Set: 1

S. No. of Question Paper:

Unique Paper Code	: 32171101_OC
Name of the Paper	: C-I: Inorganic Chemistry –I (Atomic Structure and Chemical Bonding)
Name of the Course	: B.Sc. (H) Chemistry
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 **four** questions.
3. A**ll** questions carry equal marks.

1. (a) (i) $BeCl_2$ has zero dipole moment while H_2S has some value. Justify.

   (ii) Which has higher melting point NaCl or CuCl? Explain with suitable reason.

   (b) Calculate the ionic radii of K^+ and Cl^- using Pauling's method if the internuclear distance between these ions is 314 pm.

   (c) Write the Schrodinger wave equation for an electron in H atom and give the significance of the various terms involved. (6,6,6.75)

2. (a) Predict the shape of the following molecules/ions on the basis of VSEPR theory:

   I_3^-, NH_3, BrF_2^+ and PCl_5

   (b) Explain, which one of the following pairs has higher ionization enthalpy:
   (i) Be and B (ii) Cu and K

   (c) Draw the MO energy level diagram of N_2^+. Calculate its bond order and comment on its magnetic behaviour. (6,6,6.75)

3. (a) What are degenerate orbitals? Comment upon the degeneracy of the 3s, 3p and 3d orbitals for the hydrogen atom and multi electron systems.

(b) Arrange the following in increasing order of bond angle and also explain the order.

(i) NH_3 and NF_3 (ii) PH_3 and PF_3

(c) Write the electronic configuration for Cr (Atomic No. 24) and Cu (Atomic No. 29). Explain why half-filled and fulfilled orbitals have extra stability. (6,6,6.75)

4. (a) Calculate the limiting radius ratio for Coordination number 4 (tetrahedral geometry) and 6 (Octahedra geometry).

(b) Explain why, the first electron gain enthalpy of O is exothermic, whereas second electron gain enthalpy is endothermic, still it exists as O^{2-} in oxides.

(c) Write Born-Lande's equation for calculating lattice energy explaining all terms in it. What is Madelung constant and on what factors it depends? (6,6,6.75)

5. (a) Write short note on any two of the following
(i) p-type semiconductors

(ii) Equivalent and Non-equivalent hybrid orbitals

(iii) Instantaneous-Induced dipole interactions

(b) (i) Differentiate between Bonding and Antibonding Molecular Orbitals.
(ii) On which law is Born-Haber cycle based? Set up a Born-Haber cycle for the formation of $CaCl_2$ with complete notations.

(c) What are Eigen Values and Eigen functions? ψ has no physical significance and ψ^2 has. Explain. (6,6,6.75)

6. (a)) (i) Calculate the percentage ionic character in HF (Electronegativity of H is 2.1 and that of F is 4.0).
(ii) Find out the lattice energy of NaCl crystal having sum of ionic radii, $d_0 = 281$ pm.

(b) Define Bent Rule? How does the bond angles in CH_2F_2 vary?

(c) State the Pauli Exclusion Principle. How can this principle be used to fix the maximum capacity of the various energy levels in an atom?

(6,6,6.75)

SET-A

Unique paper code	:	32495301
Name of the paper	:	Biochemical Applications in Forensics
Name of the course	:	B.Sc. (H) Biochemistry (LOCF)
Semester	:	III (LOCF)
Duration	:	4 hours (including the time for downloading Question paper and uploading answer sheet)
Maximum Marks	:	75

Instructions for the candidate

*There are 6 questions. Attempt **ANY FOUR** questions.*
All questions carry equal marks.

1. What significant physical properties of blood determine the shape of a blood drop in flight? Explain in detail the methods used for documenting blood stain patterns. What important information can be derived from the examination of blood stain patterns? In the picture below identify the pattern in A-F. Justify your answer.

(2, 4, 4, 8.75)

2. What are the important guidelines for collection, packaging and storage of biological materials from a crime scene? Differentiate presumptive and confirmatory test for characterizing and identification of biological material from crime scene. Discuss one presumptive and one confirmatory test for identification of Blood and Semen.

(6.75, 4, 8)

3. Police discover a badly decomposed body buried in an area where a man disappeared some years before. The case was never solved, nor was the victim's body ever recovered. As the lead investigator, you suspect that the newly discovered body is that of the victim. How would you go about using DNA technology to test your theory as well as the information obtained from hair? Mention the important regions within the genome that are variable between individuals and have become the focus of forensic genetics for DNA profiling and also mention the method of their estimation/typing. Why RFLP method has been replaced by STRs in most forensic laboratories? Also mention the role of CODIS in DNA profiling.

(4, 7.75, 3, 4)

4. Rigor mortis, livor mortis, and algor mortis are all used to help determine the time of death. Mention the principle behind these methods as well as describe at least one condition that would render that method unsuitable or inaccurate for determining time of death. Also, discuss the role of forensic entomology in estimating the time of death. When a forensic anthropologist generates a biological profile, what is that likely to include? Mention the approximate gender, ancestry, age range, and height of the skeleton based on the information given below during creating a forensic anthropology victim profile.

