1** which is compulsory.

　(d) Draw well labelled diagram wherever necessary.

1. (a) Define the following (any **five**) :　　$5 \times 1 = 5$

　　(i) Coenobium

　　(ii) Zygospore

(iii) Sporophyll

(iv) Endospore

(v) Sulphur shower

(vi) Heterophylly

(vii) Cleistothecium

(b) Fill in the blanks (any **five**) :   5 × 1 = 5

(i) Viruses infecting fungi are called......

....

(ii) Main biochemical constituent of bacterial cell wall is.....................

....

(iii) Early blight of Potato is caused by

....

(iv) Bryophytes are non vascular plants i.e. they lack .... and

....

(v) .... is a heterosporous pteridophyte.

(vi) Sago is obtained from ....

(vii) Young leaves of *Cycas* show ....vernation.

(c) Match the following :   5 × 1 = 5

(i) Winged pollen grain   (i) *Chlamydomonas*

(ii) Horse tail   (ii) *Pinus*

(iii) Cup shaped chloroplast   (iii) Virus

(iv) Columella   (iv) *Equisetum* spp.

(v) Capsomere   (v) *Rhizopus*

2. Differentiate the following (any **three**) :

$$3 \times 5 = 15$$

(i) Perithecium and Apothecium

(ii) Conceptacle and Receptacle

(iii) Lytic and Lysogenic cycle

(iv) Manoxylic and Pycnoxylic wood

(v) Sporophyte of *Marchantia* and *Funaria*

3. Draw well labelled diagrams of the following (any **three**) :

$$3 \times 5 = 15$$

(i) Structure of T_2 phage

(ii) Carposporophyte of *Polysiphonia*

(iii) V.S. thallus of *Marchantia*

(iv) V.S. of gill of *Agaricus*

(v) T.S. of Coralloid root of *Cycas*

4. Write short notes on the following (any **three**) :

$$3 \times 5 = 15$$

(i) With the help of suitable diagram briefly explain Stelar evolution in Pteridophytes.

(ii) Write different adaptations seen in Bryophytes for terrestrial habitat.

(iii) With the help of suitable diagram explain structure of a bacterial cell.

(iv) Discuss different modes of nutrition in Fungi.

(v) Explain sexual reproduction in *Fucus* with the help of suitable diagram.

5. Attempt any **three** of the following : 3 × 5 = 15

(i) Illustrate the life cycle of nannandrous species of *Oedogonium.*

(ii) Discuss hydrophytic and xerophytic characters of *Equisetum.*

(iii) Discuss stages of life cycle of *Puccinia* on Primary host plant along with the pathological symptoms seen on the host.

(iv) Discuss alternation of generation in Bryophytes with the help of a suitable example.

(v) Discuss generalized transduction in Bacteria.

6. Attempt the following (any **three**) : 3 × 5 = 15

(i) Importance of Bacteria in Industry.

(ii) Discuss ecological and economic importance of *Sphagnum.*

(iii) Economic use of Fungi.

(iv) Discuss the role of algae in Industry.

(v) Discuss general characteristics of Ascomycetes.

Your Roll No. : ....

Sl. No. of Q. Paper : **193**   I

Unique Paper Code : 42171103

Name of the Course : **B.Sc.(Prog.)**

Name of the Paper : Atomic structure, bonding, general organic chemistry and aliphatic hydrocarbons.

Semester : I

Time : 3 Hours   **Maximum Marks : 75**

Instructions for Candidates :

    (a) Write your Roll No. on the top immediately on receipt of this question paper.

    (b) Attempt any **three** questions from each Section. Use separate Answer booklet for each Section.

