[This question paper contains 8 printed pages]

Roll No. | | | | | | | | | | |

No. of Question Paper : 7691

Unique Paper Code : 42177925 J

Name of the Paper : Chemistry of *d*-block Elements, Quantum Chemistry and Spectroscopy

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

Semester : V

Duration : 3 Hours Maximum Marks : 75

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

Attempt *six* questions in total with *three* from Section A and *three* from Section B.

Attempt Section A and Section B separately on same answer sheet. Do not mix the questions of Section A and Section B.

Use of scientific calculator and Log table is allowed.

SECTION A

INORGANIC CHEMISTRY

Attempt any *three* questions in this section.

***All* questions carry equal (12.5) marks.**

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

(*i*) $K_2[OsCl_5N]$

P.T.O.

(*ii*) $[Cu(en)_2][Ni(CN)_4]$

(*iii*) $[Cr(H_2O)_4Cl(NCS)]NO_3$

(*iv*) $[(NH_3)_4Co(NH_2)(OH)Co(NH_3)_4]Br_4$.

(*b*) Give brief reasons for any *two* of the following :

(*i*) Copper (II) salts are coloured but copper (I) salts are colourless.

(*ii*) Transition metals are less reactive than metals of Groups 1 and 2.

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

(*c*) Calculate in kJ mol^{-1}, the CFSE attained by Fe^{2+} ions in a weak field octahedral oxide ion environment, given Δ_0 for Fe^{2+} in oxide ion environment = 124 kJ mol^{-1}. What would be the CFSE in a tetrahedral environment of oxide ion ? 4.5,4,4

3.

2. (*a*) Write the formulae of the following according to IUPAC convention :

(*i*) Zinc tetrafluoridobromate(III)

(*ii*) μ-peroxidobis{pentaamminecobalt(III)} hydroxide

(*iii*) Pentaamminesulphatorhodium(III) tetrahydroxido-ferrate(II)

(*iv*) Sodium pentacarbonylmanganate(-I).

(*b*) Explain why an octahedral complex of copper (II) shows tetragonal distortion. Draw the splitting diagram for a case where the axial bonds are longer than the equatorial bonds. Will an octahedral nickel (II) complex show such a distortion? Justify.

(*c*) A and B have the empirical formula $Cr(NH_3)_3(H_2O)_2Br_2Cl$. On reaction with excess $AgNO_3$, A yields 2 moles of AgBr while B yields 1 mole of AgBr. Based on these observations give the formulae of A and B and identify the isomerism displayed. 4.5,4,4

3. (*a*) Identify the species which matches with the property stated and give reasons for your choice (any *three*) :

(*i*) Greater value of Δ_0 : $[Co(NH_3)_6]^{3+}$, $[Rh(NH_3)_6]^{3+}$

(*ii*) Optically active : cis $[CoCl_2(en)_2]^+$, trans $[CoCl_2(en)_2]^+$

(*iii*) Oxidizing agent :Ce^{4+}, Eu^{2+}

(*iv*) Forms chelate with metal : methylamine , glycine.

(*b*) Using VBT show that changing the ligand alters the geometry and magnetic behaviour of tetracoordinated Ni(II) complexes. Also calculate the spin only magnetic moment, wherever applicable.

(*c*) Construct the Latimer diagram of copper from t following data :

$Cu^{2+} \rightarrow Cu^{+}$ Eo = 0.15 V

$Cu^{+} \rightarrow Cu$ Eo = 0.50 V

Calculate skip step emf value for the change $Cu^{2+} \rightarrow C$

Identify any species which may disproportionate an explain by necessary calculations.

Or

(*c*) Briefly discuss any *two* of the following :

(*i*) Lanthanoid Contraction

(*ii*) Spectrochemical Series

(*iii*) Inner and outer orbital complexes. 4.5,4.

4. (*a*) A complex of the type $[M(NH_3)_2Cl_2]$ exists in two isometri forms A and B. What will be the geometry of the comple and hybridization of central metal ? Draw the isomers an give one method of distinction between them.

(*b*) Explain why $\Delta_t = 4/9\ \Delta_o$. Why are low spin tetrahedra complexes not known ?

(*c*) Given brief reasons for any *two* of the following :

(*i*) Transition metals display variable oxidation states.

(*ii*) The magnetic behaviour of the lanthanoids is different from that of the metals of the 3*d* series.

(*iii*) Transition metals form interstitial and non-stoichiometric compounds. 4.5,4,4

SECTION B

(PHYSICAL CHEMISTRY)

Physical Constants

Planck's constant 6.626×10^{-34} Js

Velocity of light 3×10^{8} ms^{-1}

Avogadro's number 6.023×10^{23} mol^{-1}

Atomic mass unit 1.661×10^{-27} kg

Mass of electron 9.109×10^{-31} kg

Mass of proton 1.67×10^{-27} kg

$\pi = 3.142$

Attempt any *three* questions in this section. All questions carry equal **(12.5)** marks.

5. (*a*) Define eigenvalue and eigenfunction. Show that exp (ax) is an eigenfunction of the operator d/dx.

(*b*) Calculate the energy difference between the $n = 1$ and $n = 2$ level for an electron in a potential well of width 50 nm with infinite potential barriers on either side (Use particle in 1-D box model).

(*c*) Write the mathematical expressions corresponding to the following operators :

(*a*) Position Operator $\hat{y}$

(*b*) Momentum Operator $\hat{p}_x$

(*c*) Kinetic energy $\hat{T}_z$ 4,4,4.5

6. (*a*) Draw a schematic diagram of all the possible transitions in electronic spectroscopy. Also, arrange the following transitions in increasing order of energy giving reasons :

$$n \rightarrow \sigma^*,\ \sigma \rightarrow \sigma^*,\ \pi \rightarrow \pi^*,\ n \rightarrow \pi^*.$$

(*b*) State and explain Stark-Einstein's law of photochemical equivalence. Also, give reasons for low and high quantum yield in photochemical reactions. 7.

(*c*) Calculate the transmittance, absorbance, extinction coefficient of a solution which absorbs 90% of a certain wavelength of light when the beam passes through a 1 cm cell which contains a solution whose molarity is 0.25M.

Or

(*c*) In an absorption cell, the transmittance of a 0.1M solution of a substance X is 80% and that of 0.1M solution of another substance Y is 60% at the same wavelength. Given that absorbance is an additive property, what is the absorbance of a solution that contains equal volumes of 0.1M X and 0.1M Y solutions ? 4,4,4.5

7. (*a*) Explain the following :

(*i*) It is not possible to obtain the pure rotational spectrum for a homonuclear diatomic molecule.

(*ii*) The linear carbon dioxide molecule gives a vibrational spectrum but not a rotational spectrum.

(*b*) Differentiate between :

(*i*) Fluorescence and Phosphorescence

(*ii*) Primary and secondary reactions.

(*c*) The rotational spectrum $^{1}H\ ^{127}I$ shows a series of lines separated by 12.8 cm^{-1}. Calculate the moment of inertia and the internuclear distance for this molecule.

Or

(*c*) Calculate the wavelength for a transition between neighbouring energy levels of a harmonic oscillator of mass equal to that of the proton and force constant 855 N m^{-1}. 4,4,4.5

8. (*a*) Briefly discuss any *three* of the following : 3×3.5

(*i*) Quantum yield

(*ii*) Zero point energy

(*iii*) Free Electron Molecular Orbital model

(*iv*) Auxochromes and chromophores.

(*b*) State True *or* False : 2×1

(*i*) A well behaved wave function is single valued and continuous.

(*ii*) Ground state energy of particle in a 1 – D box corresponds to $n = 0$.

3,400

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7552 **J**

Unique Paper Code : 32173909

Name of the Paper : Pharmaceutical Chemistry

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

Semester : III

Duration : 2 Hours Maximum Marks : 37

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **three** questions in all. Question No. **1** is compulsory and carries **15** marks.
3. **All** other questions are of **11** marks each.

1. Attempt **any five** questions : (5×3=15)

   (i) What are the medicinal uses of Sulphacetamide. Give its structure.

P.T.O.

(ii) How is Paracetamol synthesized? Write the chemical reactions involved.

(iii) Which class of the drug does Glyceryl trinitrate belong to? Write its structure.

(iv) What is apharmacophore? Give one example.

(v) What are the medicinal uses of Acyclovir? Give its structure.

(vi) What are anti-bacterialagents. Give one example along with its structure.

2. (i) Write short note on the following : (4)

(a) Central Nervous System targeting drugs

(b) Antibiotic agents

(ii) What are NSAIDs? Give examples of common drugs used for the same. Briefly discuss their mode of action. (4)

(iii) Describe the drug discovery timeline for Penicillin. How can it be produced commercially using fermentation technique? (3)

(i) Match the following : (4)

1	Streptomycin	a	Antiviral agent
2	Ibuprofen	b	Antifungal drug
3	Sulphanethoxazole	c	Antibiotic
4	Acyclovir	d	Antipyretic agent

(ii) Give the synthesis and uses of Dapsone. (4)

(iii) What do you understand by the terms lead compound and drug toxicology? (3)

(i) Give the structure of the following drugs : (4)

(a) Aspirin

(b) Chloramphenicol

(c) Penicillin

(d) Diazepam

(ii) Explain the synthesis of Ethyl alcohol **OR** Vitamin C using fermentation method. (4)

(iii) Describe drug modification and its role in mode
drug development.

[This question paper contains 3 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7553** **J**

Unique Paper Code : 32173910

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

Name of the Paper : Chemistry of Cosmetics and Perfumes

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 **three** questions in all.

(c) Question No.**1** is compulsory and carries **14** marks.

(d) **All** other questions are of **12** marks each.

1. (a) What are the main ingredients used in the preparation of shampoos ? Explain their roles and the cleansing action of shampoos. 5

P.T.O.

(b) Discuss the method of preparation Lipsticks in detail.

(c) Name the various creams used for s benefits. Describe the method for preparation of cold creams.

2. (a) Differentiate between Deodorants Antiperspirants.

(b) Discuss the different types of surfact used in the preparation of shampoos.

(c) What are the uses of Eugenol essential

3. (a) Discuss the ingredients used in formulation of Hair dyes.

(b) What are essential oils ? Comment on chief characteristics of Essential oils.

(c) List the different ingredients used in preparation of Nail Enamels. Explain method of its preparation.

4. Write short notes on any **three** of the following : 4×3=12

(a) Importance of Eucalyptus Oil and Sandalwood Oil

(b) Artificial Flavours

(c) Talcum Powder

(d) Sunscreen Lotion

This question paper contains 4 printed pages]

Your Roll No. : .....