Cranium: Size Medium	Eye orbits: Squared
Forehead: Rounded, projected outward	Nasal cavity: Large, wide
Mastoid process: Absent	Incisors: Smooth
Jaw Angle = 110 degrees	Pelvis Opening: wide circular
Teeth: All permanent	Sacrum: short, wide, turned outward
Sagittal suture: Not fused	Subpubic angle 90–100 degrees
Coronal suture: Not fused	Femur Fully fused, 44.1 cm long
Clavicle Fully fused	

(9,3.75, 2, 4)

5. The following are fingerprint patterns of three people (A, B, C) with criminal records for robbery. Identify the following fingerprints and discuss the three important fundamental of fingerprints. What is AFIS and explain how it helps in fingerprint identification. What are the three main types of fingerprints that can be found at a scene? Discuss the physical and chemical methods for development of a latent fingerprint.

A B C

(9, 2.75, 3, 4)

6. Name six specimen types that are often tested in forensic toxicology. Mention different groups of medicinal drugs often involved in fatalities. Describe in detail four methods for drug screening and mention the advantages and disadvantages of each. Explain the three methods of metal analysis.

(3, 2, 7.75, 6)

SET-A

Your Roll No. :

Sl. No. of Q. Paper :

Unique Paper Code : 32171301_OC

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

Name of the Paper : Chemistry C-V Inorganic Chemistry II:
s- and p- Block Elements

Semester : III

Duration: 2 Hours Maximum Marks : 75

Instructions for Candidates:

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

(ii) Attempt any **four** questions.

(iii) All questions carry equal marks.

Q1. Explain **any five** of the following, giving suitable reasons:

(a) Boric Acid is a weak acid in aqueous solution but behaves as strong acid in presence of polyhydroxy compounds.

(b) Alkaline earth metals are harder, denser and have higher melting and boiling points as compared to alkali metals.

(c) Silicones are inert and water repellent.

(d) NH_3 has higher basicity and dipole moment than PH_3.

(e) Iodine has very low solubility in water and high solubility in aqueous solution of KI.

(f) The reaction $PbCl_2 + Cl_2 \rightarrow PbCl_4$ is reversed at 25 °C while the reaction $GeCl_2 + Cl_2 \rightarrow GeCl_4$ is rapid at the same temperature.

(3.75 x 5)

Q2. (a) Explain using Ellingham diagram, why metal oxides are unstable at high temperatures. Why in some cases does the slope of line in the diagram change abruptly?

(b) Draw and explain the electron deficient structure of diborane. How does diborane react with NH_3 under different conditions?

(c) Draw the structure of oxyacids of chlorine in various oxidation states and arrange them in order of increasing acidic strength. Justify your answer.

(6.25, 6.25, 6.25)

Q3. (a) Explain the bonding involved in the cyclic structure of phosphazene. What will be the product of hydrolysis of $(NPCl_2)_3$.

(b) Differentiate between interhalogen and pseudohalogen compounds. Why are interhalogen compounds more reactive than halogens?

(c) Draw the structure of basic beryllium acetate. Why Be forms more complex compounds than other members of the same group?

(6.25, 6.25, 6.25)

Q4. (a) On heating, Sulphur melts to a mobile liquid but on further heating the viscosity increases sharply and then decreases again. Explain

(b) What is hydrometallurgy? Describe using chemical reaction the cyanide method for the extraction of Ag.

(c) Chemistry of Boron is similar to Silicon. Give examples in support of the statement.

(6.25, 6.25, 6.25)

Q5. (a) Complete and balance the following reactions. (**Any Five**)

(i) $BeO + NaOH \rightarrow$

(ii) $B_2H_6 + H_2O \rightarrow$

(iii) $SiH_4 + CuSO_4 \rightarrow$

(iv) $P_4 + SOCl_2 \rightarrow$

(v) $H_2SO_4 + H_2S \rightarrow$

(vi) $U + ClF_3 \xrightarrow{50-90°C}$

(b) Compare the basicity and reducing powers of H_3PO_4, H_3PO_3, and H_3PO_2. Give reason for your answer.

(c) How is borazine prepared? Why is it called inorganic benzene? Compare and contrast the chemical properties of borazine and benzene.

(6.25, 6.25, 6.25)

Q6. Write short notes on (any three):

(a) Zone refining

(b) Allotropes of Phosphorous

(c) Solutions of alkali metals in Liquid Ammonia

(d) Peroxoacids of Sulphur

(6.25, 6.25, 6.25)

Unique Paper Code : 32171302_OC

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

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

Oxygen Containing Functional Groups

Semester : III

Duration : 3 hours

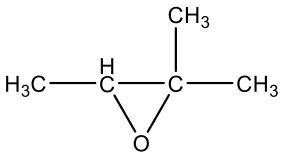
Maximum Marks: : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt any four questions in all.
3. All questions carry equal marks.
4. This question paper contains three pages.

Q1 a) An organic compound A ($C_5H_{10}O$) on treatment with hydroxylamine gives two isomeric compounds B and C. B and C on reaction with acid separately gives D and E, respectively. Compound A does not give tollen's test. Compound A on reduction with $NaBH_4$ followed by dehydration with conc. H_2SO_4 gives compound F. Compound F on oxidative ozonolysis forms CH_3COOH and CH_3CH_2COOH. Identify A, B, C, D, E and F. Write all the reactions and mechanisms involved.