Section - A

1. (a) Write Schrodinger's wave equation and explain various terms involved in it.   2.5

(b) Explain as to why orbitals 1p, 2d or 3f are not possible ? 3

(c) Draw the Molecular Orbital diagram for NO molecule. 3

(d) Plot radial probability distribution curves for 4s, 4p, 4d and 4f orbitals. 4

2. (a) What is the significance of ψ and ψ^2 ? Explain. 2

(b) Bond angles in CH_4, NH_3, and H_2O are different inspite of same hybridisation. Explain. 3

(c) Write the hybridization of the central atom and shape of the following molecules :

PCl_5, ClF_3, $SnCl_2$ 3

(d) Write the M.O. configuration of O_2^+, O_2, O_2^- and O_2^{2-} and arrange them in increasing order of their bond length. 4.5

3. (a) Arrange the following compounds in the increasing order of their hardness :

AgF, AgBr, AgCl 1.5

(b) Explain why He_2 molecule does not exist ? 2

(c) Write the expression of Born – Lande equation and explain the terms involved in it. 3

(d) Write short notes on : 6

(i) Heisenberg's Uncertainty Principle

(ii) Lattice Energy

(iii) Solvation Energy

4. (a) The observed dipole moment of HX molecule is 1.92 D and bond distance is 1.20Å. Calculate the % ionic character of the molecule, HX. (electronic charge e = 1.602 x 10^{-19} C). 2.5

(b) What are Eigen functions and Eigen values ? 3

(c) Explain the stability of half filled and full filled orbitals. 2

(d) Calculate the heat of formation ΔH_f of MgF_2 from its elements using Born- Haber's cycle with the given data. 5

Sublimation Energy of Mg, (S) = 146.4 $kJmol^{-1}$

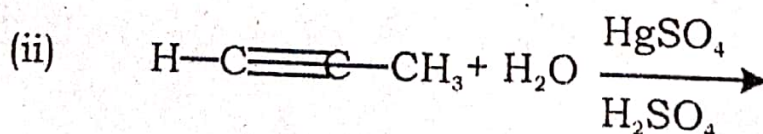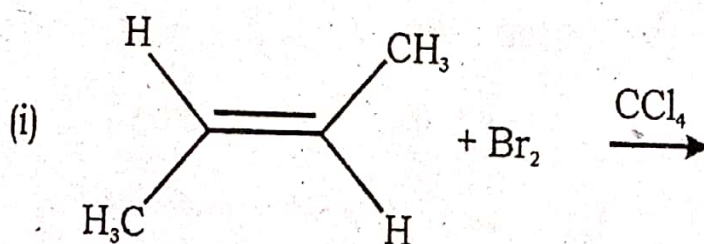Dissociation Energy of F_2, (D) = 158.9 $kJmol^{-1}$
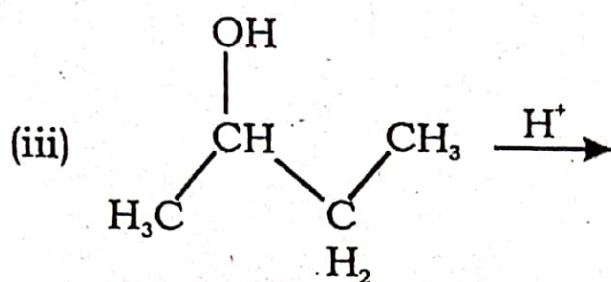
Ionization Energy of Mg^{2+} (I) = 2184.0 $kJmol^{-1}$

Electron Affinity of F(g) to F^- (E) = – 334.7 $kJmol^{-1}$

Lattice Enthalpy of MgF_2 (U_o) = –2922.5 $kJmol^{-1}$
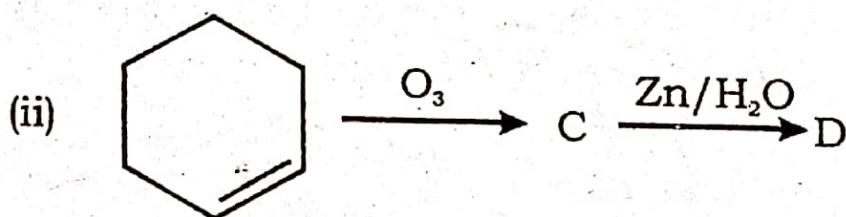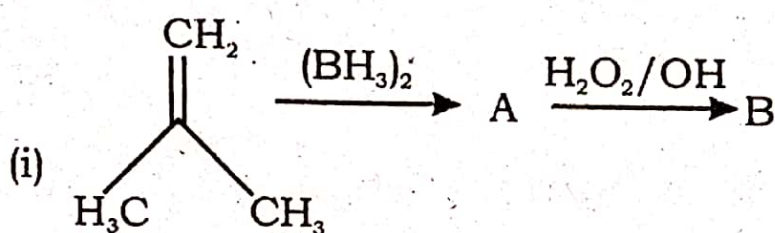
.3 P.T.O.