Sl. No. of Q. Paper : **7607** **J**

Unique Paper Code : 32173911

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

Name of the Paper : Pesticide Chemistry

Semester : V

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 **five** questions in all.

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

1. Attempt any **five** of the following : 2×5=10

(a) Write the structural formula of butachlor.

(b) Write the structural formula of pyrethrin.

(c) Write the name of any **two** synthetic pesticides.

(d) Draw the structural formula and IUPAC name of any herbicide.

P.T.O.

(e) Write the structural formula of cabofuran.

(f) Fill in the blanks :

(i) Carbamate esters are also called .....

(ii) Butachlor is a herbicide of the ..... class.

2. (a) How DDT can be synthesized, write the chemical reaction ? 2

(b) Discuss the mode of action of Fungicides. 2

(c) Write the chemical reaction for the synthesis of Chloranil. 2

(d) Write the structural formula of Atropine. 1

3. (a) What are systemic herbicides ? 2

(b) Write the chemical reaction for the synthesis of parathion. 2

(c) Discuss about the pre-emergence herbicides. 2

(d) Write the IUPAC name of carbofuran. 1

4. (a) What is the mode of action of insecticides ? 2

(b) Discuss the benefits and hazards of pesticides. 2

(c) Write the chemical reaction of degradation of DDT. 2

(d) Write the IUPAC name of chloranil. 1

5. (a) How α, β - unsaturated ketonic group in quinones be utilized in making them an active fungicide ? 2

(b) How carbaryl can be synthesized using isocyanate ? 2

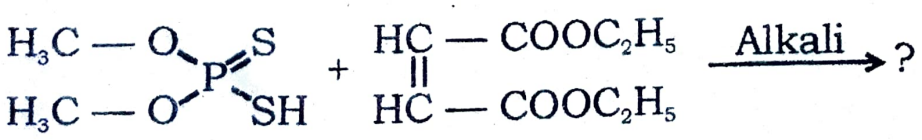
(c) Give examples of two broad - spectrum carbamate insecticides. 2

(d) Which family parathion belongs ? 1

6. (a) What are the common side effects of pesticides ? 2

(b) Write the structure and name of all isomeric forms of HCH. 3

(c) Write the product : 2



7. (a) Match the following : 2

(i) Herbicides	(a) Natural pesticide
(ii) Lindane	(b) Carbamates
(iii) Pyrethroid	(c) Weeds
(iv) Oxamyl	(d) Organochlorides

(b) Carbamates are preferred over organophosphate pesticides, give any **two** reasons. 2

(c) Write the structural formula of paraoxon. 2

(d) Write name of the pesticide which can be toxic to honey bees. 1

This question paper contains 4+2 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : **8296**

Unique Paper Code : **32175915**

Name of the Paper : **Solutions, Phase Equilibrium, Conductance, Electrochemistry & 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

(Attempt *all* questions in this section.)

1. Attempt any *nine* :

(*a*) Construct cell for the reaction

$$Zn + AgCl \rightleftharpoons ZnCl_2 + Ag$$

P.T.O.

(*b*) State the importance of salt bridge.

(*c*) State the importance of conductometric titration ov visual titration.

(*d*) Transport number of Cl^- in NaCl is greater than C in HCl.

(*e*) Name any *three* reference electrode.

(*f*) Write any *two* conditions under which the distribution la is valid.

(*g*) State Raoult's law. Show that Raoult's law special ca of Henry's law.

(*h*) State Kohlrausch's law.

(*i*) Draw the conductometric titration curve of dibasic ac acid and strong base.

(*j*) Define azeotropes.

(*k*) Give the unit of molar conductivity.

(*l*) Give the conditions required for reversible cell. 1½

(*a*) At 300K, the molar conductivities at infinite dilution NH_4Cl, NaOH and NaCl are 129.8, 217.4 and 108 ohm^{-1} cm^2 respectively, if the molar conductivity of centinormal solution of NH_4OH is 9.33 ohm^{-1} cm Calculate the pH of NH_4OH solution at this dilution.

(*b*) Calculate the free energy change of the following cell at 25°C :

$$Sn/Sn^{2+} (\alpha = 0.6)//Pb^{2+} (\alpha = 0.3)/Pb$$

Standard EMF of the cell is 0.014 volt.

(*c*) In the distribution of solute between water and chloroform, the following results were obtained :

Water (C_1)	0.163	0.761
Chloroform (C_2)	0.436	5.43

What information do you gather regarding the molecular state of the solute in chloroform ? 4×3

3. Explain any *three* of the following :

(*a*) Effect of impurities on phenol H_2O system

(*b*) Clausius-Clapeyron equation

(*c*) The phase diagram of water

(*d*) Conductometric titration of strong acid with strong base

(*e*) Hydrogen electrode

(*f*) Distribution law. 4×3

Section B

(Attempt any *three* questions.)

4. (*a*) Arrange the following in the order of increasing acidic strength and justify your answer :

C_6H_5COOH, CH_3COOH, p-$NO_2C_6H_4COOH$

(*b*) Discuss the basicity of the following and arrange them in the order of increasing basic strength :

$C_6H_5NH_2$, $C_6H_5NHCH_3$, CH_3NH_2, $CH_3CH_2NH_2$.

(*c*) Explain why Acetyl Chloride reacts more readily towards nucleophilic addition as compared to Acetamide ?

(*d*) Complete the following reactions to predict the structures A to D.

(*i*) $C_6H_5CHO + (CH_3CO)_2O \xrightarrow{CH_3COONa} A$

(*ii*) $C_6H_5NH_2 \xrightarrow[0-5°C]{NaNO_2/HCl\ (aq.)} B \xrightarrow[(alkaline)]{2\text{-Naphthol}} C$

(*iii*) $C_6H_5-\overset{\overset{O}{\|}}{C}-NH_2 \xrightarrow{Br_2/KOH\ (aq.)} D$

(*e*) Describe the Hofmann-Elimination reaction using a suitable example. 2,2,2,4,2½

5. (*a*) Define Isoelectric point. Calculate isoelectric point (pI) of Valine (pKa1 = 2.32, pKa2 = 9.62).

(*b*) Outline the synthesis of Alanine using strecker synthesis.

(*c*) What is Claisen Condensation ? Explain its mechanism.

(*d*) What is DCC ? What is its significance in peptide synthesis ?

(*e*) Prepare a dipeptide Ala-Gly using Merrifield Solid phase peptide synthesis. 2,2½,2½,2½,3

6. (*a*) Write short notes on any *three* of the following :

(*i*) Anomers and Epimers

(*ii*) Mutarotation

(*iii*) Electrophoresis

(*iv*) Carboxylic Acid and their derivatives

(*b*) How is ethyl amine prepared using Gabriel-Phthalimide synthesis.

(*c*) Discuss the Hinsberg test used for identification of 1°, 2° and 3° amines. 7½,2½,2½

7. (*a*) Though both lactose and sucrose are disaccharides, but lactose reduces Tollen's reagent whereas sucrose doesn't ? Explain and justify.

(*b*) How do Malltose and Cellubiose differ in their structures ?

(*c*) Draw the Haworth projection for β-D Fructofuranose and α-D Glucopyranose.

(*d*) How will you convert the following :

(*i*) D-Arabinose to D-Glucose and

(*ii*) D-Glucose to D-Fructose

(*e*) What is Glucosazone ? Explain its preparation with the help of a chemical reaction. 2½,2½,2,3,2½

his question paper contains 4+2 printed pages]

Roll No. | | | | | | | | | | | |

No. of Question Paper : **8452**

nique Paper Code : **32175901** **J**

ame of the Paper : **Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons**

ame of the Course : **Generic Elective : Chemistry**

emester : **I**

uration : **3 Hours** Maximum Marks : **75**

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

Attempt *three* questions from each section.

Section A

(Inorganic Chemistry)

Attempt *three* questions. Question No. **1** is compulsory.

(*a*) Why is s-orbital spherically symmetrical ? 2

(*b*) Calculate the wavelength of a 1000 kg rocket moving with a velocity of 300 km per hour ?

($h = 6.625 \times 10^{-34}$ Js) 3

(*c*) CuCl and AgCl are insoluble in water while NaCl is soluble. Why ? 2

P.T.O.

(*d*) Explain the hybridization in H_2O and NH_3. 4.

(*e*) Explain the significance of Ψ and Ψ^2. 2

2. (*a*) Write the time independent Schrodinger's wave equatio in three-dimensional motion and explain the term involved.

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

(*c*) Draw the MO diagram for CO molecule. Explain.

(*d*) Calculate the heat of formation (ΔH_f) of KF from i elements from the following data by the use of Born Haber cycle : 5.

ΔH_{sub} = 87.8 kJ/mol; ΔH_{diss} = 158.9 kJ/mol; ΔH_{IE} = 414. kJ/mol; ΔH_{EA} = –334.7 kJ/mol; U_0 = –807.5 kJ/mol.

3. (*a*) Write short notes on :

(*i*) Fazan's Rule

(*ii*) Heisenberg's Uncertainty Principle

(*iii*) Born Lande's equation.

(*b*) Arrange the following in increasing order of their bon order based on their MO diagram :

$$O_2,\ O_2^+,\ O_2^-$$

(*c*) Explain why He_2 molecule does not exist ?

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

(*b*) Write the hybridization of the central atom and shapes of the following molecules :

PCl_5, ClF_3, $SnCl_2$, XeF_4 4

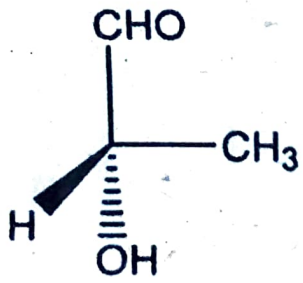
(*c*) $SnCl_4$ is more covalent than $SnCl_2$. Explain. 2

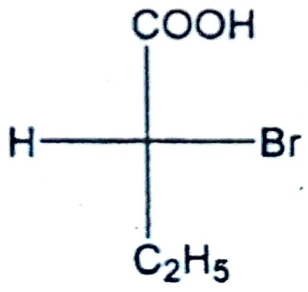
(*d*) Explain the stability of half filled and fully filled orbitals. 2

Section B

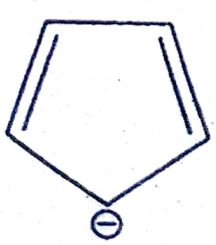
(Attempt any *three* questions.)