15

b) Explain the reaction when  is treated with methanol in acidic medium. **3.75**

Q2 a) How will you prepare a & b from ethyl acetoacetate and c, d & e from diethyl malonate? **15**

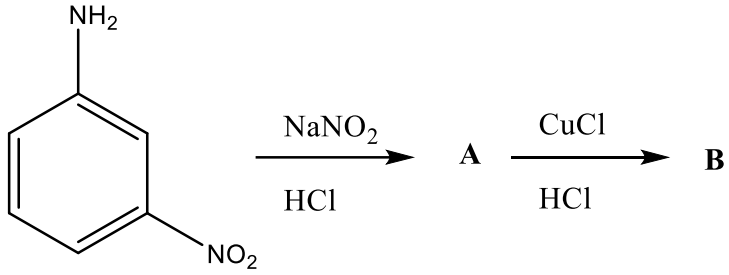
i) Pentane-1,5-dioic acid
ii) 2-Methylhexanoic acid
iii) Succinic acid
iv) Cinnamic acid
v) 5,5-Dimethyl barbituric acid

b) S_N1 reactions show racemization as well as inversion of configuration. Explain **3.75**

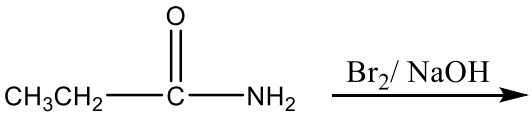
Q3 a) Explain why **15**

i) Enol form of ethylacetoacetate is more stable than that of ethylacetate?
ii) Benzoic acid is stronger acid than acetic acid?
iii) Maleic acid is stronger acid than fumaric acid for first dissociation but for second dissociation it is weaker than fumaric acid?
iv) Aryl halides are weaker than alkyl halides towards nucleophilic substitution reactions?
v) Acetone can be prepared from CH_3COCl and $(CH_3)_2Cd$ and not from CH_3COCl and CH_3MgCl?

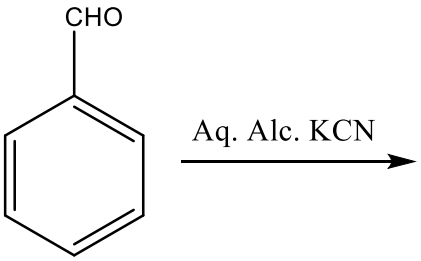
b) Identify A and B **3.75**

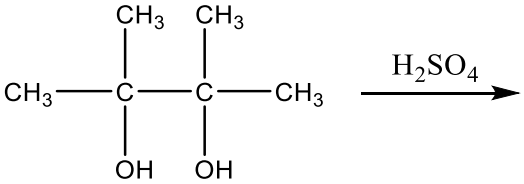


Q4 a) Compete the following, giving name of the reaction and mechanism involved (*Any three*) **15**

i) 

ii) HCOOH + PhCHO $\xrightarrow{\text{conc. NaOH}}$

iii) 

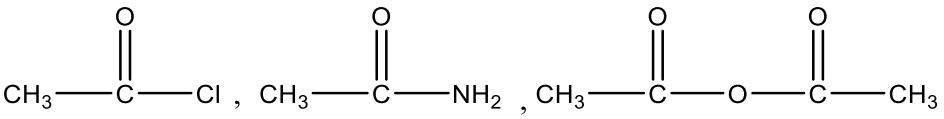
iv) 

b) *p*-Chlorotoluene on treatment with $NaNH_2$ and liq. NH_3 gives *m*-toluidine. Explain **3.75**

Q5 a) How will you carry out the following conversions (*Any three*) **15**

i) Phenol to Aspirin
ii) Benzene to Fluorobenzene
iii) Aniline to iodobenzene
iv) Benzaldehyde to benzamide

b) Arrange the following compounds in order of increasing reactivity towards hydrolysis and give reason **3.75**



Q6 a) What happens when **12.75**

i) Dicarboxylic acids succinic acid, glutaric acid and adipic acid are heated with acetic anhydride and the product is distilled at 300 ºC.
ii) Phenol is treated with $CHCl_3$ and NaOH and the product is treated with alkaline $KMnO_4$.
iii) Benzaldehyde is treated with acetic anhydride in presence of sodium acetate.

b) Write a short note on of the following (*Any two*) **6**

i) Claisen rearrangement
ii) Knoevenagel reaction
iii) Aldol condensation

Unique Paper Code	:32171302
Name of the Paper	: Chemistry C-VI Organic Chemistry-II: Oxygen Containing Functional Groups
Name of the Course	:B.Sc. (H) Chemistry
Semester	:III
Duration	:2 hour
Maximum Marks	:75

Instructions for Candidates:

(i) **Attempt four questions in all. Question No. 1 is compulsory.**

(ii) **Give reactions wherever possible clearly indicating the reagent(s) involved.**

1. **(15,6)**

(a) An organic compound **A** having molecular formula C_4H_8O on treatment with CF_3COOOH gives compound **B** ($C_4H_8O_2$). Two moles of Compound **B** undergo self-condensation in the presence of sodium ethoxide in ethanol gives compound **C** ($C_6H_{10}O_3$). When compound **C** is reacted with one mole of methyl bromide in the presence of sodium ethoxide in ethanol gives compound **D** ($C_7H_{12}O_3$). Compound **D** on treatment with dil. aq. KOH solution that is followed by acidification gives compound **E** ($C_5H_8O_3$), which gives positive bicarbonate test. Compound **E**, when heated gives compound **A**. Compound **A** gives negative Fehling's/Tollen's test and positive iodoform test. Deduce the structure of compounds **A**-**E**, write the name of the reaction involved (*if any*). Write the mechanism of the ***any one*** of the following steps:

(i) Conversion of **A** to **B**

(ii) Conversion of **B** to **C**

(b) Write the products and give the mechanism of the reaction when benzaldehyde is treated with:

(i) Aqueous ethanolic KCN solution

(ii) Hydroxylamine hydrochloride in the presence of sodium acetate

2. **(3,3,3,3,3,3)**

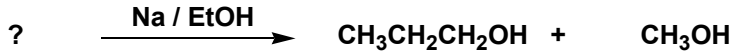
(a) Compare the acidic strength of phenol with that of *p*-nitrophenol.