Section - B

5. (i) Differentiate between homolysis and heterolysis using suitable examples.   2.5

   (ii) Explain why tert.-butyl carbocation is more stable than methyl carbocation.   3

   (iii) Draw the energy diagram for the conformations of n-butane.   2

   (iv) Draw all possible stereoisomers of 2, 3-Dibromobutane using Fischer projection. Identify the erythreo, threo and the meso forms. Comment on the optical activity of the meso form.   5

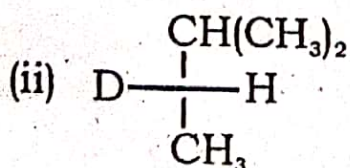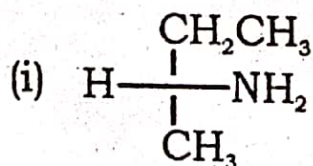6 (a). Give the mechanism and product formed in the given reactions :   9

(i)

$+ Br_2 \xrightarrow{CCl_4}$

(ii) $H\text{—}C\equiv C\text{—}CH_3 + H_2O \xrightarrow[H_2SO_4]{HgSO_4}$

4

(iii)

$$\underset{H_3C}{\overset{OH}{\underset{\underset{\overset{|}{C}}{\overset{|}{CH}}}{\overset{|}{\underset{H_2}{}}}} CH_3 \xrightarrow{H^+}$$

(b) Complete the following reactions :

3.5

(i)

$$\underset{H_3C}{\overset{CH_2}{\underset{CH_3}{}}} \xrightarrow{(BH_3)_2} A \xrightarrow{H_2O_2/OH} B$$
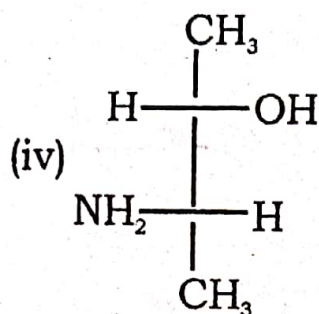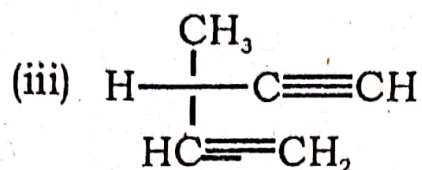
(ii)

$$\xrightarrow{O_3} C \xrightarrow{Zn/H_2O} D$$

7. (a) Give priority numbers to the groups attached and assign R/S configuration to the chiral centres in the given compounds :   5

(i) $H \overset{CH_2CH_3}{\underset{CH_3}{\overset{|}{\underset{|}{—}}}} NH_2$

(ii) $D \overset{CH(CH_3)_2}{\underset{CH_3}{\overset{|}{\underset{|}{—}}}} H$

5

P.T.O.

(iii)   H——C(CH₃)—C≡CH
        with HC≡CH₂

$$(iii) \quad H-\overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle HC=CH_2}{|}}{C}}-C\equiv CH$$

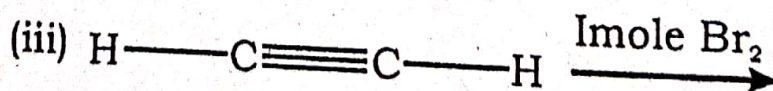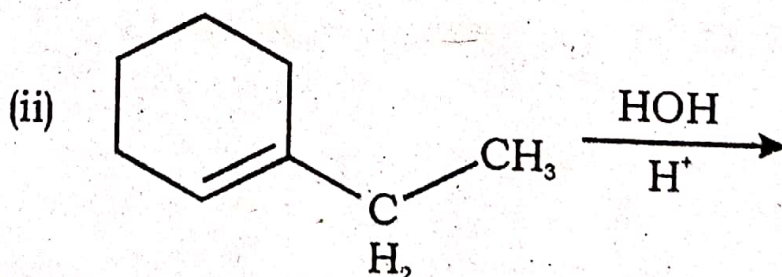$$(iv) \quad \overset{\overset{\displaystyle CH_3}{|}}{\underset{\underset{\displaystyle CH_3}{|}}{H-C-OH}} \\ NH_2-C-H$$