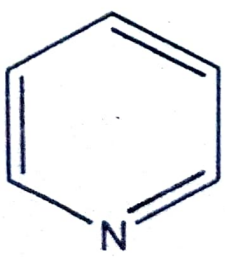
5. (*a*) Assign priority order and designate R/S to the following : 4

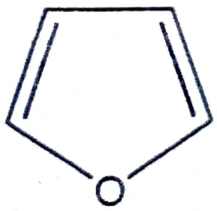




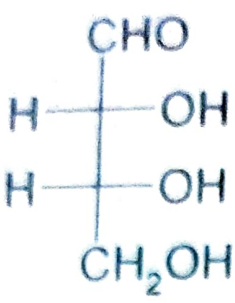
(*b*) Which of the following are aromatic, non-aromatic and anti-aromatic ? Justify your answer : 4

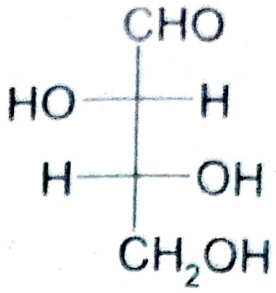




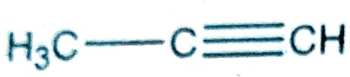


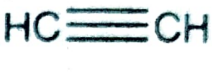
(c) With reason assign erythro and threo to the following : 2





(d) Which of the following is more acidic and why : 2.5

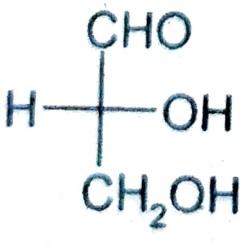


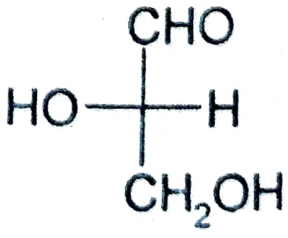


6. (a) Draw different conformations of 1,2-ethanediol and arrange them in increasing order of stability. 4

(b) Differentiate between enantiomers and diastereomers with suitable examples. 4

(c) Indicate which of the following is designated as D and which as L and why : 2



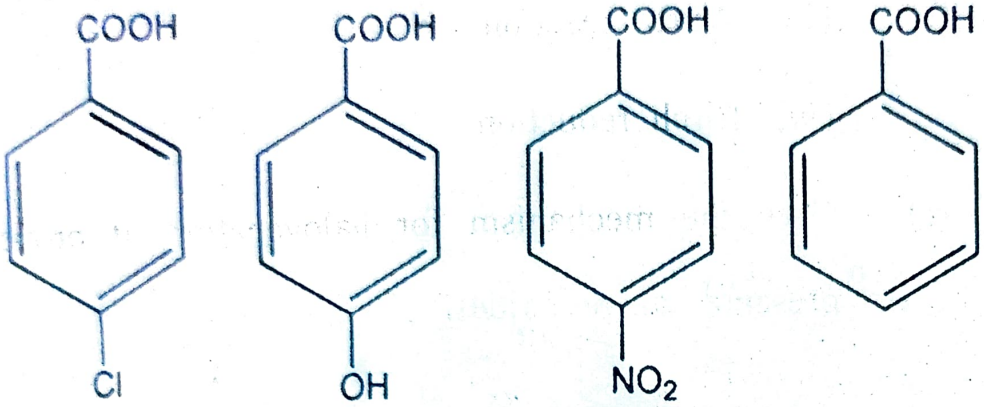


(d) Boat conformation of cyclohexane is lesser stable than chair conformation. Justify with reasons. 2.5

(*a*) Arrange the following radicals in increasing order of stability and justify your answer : 4

$(CH_3)_3C$ CH_3 $(CH_3)_2CH$ CH_3CH_2

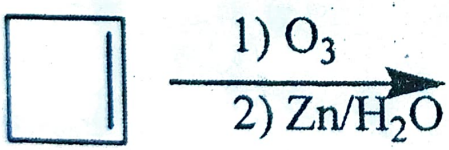
(*b*) Which one of the following is more acidic and why : 4



(*c*) Out of CH_3CH_2OH and CH_3OCH_3, which one has higher boiling point and why ? 2

(*d*) Write a short note on hyperconjugation. 2.5

8. (*a*) Complete the following reactions :

(*i*) 

(*ii*) $H_2C{=}{=}CH_2 \xrightarrow{\text{dil } KMnO_4}$

(*iii*) 

(*iv*) $H_3C—CH_2—Br \xrightarrow{Na,\ Ether}$

(*b*) Write short notes on any *two* of the following :

(*i*) Hydroboration Oxidation reaction

(*ii*) Wurtz reaction

(*iii*) Birch reduction. 6

(*c*) Give the mechanism for halogenation of propene in presence of peroxides. 2.5

This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7318 J

Unique Paper Code : 42171103 – OC

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

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

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. Attempt any **three** questions from each Section.
3. Use separate Answer booklet for each section.

SECTION – A

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 th radii of K^+, but the melting point of AgCl is muc lower than that of KCl. Explain.

(d) How Born Haber's Cycle can explain the stabilit of ionic compounds?

(e) Explain why PCl_5 is more reactive than SF Molecule. (2.5,2.5,2.5,2.5,2.5

2. (a) Write Schrodinger's wave equation and explai various terms involved in it.

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

(c) Explain the stability of half-filled and fully-fille orbitals.

(d) Plot radial probability distribution curves for 4s 4p, 4d and 4f orbitals. (2.5,3,3,4

3. (a) Observed dipole moment of HX molecule is 1.9 D and bond distance is 1.20 Å. Calculate the % ionic character of the molecule, HX.

(b) Write the hybridization of the central atom an shape of the following molecules.

PCl_5, ClF_3, $SnCl_2$

(c) Draw the Molecular Orbital diagram for N_2 molecule.

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

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 (Uo) = –2922.5 $kJmol^{-1}$

(2.5,3,3,4)

(a) Compare the covalent character in NaCl and CuCl by giving reason.

(b) How does Molecular Orbital Theory account for the paramagnetic character in O_2 molecule?

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

(d) Write short notes on :

(i) Heisenberg's Uncertainty Principle

(ii) Fajan's Rule

(iii) Solvation Energy (1.5,2,3,2×3)

P.T.O.

SECTION – B

5. (a) Two isometric hydrocarbons (A) and (B) ha molecular formula C_4H_6. Both compoun decolorize Br_2 in CCl_4 and react slowly with co H_2SO_4. (A) forms precipitate with ammonical sil oxide and on oxidation yields propionic acid a CO_2. Compound (B) does not produce a precipitate with ammonical silver oxide but oxidation gives oxalic acid and CO_2. Suggest t structural formulae for (A) and (B). (ii)

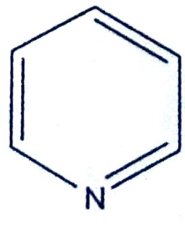
(b) Explain relative stabilities of primary, seconda and tertiary carbanion with suitable examples.

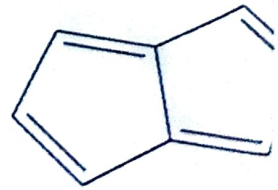
(c) An aqueous solution of tropylium bromide treatment with silver nitrate yields precipitate silver bromide. How will you account for th observation?

(d) The boiling point of n-alkanes increases as t molecular mass increases. Explain. (4.5,3,3,

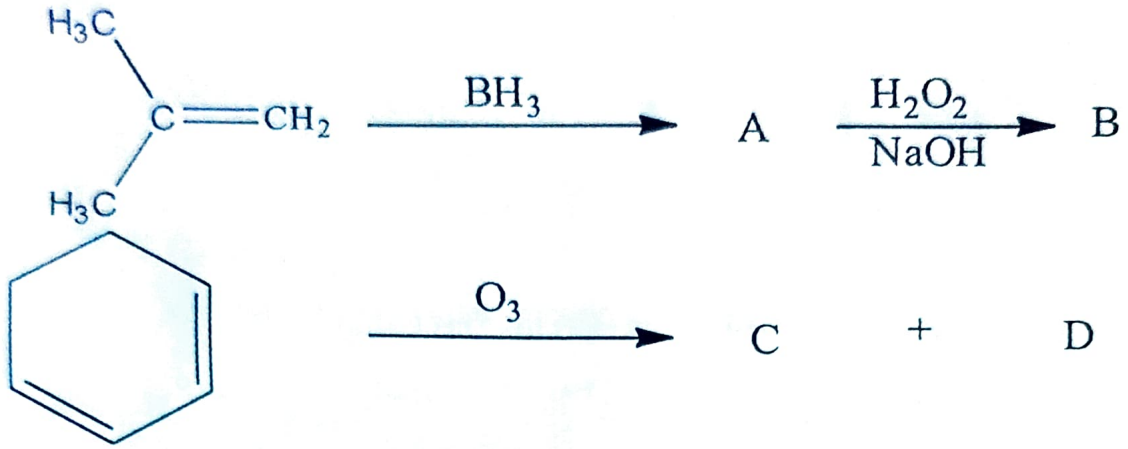
6. (a) What is Huckel's rule of aromaticity? Which the following are aromatic, non-aromatic or an aromatic.

(i) 

(ii) 

(iii) 

(b) Complete the following reactions and identify A, B, C and D



(c) What does conformation mean? Draw Boat and Chair conformations for cyclohexane. Giving reasons state which one is more stable of the two. (4.5,4,4)

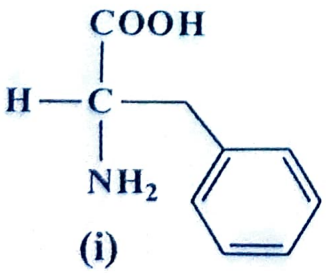
(a) Differentiate between the following **(any two)** :

(i) Homolytic and Heterolytic fission

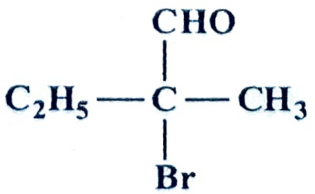
(ii) Resonance and hyperconjugation

(iii) Inductive and Electromeric Effect

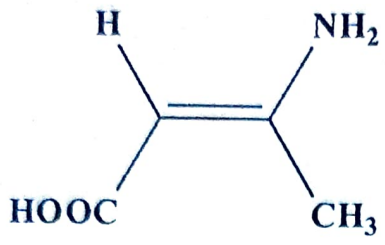
(b) Assign E/Z or R/S configuration to the following.