(b) Write the equation involved and the product formed when 3,3-dimethylbut-1-ene is subjected to oxymercuration-reduction reaction. Mention the reagent used stepwise and comment on the regioselectivity of the reaction.

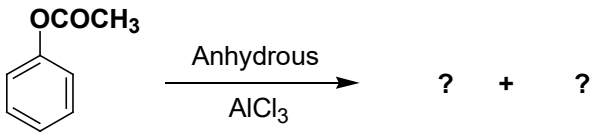
(c) Suggest a chemical test to distinguish between propan-1-ol and propan-2-ol. Write the equation involved.

(d) Complete the following reactions:

(**i**) 

(**ii**) 

(e) The given phenyl ester undergoes rearrangement upon treatment with anhydrous $AlCl_3$ to give two isomeric products.



(i) Write the structure of possible products.

(ii) Suggest a reaction condition to favor the formation of the either of the two products.

3. **(6,6,3,3)**

(a) Using ethyl acetoacetate **or** diethyl malonate, outline the method of synthesis for ***any three*** of the followings:

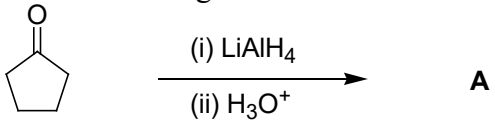
(i) 3-Methylhexan-2-one

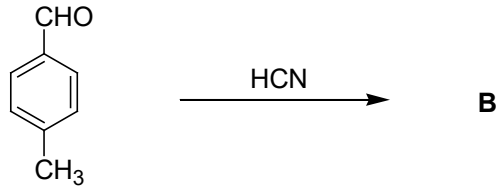
(ii) α-Methyl succinic acid

(iii) Adipic acid

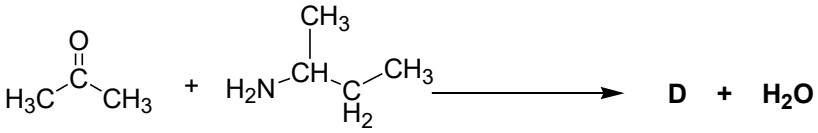
(iv) Veronal or Barbital

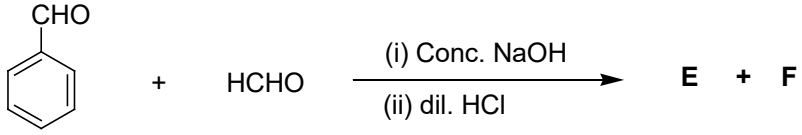
(b) Complete the following chemical reactions:

(i) 

(ii) 

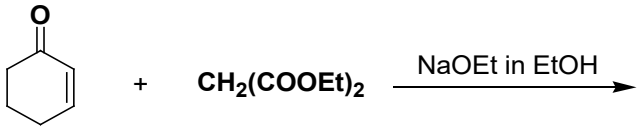
(iii) $CH_3CH_2CH_2CHO$ $\xrightarrow[(ii)\ H_3O^+]{(i)\ CH_3CH_2CH_2MgCl}$ **C**

(iv) 

(v) 

(c) Suggest a method for the synthesis of cinnamic acid using benzaldehyde. Name the reaction involved.

(d) For the reaction given below, give the product formed while briefly discussing the mechanism involved.



4.

(a) How will you distinguish between the following pair of molecules with suitable reactions. (***attempt any three***) **(2x3)**

(i) β- and γ-hydroxy carboxylic acids

(ii) Benzoic acid and cyclohexanone

(iii) Ethanal and propanal

(iv) Phenol and benzoic acid

(b) Carry out the following conversions: (**3x4**)

(i) Propanoic acid to propanal

(ii) Acetic acid to 2-hexanone

(iii) Chlorobenzene to aniline

(iv) *n*-Propanol to butanamide

5. (**3x6**)

(a) What are ambident nucleophiles? How will you convert alkyl halides into nitro alkane and alkyl nitrite ? Explain.

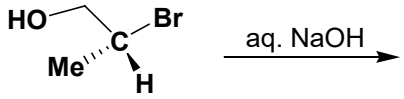
(b) S_N2 reactions involve complete inversion of configuration. Explain.

(c) Why 2,4,6-trinitrochlorobenzene is easily hydrolyzed in the presence of aq. NaOH solution but not chlorobenzene ?

(d) Why salicylic acid is stronger acid than *p*-hydroxybenzoic acid ?

(e) What product is formed when 2-phenyl-1-ethanal is treated with dil. aqueous NaOH solution ?

(f) Why the substitution of bromine in the following reaction proceeds with retention of configuration ? Explain.



6. Write a short note on ***<u>any three</u>*** of the followings: (**6x3**)

(a) Claisen rearrangement

(b) Wittig reaction

(c) Beckmann rearrangement

(d) S_N1 mechanism

(e) Benzyne mechanism

Unique Paper Code	**: 32171303**
Name of the Paper	**: Chemistry C-VII Physical Chemistry III: Phase Equilibria and Electrochemical Cells**
Name of the Course	**: B.Sc. (H) Chemistry**
Semester	**: III**
Duration	**: 3 hour**
Maximum Marks	**: 75**

Instructions for Candidates

1. On the first page of the answer sheet, write down the following:
   -Paper title
   -Unique Paper Code
   -Date of exam
   -Student name
   -Course name
   -University Roll No.
2. Attempt ***four*** questions in all.
3. Use of scientific calculator, log tables and graph paper is permitted.