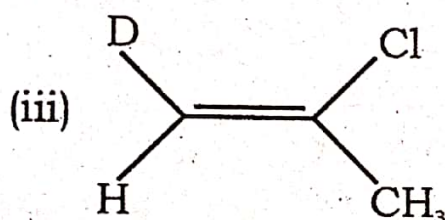(b) Describe Wurtz reaction.   1.5

(c) Giving reason, write the major product formed in the following reactions :   6

$$(i) \quad \underset{H_3C}{\overset{\displaystyle CH_2}{\diagup\hspace{-0.3em}\diagdown}}\underset{CH_3}{} \quad + HBr \xrightarrow{\text{peroxide}}$$

(ii) [cyclohexene ring]—CH₂—$\overset{}{C}$—CH₃ $\xrightarrow[H^+]{HOH}$

$$(iii) \quad H-C\equiv C-H \xrightarrow{\text{Imole Br}_2}$$
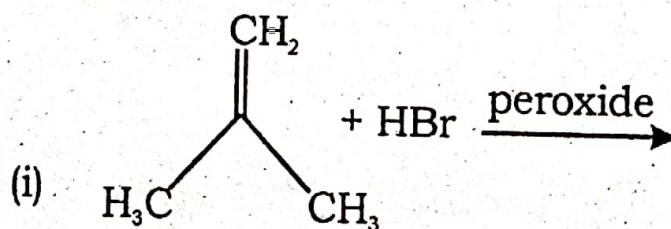
8. **(a)** Giving priority numbers to the groups attached assign E/ Z to the following geometrical isomers : 6

(i) C_6H_5 — CH_3 / H — H

(ii) H_3CO — NH_2 / H_3C — H

(iii) D — Cl / H — CH_3
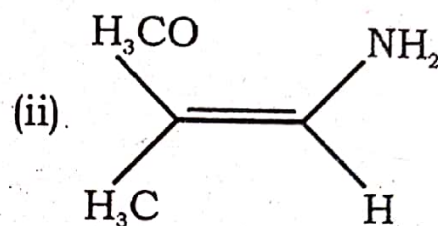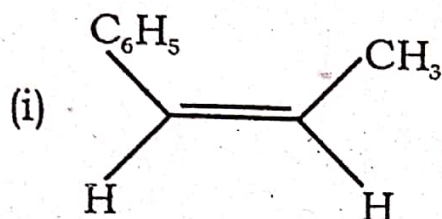
(b) Give stepwise synthesis of acetylene using 1, 2-dichloroethane. 1.5

(c) Convert the following : 5

(i) to Sawhorse projection

7 P.T.O.

(ii) to Fischer Projection

HOOC

HO

H

H

HO   COOH
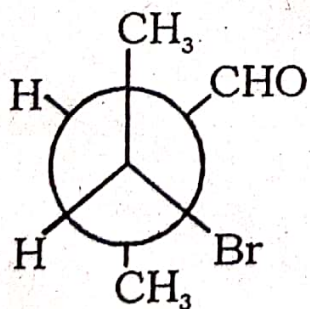
(iii) to Fischer Projection

CHO

OH

H₃C

H
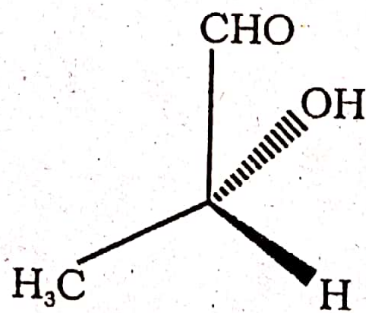
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Your Roll No. : ....