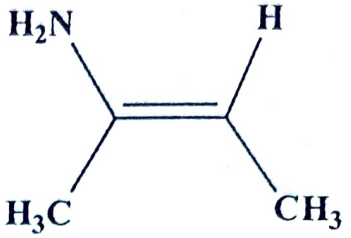
(i)



(ii)



(iii)



(iv)

(c) How many stereo-isomers are possible for tarta acid HOOCCH(OH)CH(OH)COOH? Write do their structure and mention the relationship w respect to each other. (2×2,1×4,4

8. (a) Which of the following species behave as nucleophile, an electrophile, both or neither:

I^-, H_3N, $BeCl_2$, CH_4, Cr^{3+}, $CH_3C{\equiv}N$, H_2, SnC $H_2C{=}O$ and NO^{2+}

(b) Why is Wurtz synthesis not a good method f preparing propane?

(c) Write short notes on the following **(any three**

(i) β Elimination reaction

(ii) Koble's electrolysis method

(iii) Hoffman elimination method for alke preparation

(iv) Kharasch peroxide effect (2.5,2.5,2.5

question paper contains 8 printed pages]

Roll No. | | | | | | | | | | | |

No. of Question Paper : **8577**

que Paper Code : **42171103**

ne of the Paper : **Atomic Structure, Bonding, General Organic Chemistry and Aliphatic Hydrocarbons**

tarta

e do

ip me of the Course : **B.Sc. (Programme)**

×4,4

nester : **I**

e as ration : **3 Hours** Maximum Marks : **75**

r:

Snc *ite your Roll No. on the top immediately on receipt of this question paper.)*

ttempt *six* questions in all, *three* questions from each Section.

od Use separate answer sheets for Section-A and Section-B.

SECTION–A

aree

(*a*) Define Lattice energy ? Write the expression for Born-Landé equation, and explain the terms involved in it. 5

(*b*) Write short notes on any *two* : 4

lke

(*i*) Heisenberg uncertainty principle

2.5

P.T.O.

19

(ii) Hund's rule (b)

(iii) Pauli exclusion principle

(c) Write the electronic configuration of Cr (Atomic N and Cu (Atomic No. 29).

(d) Why $BaSO_4$ is insoluble in water ?

2. (a) Predict the shape and type of hybridization in ea the following molecules :

$$PCl_5,\ H_2O,\ ClF_3,\ SF_4.$$

(b) Draw the MO diagram for N_2 molecule and calcula bond order.

(c) Which is more covalent in the following pairs ? Expl

(i) $FeCl_2$, $FeCl_3$

(ii) LiI, CsI

(iii) CuCl, NaCl 5.

3. (a) Calculate the uncertainty in the position of a part whose uncertainty in momentum is 3.3×10^{-2} kg m $(h = 6,62 \times 10^{-34}$ Js)

(*b*) Calculate the lattice energy of NaCl crystal from the following data by the use of Born-Haber Cycle. Sublimation energy for $Na_{(s)}$ =108.7 kJ/mol Dissociation energy for $Cl_{2(g)}$ = 225.9 kJ/mol , Ionization energy for $Na_{(g)}$ = 489.5 kJ/mol, Electron affinity for $Cl_{(g)}$ = –351.4 kJ/mol, Heat of formation of $NaCl_{(s)}$ = –414.2 kJ/mol. 3

(*c*) What is the physical significance of Ψ^2 ? When do we use $\Psi\Psi^*$ instead of Ψ^2 ? 3

(*d*) Give the possible value of quantum number for an electron in 4*d* & 3*p* orbital. 2½

(*a*) What is dipole moment ? The dipole moment of NH_3 is 1.7 D while that of NF_3 is 0.2 D. Explain briefly. 4

(b) What are Eigen functions & Eigen values ? Explain why He_2 molecule does not exist ? 4

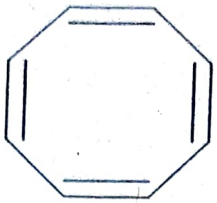
(*c*) Draw the radial distribution curve for 3*s*, 3*p* & 3*d* orbitals. 3

(*d*) Calculate the possible value of *m* for l = 2. 1½

SECTION-B

(*a*) Giving suitable explanation, classify the following as aromatic or not aromatic in nature : 4½

(*i*) 

(*ii*) 

(*iii*) 

(*b*) From the following attempt any *three* :

(*i*) Classify the following as nucleophiles electrophiles :

$\bar{C}N$, $\overset{+}{N}O$, SO_3, $:CCl_2$

(*ii*) Which of the following cation is more stable why ?

$CH_3—CH_2—CH_2^+$ and $CH_2 = CH—CH$

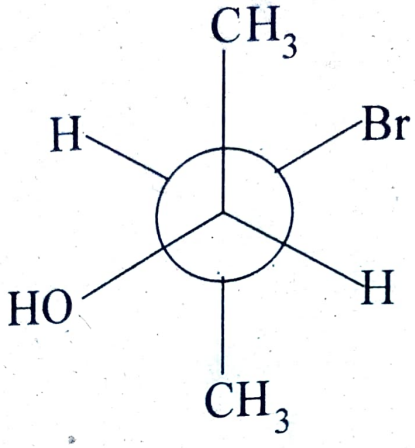
(*iii*) Which of the following free radicals is most st and why ?

$CH_3\dot{C}H_2$, $(CH_3)_2\dot{C}H$ and $(CH_3)_3\dot{C}$

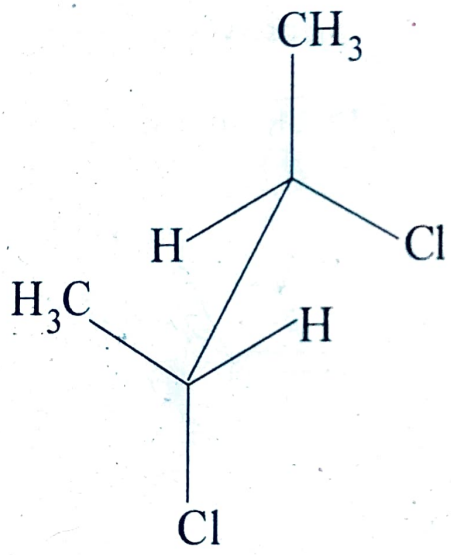
(*iv*) Draw the chair and boat conformations cyclohexane and comment on their stability.

(*c*) Giving the steps involved convert the following into Fischer projection (attempt any *one*) : 2

(*i*)



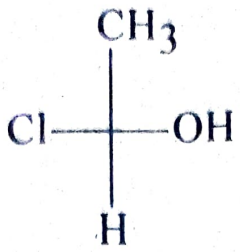
(*ii*)



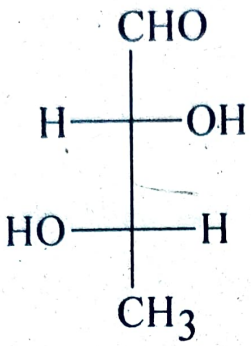
(*a*) Draw the different conformations of butane; arrange them in increasing order of stability, with explanation. 5

(*b*) Assigning the priority order, explain how will you arrive at R-/S-configuration at each stereocentre in the following : 4½

(*i*)

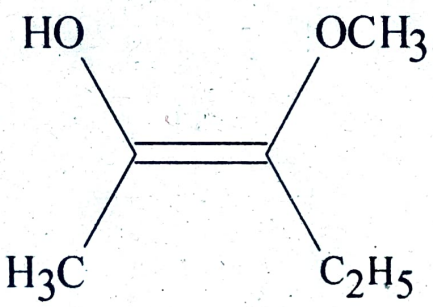


(*ii*)

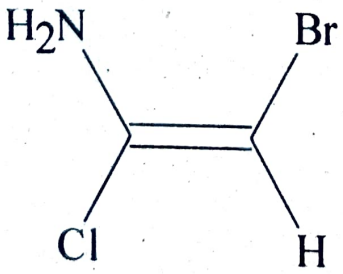


(*c*) Assigning the priority order, explain how will you designate E-/Z-to the following : 3

(*i*)

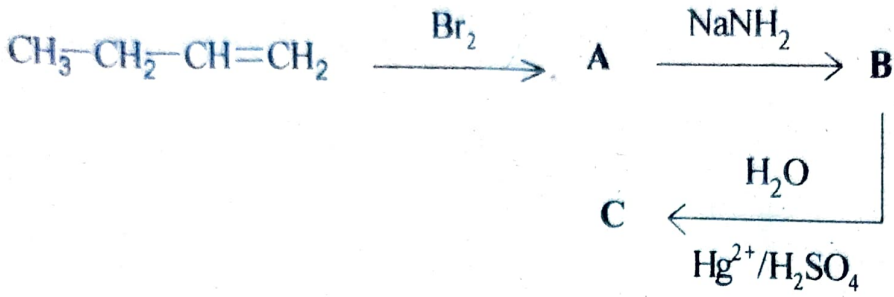


(*ii*)



7. (*a*) What happens when propene reacts with bromine in presence of light. Give suitable mechanism. 4

(*b*) Complete the following sequence of reactions and identify A-C : 3



(*c*) The peroxide effect (Kharasch effect) is observed only in reaction of alkene with HBr and not with HCl and HI. Explain why ? 3

(*d*) How will you distinguish pent-1-yne and pent-2-yne ? 2

(*a*) Complete the following reactions (attempt any *five*) : 1½×5

(*i*) $CaC_2 + H_2O \longrightarrow ? \xrightarrow{HBr} ?$

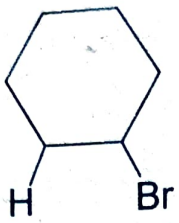
(*ii*) $CH_3-CH_2-CH=CH_2 \xrightarrow[THF]{Hg(OCOCH_3)_2\ ;\ H_2O} ? \xrightarrow{NaBH_4} ?$

(*iii*) $CH_3C \equiv CH \xrightarrow{NaNH_2} ? \xrightarrow{CH_3CH_2Br} ?$

P.T.O.

(*iv*) $3CH_3CH_2—CH=CH_2$

$$\xrightarrow{BH_3} ? \xrightarrow{H_2O_2/NaOH} ?$$

(*v*) 

$$\xrightarrow{\text{alc. KOH}} ?$$

$$\xrightarrow[\text{(Cold)}]{\text{alkaline } KMnO_4}$$

(*vi*) $CH_3CH_2CH_2Br + CH_3CH_2Br$

$$\xrightarrow[\text{dry ether}]{2Na} ? + ? +$$

(*vii*) $? \xrightarrow[(2)\ Zn/H_2O]{(1)\ O_3} CH_3CH_2CH_2CHO + HCHO$

(*b*) Giving examples, write a short note on the followin (any *two*) : 2½×

(*i*) Hyperconjugation

(*ii*) Erythro and threo stereoisomers

(*iii*) Preparation of alkanes using Grignard reagen

[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7341 **J**

Unique Paper Code : 42174304

Name of the Paper : Solutions, Phase Equilibrium & Functional Group Organic Chemistry

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

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 **six** questions in all, **three** questions from each Sections.
3. Use of scientific calculator is allowed.