Q1.

a) Solid CO_2 is called dry ice. Explain.
b) A liquid has normal boiling point at 338.15 K. Using Trouton's Rule, determine the vapour pressure of a liquid at 325.15 K
c) Draw a labeled phase diagram of water. Using this phase diagram, explain why skating is possible on ice.
d) Is it possible to separate an azeotropic mixture into two pure components by isobaric fractional distillation? Explain.

3, 5, 8, 2.75

Q.2

a) Enthalpy of chemical adsorption of H_2 on the surface of Ni is slightly positive yet the adsorption is spontaneous. Explain.
b) Show that the heterogenous equilibria of three components A, B and C distributed in three different phases as depicted below is in accordance with the phase rule.
(Note: the three components do not react with each other)

$$\underset{\text{Phase 1}}{A + B} \quad \rightleftharpoons \quad \underset{\text{Phase 2}}{B + C} \rightleftharpoons \quad \underset{\text{Phase 3}}{A + B + C}$$

c) Draw a labeled phase diagram of a two-component system (A-B) with the data given below:
   (i) Melting point of A = 751°C
   (ii) Melting point of B = 1350 °C
   (iii) Melting point of a congruently melting compound AB_2 =1040 °C
   (iv) A compound A_2B melts incongruently at 370 °C to give a melt of 48 mass % B
   (v) Eutectic at 210 °C and 58 mass % of B
   (vi) Eutectic at 580 °C and 88 mass % of B

d) State whether the following statements are true or false.
   (i) $\left(\frac{dp}{dT}\right)_{s \rightleftharpoons v} > \left(\frac{dp}{dT}\right)_{l \rightleftharpoons v}$
   (ii) A multistage solvent extraction is more efficient process as compared to the single stage extraction.

3, 5, 8, 2.75

Q.3

a) On the basis of the critical temperatures, T_c of the gases given below, predict and explain which of the following gases will exhibit maximum adsorption on 1 g of charcoal at room temperature.

Gas	CO_2	NH_3	H_2
T_c / K	404	405	33

b) Using Duhem-Margules equation, show that in a binary liquid mixture if one component behaves ideally then the other must also exhibit ideal behavior.

c) Consider an ideal behavior for a binary liquid mixture of two liquids A and B.($p_A^o = 300$ mm Hg and $p_B^o = 800$ mm Hg). When one mole each of the two components is mixed at 323 K and the pressure over the liquid mixture is reduced, eventually the first trace of vapours is formed at a definite pressure. Calculate

i. the pressure at which this first trace of vapour forms
ii. the composition of first trace of vapour formed
iii. the composition of vapour phase when the last trace of the liquid remains to be vaporized.

d) Addition of naphthalene increases the CST of the phenol-water system at constant pressure. Explain.

3, 5, 8, 2.75

Q.4

a) If a gas follows the Langmuir adsorption isotherm on a surface of a solid such that at 298 K the $K_{eq} = 0.66\ kPa^{-1}$. Calculate the pressure of the gas when the fraction of surface coverage is 25%.

b) Derive an expression for the reduction potential of a Metal-Metal ion half cell

c) Give the cell representation of the galvanic cell for each of the following reactions and write the expressions for the cell potential based on Nernst equation.

(i) $Ag^+(aq) + Cl^-(aq) \rightleftharpoons AgCl\ (s)$

(ii) $Ni^{2+}(aq) + H_2(g) + 2OH^-(aq) \rightleftharpoons Ni(s) + 2H_2O(l)$

d) Write the limitations of hydrogen electrode.

3, 5, 8, 2.75

Q.5

(a) Explain the concept of liquid junction potential in a Galvanic cell. How can the liquid junction potential be eliminated?

(b) Describe the use of quinhydrone electrode for the measurement of pH of a solution.

(c) Calculate the mean ionic activity ($a_\pm$) of the ions in an aqueous solution of CdI_2 at 300 K using the cell potential of the following Galvanic cell. Also calculate the mean ionic molality ($m_\pm$) in the electrolyte solution. The E_{cell} value is 0.286 V at 300 K

$$Cd \,|\, CdI_2\ (aq,\ 0.01\ mol\ kg^{-1}) \,|\, AgI(s) \,|\, Ag$$

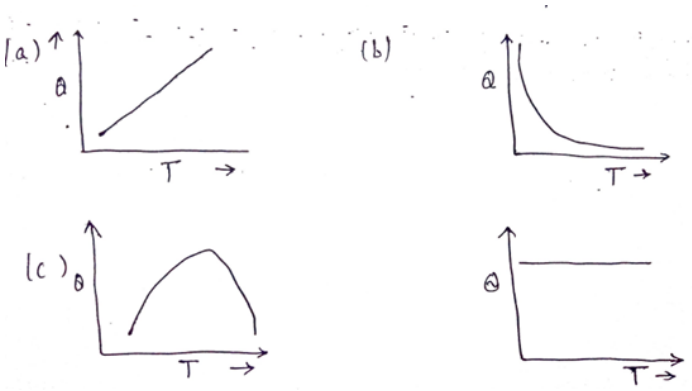
Given: $E^{\ominus}_{I^-|AgI|Ag} = -0.145\ V$ and $E^{\ominus}_{Cd^{2+}|Cd} = -0.396\ V$

(d) Cuprous ion is written as Cu_2^{2+} and not as Cu^+. Explain.