Sl. No. of Q. Paper : **209**   I

Unique Paper Code : 42234301

Name of the Course : **B.Sc.(Prog.)**

Name of the Paper : Physiology and Biochemistry

Semester : III

Time : 3 Hours   *Maximum Marks : 75*

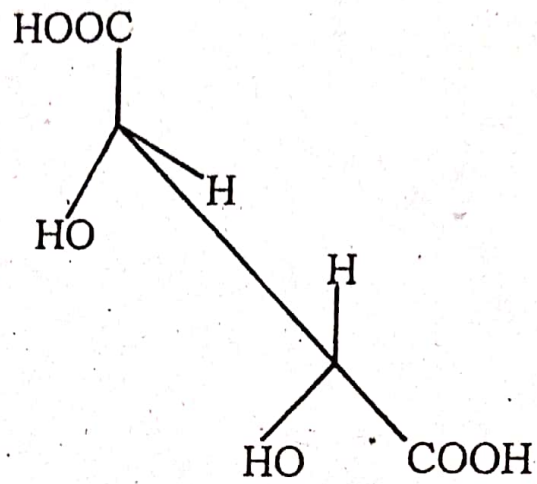**Instructions for Candidates :**

   (a) Write your Roll No. on the top immediately on receipt of this question paper.

   (b) Attempt **five** questions in **all**, two each from **Section-A** and **Section-B**.

   (c) Question **NO.1** is compulsory.

   (d) Attempt both sections in same answer sheet.

<div align="right">

P.T.O.

</div>

209

1. (a) Define the following terms : $1 \times 5 = 5$

    (i) Dead space

    (ii) Goitre

    (iii) Peristalsis

    (iv) K_m

    (v) Aminotransferase

(b) Distinguish between the following :

                                $2 \times 4 = 8$

    (i) I bands and A bands

    (ii) Tricuspid valve and Bicuspid valve

    (iii) Transketolase and Transaldolase

    (iv) Anabolic pathway and Amphibolic pathway

(c) Expand the following terms : $1 \times 4 = 4$

    (i) GFR

    (ii) PNS

    (iii) LDH

    (iv) NADPH

(d) Match the following : $1 \times 5 = 5$

    (i) Aldosterone   (a) Axon

    (ii) Pyruvate carboxylase   (b) Intestinal juice

2

(iii) Crypts of   (c) Adrenal cortex
       Lieberkuhn

(iv) Pentose Phosphate (d) Gluconeogenesis
       Pathway

(v) Nodes of Ranvier   (e) Synthesis of
                            Ribose

(e) Give one function of the following :

$$1 \times 5 = 5$$

(i) Fibrinogen

(ii) Sertoli cells

(iii) Semilunar valves

(iv) Flavoproteins

(v) Coenzyme A

Section - A

2. (a) Explain "Sliding filament theory" in muscle contraction with appropriate diagram.   4

(b) Describe the processes involved in urine formation by the kidneys.   8

3. (a) Elaborate on the transport of O_2 and CO_2 in blood.   8

P.T.O.

(b) Discuss the process of fat digestion and absorption in the Small intestine. 4

4. Write short notes on any **three** of the following:

4+4+4

(a) Thyroid gland

(b) Conduction of cardiac impulse

(c) Hormonal control of menstrual cycle

(d) Action potential

Section - B

5. Discuss the steps involved in Glycolysis.

12

6. (a) Describe the biosynthesis of Palmitic acid.

8

(b) Briefly explain the process of Oxidative deamination. 4

7. Write short notes on **any three** of the following:

4+4+4

(a) Glycogenolysis

(b) Competitive inhibition

(c) Cori cycle

(d) Lock and Key model

2000

[This question paper contains 4 printed pages]

Your Roll No. : ....

Sl. No. of Q. Paper : **211**   I

Unique Paper Code : 42224303

Name of the Course : **B.Sc.(Prog.)**

Name of the Paper : Thermal Physics and Statistical Mechanics

Semester : III

Time : 3 Hours   *Maximum Marks : 75*

Instructions for Candidates :

   (a) Write your Roll No. on the top immediately on receipt of this question paper.

   (b) Attempt **five** questions in **all** including Question No.**1** which is compulsory.

   (c) All questions carry equal marks.

1. Attempt any **five** of the following :   5×3=15

   (a) The entire heat given to an ideal gas in an isothermal process is spent in doing work only. Explain.

   (b) Show that for an ideal gas $C_p - C_v = R$.

P.T.O.

(c) Derive an expression for the work done by an ideal gas during an adiabatic expansion.

(d) State law of equipartition of energy and discuss briefly its applications to specific heat of monoatomic gases.