SECTION A

Attempt **three** *questions in all. Questions No.* **1** *is compulsory.* **All** *questions carry equal marks.*

1. Answer any **five** questions:

(a) State Nernst distribution law and give its limitations.

P.T.O.

(b) If the molar conductivities at infinite dilution of NaCl, HCl and CH_3COONa are 126.4, 426.1 and 91.0 $ohm^{-1}\ cm^2\ mol^{-1}$ respectively, what will be the molar conductivity of Acetic acid?

(c) The role of salt bridge is to reduce the liquid junction potential. Comment.

(d) What is azeotropic mixture? Is it possible to separate the components of an azeotropic system using distillation?

(e) Can a solution of 1 M Copper Sulphate be stored in a vessel made of Nickel metal? Given that $E°_{Ni^{+2}/Ni} = -0.25$ V and $E°_{Cu^{+2}/cu} = 0.34$ V.

(f) Effect of increasing the pressure and temperature on the triple point of water. Explain.

(2½×5=12½)

2. (a) Drive the integrated form of Clapeyon-Clausius equation for liquid-gas equilibria.

(b) State and explain the phase rule. Explain that Sulphur system at any of its triple point is a non variant system.

(c) What is Critical Solution Temperature? Explain with reference to Phenol water system.

(4,4,4½)

3. (a) Define EMF of a cell. Give the method for its experimental determination.

(b) Between 0°C and 90°C, the potential of the cell

$Pt \mid H_2$ (g, 1 atm) | HCl (m = 0.1) | AgCl (s) | Ag

is given by

$$E_{(volts)} = 0.3551 - 0.3422 \times 10^{-4}t$$

Where t is the temperature in Celsius. Write the cell equation and calculate ΔG, ΔH and AS for the cell at 50°C.

(c) State the principal underlying the potentiometric titrations. What are the advantages of potentiometric titrations over volumetric titrations. Draw the potentiometric titration curve involving strong acid and strong base. (4,4,4½)

4. (a) Specific conductivity of a saturated solution of AgCl at 25°C was found to be 3.41×10^{-5} ohm^{-1} cm^{-1}. The specific conductivity for water used to make up the solution was 1.60×10^{-6} ohm^{-2} cm^{-1}. Determine the solubility of AgCl in water. Ionic conductances of Ag^+ and Cl^- at 25°C are 60.3 ohm^{-2} cm^{-1} and 78.0 ohm^{-2} cm^{-1} respectively.

(b) Write short note on any **two** :

(i) Hydrogen half Cell

(ii) Congruent and incongruent meeting poi

(iii) Steam distillation

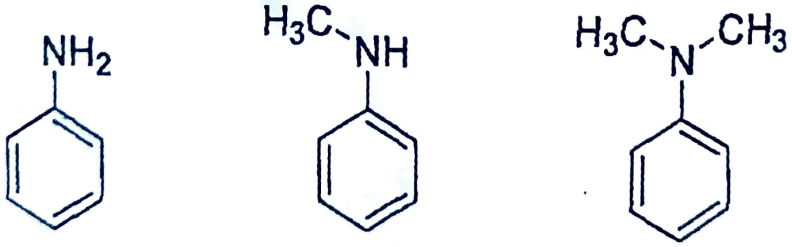
(iv) Conductometric titration of CH3COOH NaOH (4½,4,

SECTION B

Attempt **three** *questions in all.* **All** *questions car equal marks.*

5. Answer the following :

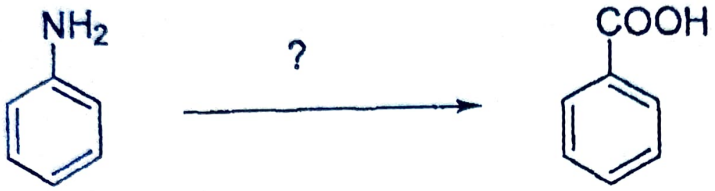
(a) How will you differentiate the following?



(b) Convert fructose to glucose.

(c) Explain Edmann degradation.

(d) Convert aniline to benzoic acid.



(3,3,3.5,3)

Answer the following :

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

(i) Hell-Volhard-Zelinsky reaction

(ii) Electrophoresis

(iii) Schotten-Baumann reaction

(b) What are essential and non-essential amino-acids?

(c) Name the components of starch.

(d) Give test to differentiate the following :

(i) Sucrose and fructose

(ii) Aniline and methylamine (6,1.5,1,4)

7. Answer the following :

(a) Write short note on the following:

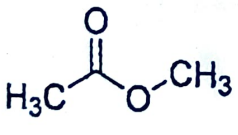
(i) Gabrial phthalimide synthesis

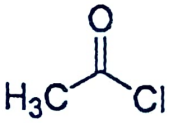
(ii) Secondary structures of proteins

(b) Write the structures of dipeptides abbreviate follows :

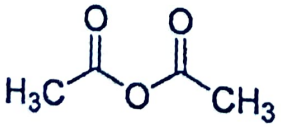
Gly-Tyr

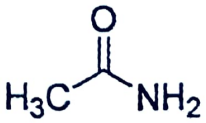
(c) Give and explain the relative reactivity orde the following derivatives of carboxylic a towards nucleophilic substitution reaction :



,


,



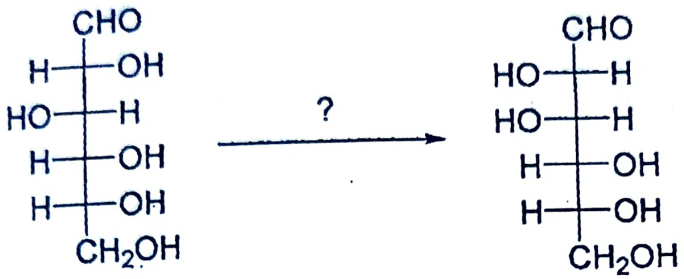
,


(d) Explain the miscibility of carboxylic acid water.

(6,1.5,

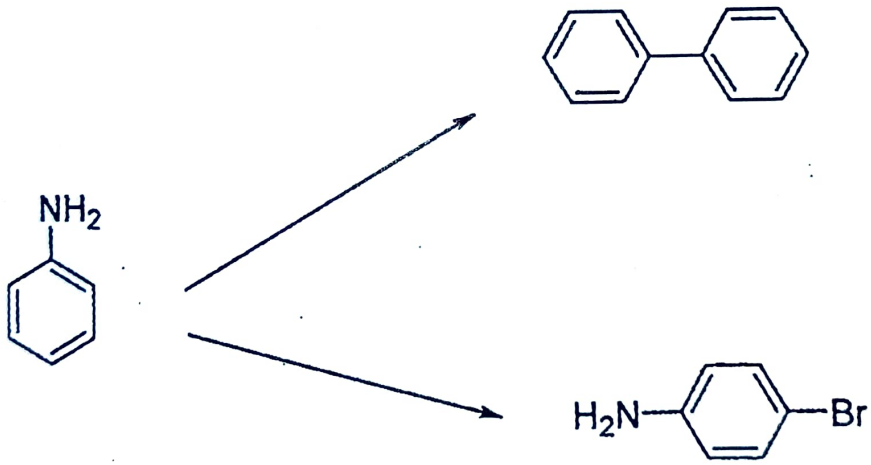
(a) Convert the following :

(i) Glucose to mannose

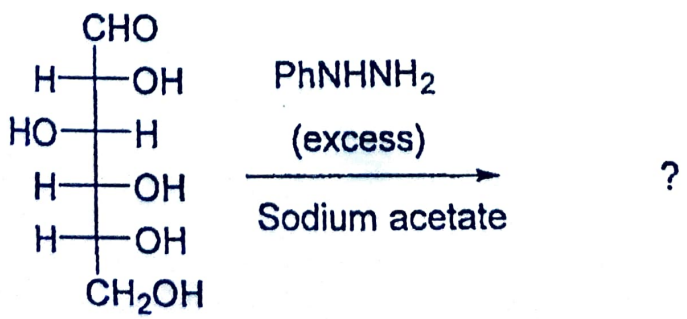


Glucose Mannose

(ii) Aniline to biphenyl and 4-bromoaniline



(iii)



(b) Outline the solid phase synthesis of Gly-Ala
(3,3,3

This question paper contains 4 printed pages.

Your Roll No. .....

Sl. No. of Ques. Paper : **7581** **J**

Unique Paper Code : **42163512**

Name of Paper : **Ethnobotany**

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

Semester : **V**

Duration : **3 hours**

Maximum Marks : **75**

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

Attempt all questions.

All parts of a question must be attempted together.

1. (a) Define the following (any *five*):

(i) Traditional knowledge

(ii) *In situ* conservation

(iii) Ethnomedicine

(iv) Biopiracy

(v) Ayurveda

(vi) Herbarium. 1×5=5

(b) Answer the following (any *five*):

(i) What are endangered taxa?

P. T. O.

(ii) Name any *two* major tribal communities of India.

(iii) What is participatory forest management?

(iv) Name any *two* plants used in religious ceremonies of tribals.

(v) Expand TBGRI. Where is it located?

(vi) Name any *two* oil-yielding plants used by tribals. 1×5=5

(c) Match the following:

(i) Natural dye	(A) *Artemisia annua*
(ii) Anti-malarial drug	(B) *Rauwolfia serpentina*
(iii) Insecticide	(C) *Indigofera tinctoria*
(iv) Jeevani	(D) *Azadirachta indica*
(v) Anti-venom	(E) *Trichopus zeylanicus*

1×5=5

2. Differentiate between the following (any *five*):

(a) Intoxicants and beverages

(b) Gums and resins

(c) Cultural and religious practices

(d) Ethnic groups and tribals

(e) Traditional and modern medicine

(f) Biodiversity and bioprospecting. 3×5=15

3. Write the botanical name, family, important plant part and uses of the following medicinal plants (any *five*):

(a) Makoi

(b) Ghritkumari

(c) Sarpagandha

(d) Shatavari

(e) Amaltas

(f) Deodar. 3×5=15

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

(a) Ethnobotany and biodiversity conservation

(b) Resin and oil yielding plants used by tribals

(c) Ethnobotanical field work

(d) Chenchus tribe

(e) *Gloriosa superba*

(f) Tribal lifestyle. 3×5=15

5. (a) What is TKDL? Explain its role in protecting the traditional knowledge by giving an example. 8

(b) What is ethnobotany? Explain in detail the relevance of ethnobotany in the present context. 7

Or

Explain the role of ancient literature and archaeological findings in ethnobotanical studies. 7

This question paper contains 3 printed pages.