3, 5, 8, 2.75

Q.6

(a) Which of the following represents the variation of physical adsorption with temperature?



(b) Determine the ΔG^o and K_{eq}^o at 298 K for the following reaction using the data given below:

$$Cu(OH)_2 \rightleftharpoons Cu^{2+}(aq) + 2\ OH^-(aq)$$

Given: $E^{\ominus}_{Cu(OH)_2,OH^-|Cu} = -0.224\ V$; $E^{\ominus}_{Cu^{2+}|Cu} = 0.337\ V$

(c) For the cell reaction,

$$Fe^{3+}\ (aq) + Fe\ (s) \rightleftharpoons Fe^{2+}(aq)$$

Construct two different galvanic cells using the following three half cells and calculate the standard cell potential for each of these cells. Compare the two cell potential values and comment on the result obtained.

Given:

(i) $Fe^{2+} + 2e^- \rightleftharpoons Fe$ $\quad E^{\ominus}_{Fe^{2+}|Fe} = 0 - 0.44\ V$

(ii) $Fe^{3+} + 3e^- \rightleftharpoons Fe$ $\quad E^{\ominus}_{Fe^{3+}|Fe} = -0.036\ V$

(iii) $Fe^{3+} + e^- \rightleftharpoons Fe^{2+}$ $\quad E^{\ominus}_{Fe^{3+},Fe^{2+}|Pt} = 0.771\ V$

(d) Why is phosphoric acid added while preparing the reaction mixture in the titration of Mohr's salt with potassium dichromate.

3, 5, 8, 2.75

Unique Paper code : 32171502

Name of the course : B.Sc. (Hons) Chemistry

Name of the paper : Chemistry C-XII Physical Chemistry V: Quantum Chemistry and Spectroscopy

Semester : V

Duration : 3 hours

Maximum Marks : 75

Instructions for Candidate:

1. **Attempt any FOUR questions in all.**
2. **Each question carries 18.75 marks.**
3. **Preferably attempt all parts of a question together.**
4. **Please show all calculations as each step carries marks.**
5. **Use of scientific calculators is allowed.**

Physical constants

Atomic mass unit	:	1.66×10^{-27} kg
Planck's constant	:	6.626×10^{-34} J s
Velocity of Light	:	3×10^{8} m s^{-1}
Boltzmann constant	:	1.381×10^{-23} J K^{-1}
Mass of Electron	:	9.1×10^{-31} kg
Avogadro's number	:	6.023×10^{23} mol^{-1}
Nuclear magneton	:	5.047×10^{-27} J T^{-1}
Bohr magneton	:	9.274×10^{-24} J T^{-1}

1. (a) Giving reason, state which of the following are acceptable wave functions in the indicated interval: (i) sin x $(0, 2\pi)$, (ii) $e^x(-\infty, \infty)$, (iii) $\frac{1}{x}$ $(0, \infty)$

   (b) Showing relevant calculations arrange the following in order of increasing magnitude:
   $10\ cm^{-1}$, 1×10^{-23} J, 0.01 m, 1 MHz

   (c) Explain why only one absorption line could be observed in the vibrational spectra of a diatomic molecule. Illustrate your answer with a suitable diagram.

   (d) The electronic spectrum of a ketone shows the following two peaks:

λ_{max} /nm	280	190
ε at λ_{max} / L mol^{-1} cm^{-1}	15	100

   Identify the electronic transition for each peak with justification and compare the intensities of the two peaks.

(4.5, 4.75, 4.75, 4.75)

2. (a) Determine whether the following functions are eigen functions of the given operator. If so, evaluate their eigen values.

   (i) $\left(\frac{d^2}{dx^2} + 2\,\frac{d}{dx} + 3\right)\{\exp(ax)\}$

   (ii) $\nabla^2\{(\cos ax)(\cos by)(\cos cz)\}$

   (b) A particle of mass m exists in a one-dimensional box of length L. Find the probability of finding the particle in the range $0 \leq x \leq \frac{L}{4}$ for the states $n = 1$ and $n = 2$.

   (c) The microwave spectrum for the $^1H^{80}Br$ molecule is observed as a series of equally spaced lines separated by 16.92 cm^{-1}. Evaluate the bond length of this molecule.

   (d) What is the 'formal' selection rule for pure rotational Raman spectroscopy? Show that the Raman lines appear at wavenumbers given by $\bar{\upsilon} = \bar{\upsilon_0} \pm 4B\,(J + \frac{3}{2})$, where $\bar{\upsilon_0}$ corresponds to the wavenumber of the Rayleigh line. Draw the possible theoretical pure rotational Raman spectrum.

(4.5, 4.75, 4.75, 4.75)

3. (a) Show that operators corresponding to $\hat{\boldsymbol{x}}$ and $\hat{\boldsymbol{p}}_{\boldsymbol{x}}$ do not commute. Give the physical significance of your result.

   (b) Write the expression for the Hamiltonian operator for Li atom explaining all the terms involved. Write the modified Hamiltonian operator and the expression for the corresponding Schrodinger's equation after applying Born Oppenheimer approximation.

   (c) Arrange the following groups in the order of their increasing IR frequencies. Give justification.