(e) Why is it not possible to obtain absolute zero ? Explain.

(f) There are 'n' molecules of a gas in a vessel. If the number of molecules be increased to '2n'. What will be the effect on (i) pressure of the gas (ii) total energy of the gas ?

(g) What is perfect black body ? How it can be realized in daily life ?

2. (a) Define entropy and give its physical significance.   4

(b) Derive an expression for the entropy of a perfect gas in term of its pressure and volume.

6

(c) Find out the relationship between adiabatic and isothermal elasticities.   5

2

3. (a) State Carnot's theorem. Prove that the efficiency of a reversible heat engine is maximum. 10

(b) A reversible heat engine converts one-fifth of heat input into work. When the temperature of the sink is reduced by 50°C, its efficiency is doubled. Find the temperature of the source and the sink.

5

4. (a) What are thermodynamic potentials ? Derive Maxwell relations from them. 10

(b) Derive Clausius - Clapeyron equation and discuss briefly its application to boiling and melting process. 5

5. (a) What are transport phenomena in gases ? Apply kinetic theory of gases to obtain an expression for the coefficient of viscosity of a gas. 8

(b) Define mean free path of the molecule of a gas and derive an expression for it. 7

6. (a) What is Joule-Thomson effect ? Discuss it's results. 5

(b) Deduce an expression for Joule Thomson coefficient for van-der-Waal's gas. 10

P.T.O.

7. (a) Derive an expression for the most probable distribution of the particles of a system obeying B.E. statistics. 7

(b) Derive Fermi-Dirac distribution formula. How does this distribution tends to classical ? 8

8. (a) Derive Maxwell's law of distribution of velocities for molecules in a gas. Explain graphically how the distribution varies with temperature. 10

(b) Discuss experimental verification of Maxwell's velocity distribution law. 5

3000

S.No of Question Paper : 1541

Unique Paper Code : 216555

Name of the Paper : LSPT -512 Genetics and Genomics

Name of the Course : B.Sc. Life Sciences (frog.)

Semester : V

Duration : 3 Hours

Maximum Marks : 75

I

(*Write your Roll No. on the top immediately on receipt of the question paper*)

Attempt **five** question in all including Question No.**1** which is compulsory.

Q1. (a) Define the following terms (**any five**)   1 x 5 = 5

(i) Pleiotropy

(ii) Aneuploidy

(iii) Barr body

(iv) Induced mutation

(v) Synteny

(vi) Multiple Allelism

(b) Give important contributions of the following scientists: 1 x 5 = 5

(i) Bateson and Punnett

(ii) H.S. Creighton

(iii) H.G. Muller

(iv) A.H. Sturtevant

(v) Karl Landsteiner

(c) Expand the following abbreviations (any five).   1 x 5=5

    (i)   TDF

    (ii) 5-BU

    (iii) mu

    (iv) PKU

    (v) HGP

    (vi) *E. coli*

Q2. Differentiate between the following (**Any five**):   3 x 5=15

    (i) ...Trisomics and Tetrasomics

    (ii) Genetic map and Physical map

    (iii) Codominance and Incomplete dominance

    (iv) Sex influenced and Sex limited traits

    (v) Paracentric and Pericentric inversion

    (vi) Maternal inheritance and Maternal effect

Q3. Write short notes on **any three**:   5x3=15

    (i) Lethal genes
    (ii) Chromosomal theory of inheritance
    (iii) Proteomics
    (iv) Lyon hypothesis

Q4. (a) Define sex determination. Explain the sex determination mechanism in *Drosophila.*   8

    (b) *Drosophila melanogaster* is a model organism. Comment.   7

Q5. (a) Describe the inheritance of kappa particles in *Paramecium* with the help of suitable   7
    diagrams. the
    (b) Explain CIB method of detection of mutations in *Drosophila.*   8

Q6 (a) Define epistasis. Explain the modified ratios obtained in F_2 population due to this type of gene interaction   12

(b) A woman with normal vision having color blind father, marries man with normal vision. What is the probability of them having color blind children?   3

Q7. (a) Briefly explain the role of polyploidy in crop improvement.   7

(b) Explain the sequencing strategies used in structural genomics.   8