Your Roll No. .....

Sl. No. of Ques. Paper : **8450** **J**

Unique Paper Code : **32165101**

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

Name of Course : **Botany : G.E. for Honours**

Semester : **I**

Duration : **3 hours**

Maximum Marks : **75**

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

Attempt five questions in all.

Question No. 1 is compulsory.

All questions carry equal marks.

Draw well-labelled diagrams wherever necessary.

1. (a) Define any *five* of the following :

(i) Hormogonia

(ii) Columella

(iii) Coenobium

(iv) Plasmid

(v) Endospore

(vi) Heterophylly

(vii) Cleistothecium. 5×1=5

(b) Fill in the blanks :

(i) Palmella stage is found in the genus ..... .

P.T.O.

(ii) Horsetail is the common name for .....

(iii) Alginic acid is present in the cell wall of the members of class ..... .

(iv) Viral particles occurring in nature without capsid are ..... .

(v) Stem rust in wheat is caused by genus ..... .

5×1=5

(c) Match the following :

Hornwort	Virus
Winged pollen grain	*Cycas*
Gongrosira stage	*Pinus*
Capsomeres	*Anthoceros*
Coralloid root	*Vaucheria*

5×1=5

2. Differentiate between any *five* of the following :

(a) Lytic and Lysogenic life cycle of bacteriophage

(b) Gram positive and Gram negative bacteria

(c) Plurilocular and Unilocular sporangia

(d) Antheridiophore and Archegoniophore of *Marchantia*

(e) Homospory and Heterospory

(f) Oogamy and Isogamy.

5×3=15

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

(a) Heterocysts

(b) Economic importance of fungi

(c) Asexual reproduction in *Marchantia*

(d) Structure of Bacteriophage.

3×5=15

4. Draw well labelled diagrams of any *three* of the following :

(a) E.M. of *Chlamydomonas*

(b) V.S. of sporophyll of *Pteris*

(c) T.S. of coralloid root of *Cycas*

(d) Structure of *Rhizopus* with sporangia. 3×5=15

5. (a) Bacteria boon or curse. Discuss. 6

(b) Give a detailed account of adaptations to land habit in bryophytes. 5

(c) Discuss parasexuality in Fungi. 4

6. (a) Discuss the disease cycle of *Puccinia graminis tritici*. 9

(b) Enumerate the xerophytic and hydrophytic characters of *Equisetum*. 6

7. (a) Compare Cyanophyceae, Chlorophyceae and Phaeophyceae on the basis of thallus structure, cell wall composition, pigments and reserve food material. Write one genera belonging to each class. 6

(b) Write the unique characteristics of *Anthoceros*. 5

(c) Write economic importance of gymnosperms. 4

This question paper contains 4+2 printed pages]

Roll No. | | | | | | | | | | |

S. No. of Question Paper : 8290

Unique Paper Code : 32165301 J

Name of the Paper : Plant Physiology and Metabolism

Name of the Course : Generic Elective – Botany

Semester : III

Duration : 3 Hours Maximum Marks : 75

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

Answer *five* questions in all including

Question No. **1** which is compulsory.

Attempt all parts of a question together.

1. Answer the following :

(A) Fill in the blanks with appropriate answer (any *five*) : 1×5=5

(*i*) In yeast, the pyruvate is converted to.....

(*ii*) Roots nodules of legumes contain.....a pigment with high affinity for oxygen.

P.T.O.

(*iii*) First stable product of Calvin cycle is .....

(*iv*) .....is a hormone involved in fruit ripening.

(*v*) Kranz anatomy is associated with .....

(*vi*) .....is a mineral element essential for nitrogen metabolism.

(*vii*) ..... is an inhibitor of cytochrome oxidase.

(B) Briefly describe any *five* of the following terms : 2×5=10

(*i*) Water Potential

(*ii*) Guttation

(*iii*) Root Pressure

(*iv*) Hydroponics

(*v*) Photoperiod

(*vi*) Biological Nitrogen fixation

(*vii*) Substrate level phosphorylation

(*viii*) Absorption spectrum of photosynthetic pigments

2. Write short account on Phytochromes under the following heads : 5+5+5=15

(*a*) Phytochrome discovery and structure

(*b*) Photo-reversibility of phytochromes

(*c*) Physiological responses of phytochrome

3. Answer the following : 5×3=15

(*a*) Role of Antenna pigments and reaction center

(*b*) Photosystem I and Photosystem II

(*c*) Draw a well labelled diagram of Z scheme of photosynthetic electron transport

4. Schematically represent any *three* of the following : 5×3=15

(*a*) Glycolysis

(*b*) Citric acid cycle

(*c*) Calvin Cycle

(*d*) Crassulacean Acid Metabolism

8290

5. Answer the following : 8+7=15

(*a*) Illustrate the mitochondrial electron transport chain and explain the chemiosmotic mechanism of oxidative phosphorylation.

(*b*) Compare the ecological advantage of C4 plants over C3 plants and discuss the factors affecting rate of photo-synthesis.

6. Write brief account on any *three* : 5×3=15

(*a*) Phloem loading and unloading

(*b*) Process of nodulation in legumes.

(*c*) Anaerobic Respiration

(*d*) Mechanism of ascent of water in tall trees

7. Attempt any *three* : 5×3=15

(*a*) Describe Physiological role of ethylene

(*b*) Mention the role and deficiency symptoms of any *two* macronutrients

(*c*) Factors affecting the rate of transpiration

(*d*) Describe the physiological roles of auxins

(*e*) Vernalization

8. Answer part A and B :

(A) Give precise cellular location and the complete biochemical reaction catalyzed by the following Enzymes (any *five*) : 5×2=10

(*i*) RuBP carboxylase

(*ii*) PEP carboxylase

(*iii*) Nitrate reductase

(*iv*) Nitrite reductase

(*v*) Hexokinase

(*vi*) Phosphofructokinase

(*vii*) Citrate synthase

(*viii*) Malate dehydrogenase

(*ix*) Succinic dehydrogenase

(*x*) Glutamate synthetase

8290

(B) Give one specific example of each of the following : $5 \times 1 = 5$

(*i*) A competitive inhibitor of an enzyme

(*ii*) A Coenzyme

(*iii*) A Cofactor

(*iv*) An irreversible inhibitor of an enzyme

(*v*) A non-proteinaceous enzyme

(*vi*) Enzyme responsible for biological nitrogen fixation

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7320 **J**

Unique Paper Code : 42161101 – OC

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

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

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. Attempt **five** questions in all.
3. Q. No. **1** is compulsory.
4. Attempt all parts of a question together.
5. Draw well labelled diagrams wherever necessary.

1. (a) Fill in the blanks : (1×5=5)

(i) ..... is the genetic material in T-phage.

P.T.O.

(ii) An alga that gives red colour to the snow is .....

(iii) Dolipore septa are present in ..... fungi.

(iv) Ribbon shaped elaters can be seen in .....

(v) ..... species of *Pinus* is known as chir pine.

(b) Define **any five** of the following : (1×5=5)

(i) Episome

(ii) Heterocyst

(iii) Woronin bodies

(iv) Apophysis

(v) Leaf trace

(vi) Sulphur shower

(c) Give an appropriate term for each of the following : (1×5=5)

(i) A process by which one bacterium transfers genetic material to another through direct contact.

(ii) Cluster of leaves surrounding the group of antheridia on antheridial branch.

(iii) Phenomenon of frequent appearance of mushroom in circles on ground.

(iv) A colony having definite number of cells arranged in a particular manner, which is determined at the juvenile stage and does not increase during its subsequent growth.

(v) A stele in which the xylem has radiating ribs and the phloem is not continuous but is present in isolated masses, alternating with the projecting angles of xylem.

2. Differentiate between any **three** of the following: (3×5=15)

(i) Gram positive and gram negative bacterium

(ii) Crozier and clamp formation

(iii) Ectomycorrhiza and endomycorrhiza

(iv) Actinostele and plectostele

(v) Manoxylic and pycnoxylic wood

3. Draw well labelled diagrams of any **three** of the following : (3×5=15)

(i) Bacterial cell

(ii) VS of needle of *Pinus*

(iii) TS of internode of *Equisetum* stem

(iv) LS of capsule of *Funaria*

(v) EM of *Chlamydomonas*

4. Write short notes on any **five** of the following : (5×3=15)

(i) Transformation in bacteria

(ii) Morphology of *Vaucheria*

(iii) Significance of lichens

(iv) Adaptations to land habit

(v) Ecological and economical importance of *Sphagnum*

(vi) Spore dispersal mechanism in *Pteris*

5. (a) What are the differences between the ovule of *Cycas* and *Pinus* at the time of fertilization? Draw diagrammatic sketches to support your answer. (6)

(b) Describe various modes of vegetative reproduction in *Marchantia*. (4)

(c) With the help of suitable diagrams describe the life cycle of nannandrous species of *Oedogonium*. (5)

6. (a) Give a general account of replication in viruses. (3)

(b) Briefly describe the various stages in the life cycle of *Puccinia graminis tritici* found on primary host with the help of suitable diagrams. (5)

(c) What is heterospory? Explain it with special reference to the pteridophytes studied by you and briefly discuss its significance. (7)

B.Sc
LS

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7542 **J**

Unique Paper Code : 42163302

Name of the Paper : Biofertilizers

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

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 in all.
3. Question No. **1** is compulsory.

1. (a) Define the following **(Any five)** : (5×1=5)

(i) Rhizosphere

(ii) Siderophore

(iii) Hartig's Net

(iv) Organic farming

P.T.O.

(v) Biopesticides

(vi) Soil reclaimation

(b) Expand the following : (5×1=5)

(i) CRYEMA

(ii) PGPR

(iii) NABARD

(iv) FYM

(vi) NPOF

(c) Give one example for the following : (5×1=5)

(i) A plant used as Biofertilizer.

(ii) Associative nitrogen fixing bacteria.

(iii) A deep burrowing earthworm.

(iv) Phosphate mobilizing micro-organism.

(v) Pioneer species in soil aggregation.

2. Write short notes on any **three** of the following : (5×3=15)

(a) Biocontrol agents and their mechanism.

(b) Composting methods.

(c) Mass multiplication of *Azolla*.

(d) Root nodule and nitrogen fixation.

(e) Green revolution.