   (i) C−F, C−Cl, C−Br, C−H (ii) C−C, C=C, C≡C

   (d) A molecule AB_2 has the following infrared and Raman spectra:

Wave number (cm^{-1})	Infrared	Raman
3756	Very strong	–
3652	Strong	Strong (polarized)
1595	Very strong	–

   Suggest the possible geometry of the molecule and assign the observed lines to the corresponding vibrations. Give suitable explanation for the assignment.

(4.5, 4.75, 4.75, 4.75)

4. (a) Draw the energy level diagram and explain bonding in the heteronuclear diatomic molecule HF.

(b) The ESR spectrum of atomic hydrogen was recorded on a spectrometer working at 9.302 GHz. The value of hyperfine coupling constant was found to be 50.7 mT. Find the value of the external applied magnetic field, *B* at which the two lines of atomic hydrogen will be observed. (g_e = 2.0023)

(c) Show that the separation between the maxima of the P and R branches of the vibrational-rotational spectra of heteronuclear diatomic molecules is given by: $\sqrt{\frac{8kTB}{hc}}$

(d) A monosubstituted aromatic compound with molecular formula C_9H_{12} gives four ^1H NMR signals (p_1-p_4). Their relative intensity ratios $p_1 : p_2 : p_3 : p_4$ are as follows:

5 (singlet) : 2 (quartet) : 2 (quartet) : 3 (triplet)

Suggest a possible structure of the molecule if δ values are in the order $p_1 > p_2 > p_3 > p_4$.

(4.5, 4.75, 4.75, 4.75)

5. (a) The normalized **1*s*** atomic orbital for the hydrogen atom is:

$\psi(r) = \frac{1}{\sqrt{\pi a_0^3}} \exp(^{-r}/_{a_0})$ where a_0 represents the Bohr radius.

Evaluate <***r***> for the electron in this orbital given that $\int r^n \exp(-ar)\, dr = \frac{n!}{a^{(n+1)}}$

(b) Consider the *FEMO* description of the linear butadiene molecule. What is the minimum excitation energy given that the average C−C bond distance is 140 pm. The β-carotene molecule which has a long-conjugated C−C structure is coloured. Explain this on the basis of the *FEMO* model.

(c) With the help of a diagram explain the difference between predissociation and dissociation.

(d) Evaluate the rotational energy corresponding to the rotational level with the maximum population $\boldsymbol{J_{max}}$**.** How can this expression be simplified if the rotational constant, *B*, is small? Suggest a reason for your answer.

(4.5, 4.75, 4.75, 4.75)

6. Write short notes on the following:
   (a) Configuration Interaction
   (b) Fluorescence and phosphorescence
   (c) Larmor precession and Larmor precessional frequency
   (d) Variation theorem

(4.5, 4.75, 4.75, 4.75)

Unique Paper Code : 32175912_OC

Name of the Paper : GE- Molecules of life

Name of the Course : General Elective: Chemistry for Honours Courses

Semester : I

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

Attempt any four questions

All questions carry equal marks

The question should be numbered in accordance to the number in the question paper

1. Write a short note on any three of the following
   (a) Merrifield Solid phase synthesis of peptides
   (b) Adenosine Triphosphate (ATP) as universal currency of cellular energy
   (c) Saponification value and iodine value
   (d) Glycolysis (6.25 X 3 marks)

2. (a) How will you differentiate between "holoenzyme and "Apoenzyme" ? (5 marks)
   (b) What are Phosphoglycerides ? Give their structural and biological significance. (5 marks)
   (c) What is enzyme inhibition ? Expain allosteric inhibition. (5 marks)
   (d) Write chemical name and systematic name of sucrose. (3.75 marks)

3. (a) Discuss Watson and Crick model of DNA. (5 marks)
   (b) Define Omega fatty acids. Mention their biological importance with appropriate example. (5 marks)
   (c) What are the limitations of open chain structure of glucose (5 marks)
   (d) What are zwitter ions? Define the isoelectric points of an amino acids (3.75 marks)

4. (a) Explain the steps involved in Kreb cycle (6 marks)
   (b) Discuss Edman degradation method for sequence analysis of polypeptides. Why is this method preferred over Sanger's method? (6.75 marks)
   (c) What happens when an aqueous solution of D-glucose is kept for some time? Name the phenomenon and discuss the mechanism involved (6 marks)

5. (a) Explain Primary, secondary, tertiary and quaternary structures of Proteins. (6 marks)
   (b) What is the effect of temperature and pH on the activity of enzymes? (5 marks)
   (c) What is fermentation? Illustrate the conversion of pyruvate to ethanol. (5 marks)
   (d) What is the difference between fat and oils? (2.75 marks)

6. a) Usually Ketones do not reduce Tollen's reagent and Fehing reagent but fructose give positive test with Tollen's reagent and Fehing reagent. Explain with chemical reactions involved. (6 marks)
   (b) How are anomers different from epimers. Give one example of each? (5 marks)
   (c) Explain the process of translation of DNA with the emphasis on the role of t-RNA and m-RNA. (5 marks)
   (d) Define calorific value of foodstuff? (2.75 marks)

[This Question paper contains 2 printed pages]

Roll No. ……

Sr No. of Question Paper :

Unique Paper Code : 32175917_OC

Name of the Paper : GE: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy

Name of the Course : Generic Elective: Chemistry for Honours

Semester : I

Duration : 3 hours Maximum Marks: **75**

Instruction for Candidates

1. Write your Course, Name, Roll No., Title of the paper and Unique Paper Code on top of the answer sheet.
2. Attempt **any two** questions from each section.
3. Each Question carries equal marks.
4. Upload your answer sheet in PDF format.