3. (a) Elaborate on beneficial effects of AMF as a biofertilizer. (10)

(b) Discuss the role of *Anabaena* in nitrogen fixation with diagrams. (5)

4. (a) What are different types of mycorrhizal associations? Explain with diagram. (10)

(b) Write various properties of a carrier required for carrier based inoculum formation. (5)

5. (a) Give detailed process of vermicomposting with diagram. (10)

(b) Write characteristic features of *Azotobactor* and its role as biofertilizer. (5)

6. (a) Discuss the harmful effects of chemical fertilizers. (5)

(b) What do you understand by sustainable agriculture and soil heath card? (5)

(c) Discuss recycling of biodegradable agricultural and industrial waste. (5)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7329 **J**

Unique Paper Code : 42231102 – OC

Name of the Paper : Animal Diversity

Name of the Course : **B.Sc. (Life Science)**

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. There are **two** sections, **Section A** and **Section B** to be answered on separate answer sheets.
3. Answer **three** questions from each section, including Question No. **1** which is compulsory.
4. Draw well labelled diagrams wherever necessary.

SECTION A
(NON CHORDATA)

1. (a) Define the following terms : (4)

(i) Pseudocoelom

P.T.O.

(ii) Metamorphosis

(iii) Torsion

(iv) Metamerism

(b) Distinguish between the following : (4)

(i) Polyp and Medusa

(ii) Polychaetae and Oligochaetae

(iii) Protostome and Deuterostome

(iv) Holometabolous and Heterometabolous

(c) State the following as True/False (2)

(i) Zoological name of earthworm is *Fasciola hepatica*.

(ii) Leucon is the simplest type of canal system.

(iii) Arthropods have open circulatory system.

(iv) Water canal system is a feature of phylum Echinodermata.

(d) State the location and function of the following : (4)

(i) Flame cell

(ii) Contractile vacuole

(iii) Typhlosole

(iv) Radula

2. (a) Explain the life cycle of *Taenia solium* with the help of well labeled diagram. (6)

(b) Describe in detail the vision in Arthropoda. (6)

3. (a) Describe Polymorphism in Hydrozoa. (5)

(b) With the help of diagram describe the canal system in *Sycon*. (7)

4. Write short notes on any **three** of the following : (3×4=12)

(i) Parasitc adaptations in Helminthes

(ii) Water vascular system in Asteroidea

(iii) Locomotory organelles in Protozoa

P.T.O.

(iv) Characteristic features of phylum Mollusca

SECTION B

(CHORDATA)

1. (a) Define the following terms : (4)

(i) Retrogressive metamorphosis

(ii) Neoteny

(iii) Pneumatic bone

(iv) Ecdysis

(b) Distinguish between the following : (4)

(i) Osmoconformers and Osmoregulators

(ii) Apoda and urodela

(iii) Protostome and Deuterostome

(iv) Homodont and Heterodont

(c) State the following as True/False : (2)

(i) Common name of *Exocoetus* is Flying frog.

(ii) All Aves are amniotes.

(iii) Osteichythes have a cartilagenous endoskeleton.

(iv) Poison gland of snake is a modified salivary gland.

(d) Write the Zoological name of the following : (3)

(i) Tongue worm

(ii) Flying lizard

(iii) Squirrel

2. (a) Draw a well labeled diagram of the poison apparatus. Discuss briefly the biting mechanism in snakes. (8)

(b) Enumerate the general features of Agnatha. (4)

3. (a) What is Osmoregulation? Explain osmoregulation in Teleost. (8)

(b) Classify Mammals up to orders with examples. (4)

P.T.O.

4. Write short notes on any **three** of the following : (3×4=12)

(i) Parental care in Amphibians

(ii) Flight adaptation in Aves

(iii) Protochordata

(iv) Origin of Mammals

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8571 **J**

Unique Paper Code : 42161101

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

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

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. Attempt **five** questions in all.
3. Question No. **1** is compulsory.
4. All parts of a question must be answered together.
5. Draw well-labelled diagrams wherever necessary.

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

(i) Plasmids that can integrate into bacterial DNA are called _____.

(ii) _____ is the principal pigment of Phaeophyceae that imparts distinctive brown colour to the thallus.

P.T.O.

(iii) Aeciospore of *Puccinia* are found on the ventral surface of _____ leaf.

(iv) *Equisetum* is commonly known as _____.

(v) Meristematic region is present in the _____ of *Anthoceros*.

(vi) Seed-scale complex is found in _____.

(b) Define the following **(any five)** : (5×1=5)

(i) Prion

(ii) Eye spot

(iii) Columella

(iv) Primary protonema

(v) False indusium

(vi) Transfusion tissue

(c) Give **one** example for each of the following : (5×1=5)

(i) A virus having double stranded DNA as a genetic material.

(ii) In the oogonium of which genus a colourless mass of cytoplasm known as wanderplasm is formed.

(iii) The sterile diploid cells present in the capsule.

(iv) The air cavities present in the internode of *Equisetum.*

(v) The common name of *Cycas revoluta.*

2. Differentiate between the following **(any three)** : (3×5=15)

(a) Transformation and transduction

(b) Unilocular and plurilocular sporangia

(c) Uredospore and teleutospore

(d) Antheridiophore and archegoniophore

(e) Strobilus of *Selaginella* and *Equisetum*

3. Draw well-labelled diagram of the following **(any three)** : (3×5=15)

(a) Structure of *Chlamydomonas*

(b) L.S. of *Anthoceros* sporophyte

(c) T.S. *of Equisetum* internode

(d) T.S. of *Cycas* coralloid root

4. Write short notes on **(any three)** : (3×5=15)

(a) Economic importance of viruses

(b) Economic importance of gymnosperms

(c) Asexual reproduction in *Marchantia*

(d) Hydrophytic and xerophytic characters of *Equisetum*

5. (a) Explain sexual reproduction in *Vaucheria* with the help of suitable diagrams. (5)

(b) Discuss the role of fungi in industry. (5)

(c) The sporophyte of *Funaria* is partially dependent. Justify the statement. (5)

6. (a) What is suphur shower? What features of pollen in *Pinus* makes it suitable for wind pollination? (3)

(b) Discuss the economic importance of bacteria giving suitable examples. (5)

(c) Describe life cycle of *Puccinia graminis tritici* with the help of suitable diagrams. (7)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 8575 **J**

Unique Paper Code : 42231102

Name of the Paper : Animal Diversity

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

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. Attempt **five** Questions in all.
3. Q. No. **1** is compulsory.

1. (a) Define any **five** of the following terms : (5)

(i) Digenetic

(ii) Torsion

(iii) Madreporite

(iv) Operculum

(v) Metagenesis

P.T.O.

(vi) Ecdysis

(vii) Autogamy

(b) Differentiate between the following terms : (12)

(i) Polyp and medusae

(ii) Catadromous and Anadromous

(iii) Gastrozooids and Dactylozooids

(iv) Anapsid and Diapsid skull

(v) Osteichthyes and Chondrichthyes

(vi) Osmoconformers and osmoregulators

(c) Give the name of the animal in which the following structure is found : (5)

(i) Tubefeet

(ii) Nematocysts

(iii) Mantle

(iv) Proglottids

(v) Placoid scales

(d) Give the scientific name and classify the following animals upto class : (5)

(i) Squirrel

(ii) Toad

(iii) Cuttle fish

(iv) Devil fish

(v) Centipede

2. Describe the life history of *Toenia solium* with the help of labelled diagrams. (12)

3. (a) Describe general characters and classification of Amphibia upto orders with suitable example.

(b) With the help of suitable diagram explain biting mechanism in snakes. (7,5)

4. (a) Define polymorphism with suitable examples and its significance.

(b) Describe canal system in *Sycon*. (6,6)

5. (a) What do you understand by osmoregulation? Give an account of osmoregulatory mechanisms adapted by fishes in varying salinity.

(b) Describe briefly migration in Birds. (7,5)

6. (a) Discuss briefly torsion in gastropods.

(b) Briefly explain metamerism in Annelida. (6,6)

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

(i) Vision in Arthropoda

(ii) Locomotion in Protozoa

(iii) Parental care in fishes

(iv) Water vascular system in Asteroidea

(4 marks each)

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7334 **J**

Unique Paper Code : 42234301

Name of the Paper : Physiology and Biochemistry

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

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 **five** questions in all, **two** each from Section **A** and Section **B**.
3. Question No. **1** is compulsory.
4. Use separate sheets for Section **A** and Section **B**.

1. (a) Define the following terms :

   (i) Pericardium

   (ii) Bohr effect

   (iii) Km

   (iv) Transamination

P.T.O.

(v) Phosphorylation

(vi) Chylomicron

(vii) Gluconeogenesis

(7)

(b) Differentiate between the following :

(i) EDV and ESV

(ii) Glucogenic and Ketogenic Amino acids

(iii) Tidal volume and Residual volume

(iv) Competitive and Non-Competitive inhibition

(8)

(c) Expand the following :

(i) ACTH

(ii) CCK

(iii) BPG

(iv) PDH

(v) FMN

(vi) PLP (3)

(d) Give the exact location and function of the following :

(i) Podocyte

(ii) AV Node

(iii) Brunners gland

(iv) Glial cells (6)

(e) Mention one contribution of the following biochemists

(i) Koshland

(ii) E.Knoop

(iii) Peter Mitchell (3)

SECTION A

2. (a) Describe the process of digestion and absorption Proteins in gastrointestinal tract. (6)

(b) Explain the process of propagation of impulse in a non myelinated nerve fiber. (6)

3. (a) Describe the mechanism of urine production in nephron. (6)

(b) Discuss the origin and conduction of heart beat. (6)

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

(i) Adrenal gland

(ii) Oogenesis

(iii) Ultra structure of skeletal muscle

(iv) Platelet Plug formation

SECTION B

(Structural Formulae to be given for all pathways)

5. (a) Describe the various steps involved in β-Oxidation of Fatty Acid. (7)

(b) Discuss the effects of substrate concentration on enzyme catalysed reactions. (5)

6. (a) Give the sequence of reactions involved in Glycolytic pathway. (7)

(b) Briefly explain the components of Electron Transport chain. (5)

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

(i) Glycogenolysis

(ii) Biosynthesis of Palmitic acid

(iii) Urea cycle

(iv) Mechanism of action of enzyme

[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7335 **J**

Unique Paper Code : 42164301

Name of the Paper : Plant Anatomy and Embryology

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

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 **five** question in all, including question number **1,** which is compulsory.
3. Attempt **all** parts of questions together.
4. Draw well labelled diagrams wherever necessary.

1. (a) Fill in the blanks (attempt any **five**) (1×5=5)

   (i) The spongy multiple epidermis found in aerial roots of epiphytes is known as .....

   (ii) The Tunica-Corpus theory is proposed by .....

P.T.O.

(iii) Lateral roots originate from .....

(iv) Type of collenchyma in which the thickenings are mainly at the angles of the cells is known as .....

(v) ..... is the fleshy outgrowth of integument at the micropylar region in seed that helps in dispersal and germination.

(vi) Persistent nucellus in black pepper is known as .....

(b) Define the following (attempt any **five**) (1×5=5)

(i) Chalazogamy

(ii) Entomophily

(iii) Hypostase

(iv) Obturator

(v) Lithocyst

(vi) Rhytidome

(vii) Fascicular cambium

(c) Match the following (attempt any **five**) (1×5=5)

(i) Composite endosperm	a) Absence of endosperm
(ii) Quiescent centre	b) Loranthceae
(iii) Pollination by water	c) Root

(iv) Sunken stomata

(v) Bulliform cells

(vi) Schuepp

(vii) Podostemaceae

d) *Zea mays*

e) Korper-kappe theory

f) Hydrophily

g) Xerophyte

2. Write short notes on any **five** of the following : (3×5=15)

(i) Microgametogenesis

(ii) Double Fertilisation

(iii) Apomixis

(iv) Metcalfe and Chalk's classification of stomata

(v) Types of Tapetum

(vi) Sclerenchyma

3. Differentiate between any **three** of the following : (3×5=15)

(i) Nuclear and Cellular endosperm

(ii) Monosporic and Tetrasporic embryo sac

(iii) Sapwood and Heartwood

(iv) Monocot and Dicot Stem

4. Draw well labelled diagrams of any **three** of the following : (5×3=15)

(i) T.S. tetrasporangiate anther at tetrad stage

(ii) L.S. monocot embryo

(iii) T.S. monocot leaf

(iv) V.S. *Nerium* leaf

(v) L.S. anatropus, bitegmic ovule showing *Polygonum* type of embryo sac

5. (a) Discuss the adaptive features of plants pollinated by wind and water with suitable example. (7.5)

(b) Describe anatomical adaptations of hydrophytes with suitable examples. (7.5)

6. (a) Describe secondary growth in dicot roots with the help of suitable diagrams. (7.5)

(b) Define polyembryony and give its classification. (7.5)

7. (a) Describe various types of ovules in angiosperms with help of suitable examples. (7)

(b) Discuss various theories explaining the organisation of root apex. (3)

(c) Write a brief essay on the structure and functions of treachery elements. (5)

[This question paper contains 3 printed pages.]

SETB

Sr. No. of Question Paper : 8805 Your Roll No.....

Unique Paper Code : 216555

Name of the Course : B. Sc. Life Sciences

Name of the Paper : Genetics and Genomics (LSPT-512)

Semester : V

Maximum Marks : 75

Duration : 3 Hours

Instructions for Candidates

1. Write your **Roll No.** on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all
3. Question **No. 1** is compulsory.
4. Attempt any **four** questions from the rest.
5. All questions carry **equal** marks.

Q1. (a) Define the followings **(any five)**: (1 x 5 = 5)

(i) Pleiotropy
(ii) Paralogs
(iii) Holandric trait
(iv) Pseudogenes
(v) Expressivity
(vi) Coupling phase
(vii) Reverse Genetics

(b) Expand the following **(any five)** (1 X 5 = 5)

(i) EMS
(ii) PKU
(iii) HGP
(iv) TDF
(v) CMS
(vi) BAC
(vii) cM

(c) Write major contribution of any five: (1 X 5 = 5)

(i) C. B. Bridges
(ii) L. Cuenot
(iii) Craig Venter
(iv) Curt Stern

(v) G. Mendel
(vi) Francis Collins
(vii) Mary Lyon

Q2. Differentiate between the following (any five) (3 X 5 = 15)

a) Paracentric Inversion and Pericentric Inversions
b) Co-dominance and Incomplete Dominance
c) Missense and Non-sense Mutations
d) Complete Linkage and Incomplete Linkage
e) Reciprocal cross and Test Cross
f) Proteomics and Transcriptomics

Q3. Write short notes on any three: (5 X 3 = 15)

a) Testicular feminization
b) C/B Method
c) Microarray
d) One gene one enzyme hypothesis
e) Chromosomal Theory of Inheritance
f) Sex Determination in *Melandrium*

Q4. (a) What are epistatic interactions? Explain dominant epistasis in detail giving one example. (2+8 = 10)

(b) Briefly answer the following (any five): (1x5 = 5)

(i) Why are there more color blind men than women?
(ii) How many Barr bodies present in Turner syndrome? an individual with
(iii) Name two eukaryotic model organisms.
(iv) Name an alkaloid which is used to produce polyploids in plants.
(v) Give chromosomal constitution of individual with Down's syndrome.
(vi) Name any one disease that is caused due to point mutation. in a gene.
(vii) The branch of genetics that deals with structure and function of genes

Q5. (a) A haemophilic man marries an unaffected woman. Their first daughter was diagnosed as a haemophilic. They are planning to have more children but wish to know whether other children will also be affected. Diagram a cross and calculate the chances of ~~affected children~~ having children that are affected with the disease. Explain the genetic basis of the disorder. (5)

(b) In *Drosophila*, red eye color (pr^+) is dominant over purple eye color and normal wing length (vg^+) is dominant over vestigial. A cross between a red eyed, normal wing length fly with a homozygous recessive parent produces a heterozygote. The F1 progeny was test crossed, the F2 progeny was as follows:

$pr^+ vg^+$	1300
$pr\ vg$	1400
$pr^+ vg$	140
$pr\ vg^+$	160
Total	3000

i. Diagram the cross giving the genotypes of parents and F1?
ii. Diagram the test cross of F1 giving genotypes. (3)
iii. Calculate the map distances between the genes and construct the genetic map? (2)
iv. Explain the genetic phenomenon observed (3)
(2)

Q6. (a) A pure sinistral female snail is crossed to a pure dextral male snail. Diagram the cross. Give the genotype and phenotype of F1, F2 and F3 generations. (7)

(b) What are base analogs? Cite an example. Discuss the molecular basis of mutation caused by any one. (2+6 = 8)

Q7. (a) Chromosomal translocations lead to aberrant gametes and progeny. Explain with suitable examples. (8)

(b) What is Comparative Genomics? List key differences and similarities between chimpanzee and human genomes (7)

[This question paper contains 6 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 7650 **J**

Unique Paper Code : 42167902

Name of the Paper : Cell and Molecular Biology

Name of the Course : **B.Sc. (Prog.) : DSE-1A**

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 **five** questions in all including Question No. **1** which is compulsory.
3. All the parts of a question must be attempted together.
4. Illustrate your answers with well-labelled diagrams wherever necessary.

1. (a) Define **(any five)** of the following :

(1×5=5)

P.T.O.

(i) Central Dogma

(ii) Middle Lamella

(iii) Operon

(iv) Resolving power

(v) Promoter

(vi) Cell Theory

(b) Expand the following (**any five**) : (1×5=5)

(i) TEM

(ii) GTF

(iii) SSB

(iv) SER

(v) 3'-UTR

(vi) TGN

(c) Match the following terms from column A with column B. (1×5=5)

Column A	Column B
(i) M. Knoll and E. Ruska	RNA as genetic material
(ii) A. Kornberg	Mitochondria
(iii) H. Fraenkel-Conrat	*Lac* operon
(iv) C. Benda	DNA polymerase 1
(v) F. Jacob and J. Monad	Electron microscope

2. Write short notes on **(any three)** of the following : (5×3=15)

(a) Factors which affect the resolving power of a microscope

(b) Theta (θ) mode of replication

(c) Molecular control of cell cycle

(d) Endosymbiotic theory

3. Differentiate between the following. Attempt any **three**. (5×3=15)

(a) Light microscopy and Electron microscopy

(b) B- DNA and Z- DNA

(c) Primary and Secondary cell wall

(d) Rough and Smooth Endoplasmic Reticulum

(e) Mitosis and Meiosis

4. (a) Discuss in detail the experiment that used radioactive isotopes and proved that DNA is the genetic material. (5)

(b) Illustrate and list the various enzymes that assemble at the replication fork in prokaryotes. Discuss their functions. (5)

(c) Explain various functions of mitochondria. Name at least two marker enzymes of mitochondria. (5)

5. (a) Explain the structure and functions of Golgi apparatus. (5)

(b) Explain in detail, the process of transcriptional initiation in prokaryotes. (5)

(c) Write a short note on Phase contrast microscopy. (5)

6. Write short notes on (any **five**) of the following : (3×5=15)

(i) Semiautonomous organelles

(ii) Anticodon

(iii) Nucleosome model

(iv) Nuclear pore complex

(v) Consensus sequences

(vi) Peroxysomes

7. (a) With illustration describe Fluid mosaic model of membrane structure with special reference to membrane proteins. (7)

(b) In the lactose operon of *E. coli,* what is the function of each of the following genes or sites.

(i) Regulator

(ii) Operator

(iii) Promoter

(iv) Structural gene z (4)

(c) Explain the mode of translation in prokaryotes. (4)

Sl. No. of Q.P. 7752

Unique Paper Code: 42237903

Name of the Paper: Animal Biotechnology

Name of the Course: B. Sc. (Prog.) - DSE

Semester: V

Maximum Marks: 75

Time: 3 Hours

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

Attempt all questions. All question carry equal marks.

1. a) Define

i. Transduction

ii. Stemsills

iii. Transformation Efficiency

iv. Isoschizomers

v. Cosmid

b) Differentiate between the following:

i. Natural and synthetics culture medium

ii. Probe and primer

iii. Genomic and cDNA libraries

iv. Lytic and Lysogenic cycle

v. Northern blotting and Western blotting

c) Expand the abbreviations

i. cDNA

ii. RFLP

iii. YAC

iv. HAC

v. PEG

d) Write important contributions of the following scientist.

i. Kary Mullis

ii. EM Southern

iii. Karl Ereky

iv. Frederic Sanger

e) Write the importance of following in biotechnology.

i. Taq polymerase

ii. T_4 DNA ligase

iii. Hind III

iv. Alkaline phosphatase

2. a) What are the restriction endonucleases? Give an account of type II restriction endonucleases.

b) Explain method of production of hGH by recombinant DNA technology.

3. a) What is a gene therapy? Describe various methods of gene therapy and its types giving example.

b) Describe technique of western blotting.

4. a) Define cloning vector. Describe pUCI18/19 as an ideal cloning vector.

b) Describe the colony hybridization methods of screening of genomic library.

5. a) Describe Agrobacterium based methods of production of transgenic plants with a suitable example.

b) What are the advantages of λ-bacteriophage based vectors.