SECTION-A

Q1.

(a) Calculate the EAN number of $HMn(CO)_5$

(b) What happens when

(i) H_2O_2 is added to acidified solution of $K_2Cr_2O_7$ having some ether.

(ii) $K_4[Fe(CN)_6]$ is treated with $FeCl_3$.

(iii) Sodium sulphate solution is treated with sodium nitroprusside.

(c) In the molecular orbital diagram of carbon monoxide, why it acts as an electron donor and acceptor through carbon and not through oxygen?

(d) What do you understand by active transport and passive transport? Give example for active transport. **(0.75, 6,6,6)**

Q2.

(a) Predict the number of metal- metal bonds in Mn_2CO_{10}.

(b) Draw the structure of Ziese's salt and explain in detail.

(c) Why free Heme is oxidized but hemoglobin is not oxidized by dioxygen?

(d) Arrange the following species according to decreasing order of the CO stretching frequency and give reasons:

(i) $[V(CO)_6]^-$, $[Cr(CO)_6]$, $[Fe(CO)_6]^{2-}$

(ii) $[Mn(CO)_6]^+$, $[V(CO)_6]^-$, $[Cr(CO)_6]$ **(0.75, 6,6,6)**

Q3.

(a) Which is more basic towards proton $[Mn(CO)5]^-$ or $[Re(CO)5]^-$?

(b) Write short notes on the following:

(i) Synthesis of potassium dichromate

(ii) Chlorophyll

(iii) Essential and non-essential metal ions **(0.75, 6,6,6)**

SECTION B

(Attempt any Two Questions)

Q4. (a) Explain Claisen Ester Condensation with suitable example and the mechanism involved.

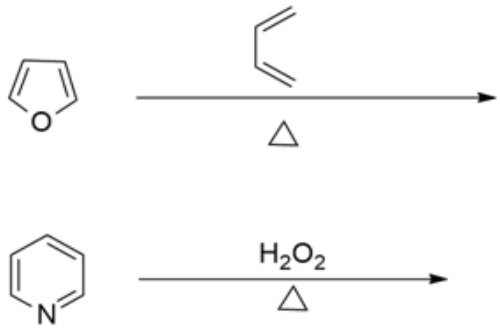
(b) How will you establish that naphthalene has two benzene rings which are orthofused ?

(c) Show all the possible electronic transitions diagrammatically in acetone.

(d) Nucleophilic substitution reactions in pyridine takes place at which position. Explain.

(6, 6, 0.75, 6)

Q5. (a) Complete the following reactions:



(b) Which among the following will have higher IR C=O vibrational frequency acetaldehyde or benzaldehyde?.

(c) Give the order of aromaticity of furan, pyrrole, thiophene and benzene with explanation.

(d) Synthesize the following using ethylacetoacetate as the starting material:

(i) Crotonic acid

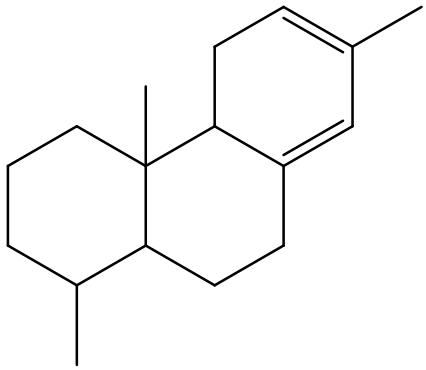
(ii) Pimelic acid

(iii) Hexane-2,5-dione

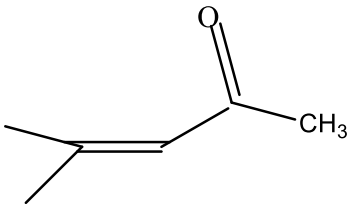
(**2, 0.75, 7, 9**)

Q6. (a) Define keto-enol tautomerism with suitable example?

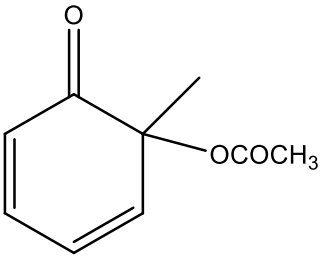
(b) Calculate λ_{max} for the following compounds:



Base value: 253 nm



Base Value: 215 nm



Base Value: 215 nm

(c) Explain different types of molecular vibrations of diatomic and triatomic molecules in IR spectroscopy. (**0.75, 12, 6**)

[This question paper contains 2 printed pages]

Unique Paper Code	:	**32175915_OC**
Name of the Paper	:	GE-3: Solutions, Phase Equilibrium, Conductance, Electrochemistry and Functional Group Organic Chemistry-II
Name of the Course	:	**General Elective: Chemistry for Honours Course**
Semester	:	I
Duration	:	2 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 Scientific calculators and log tables is allowed.
3. Use Separate sheets for **Section A** and **Section B**.

Section A
(Physical Chemistry)
Attempt any two questions in this section

Q. 1 Attempt the following questions briefly:

(a) What is the effect of adding succinic acid on the CST of phenol-water system? Explain with reasons. (3)

(b) Difference between a reversible and an irreversible cell. (3)

(c) What is electrode potential? Absolute value of electrode potential cannot be determined. Why? (3)

(d) Give conditions under which the distribution law is valid. (3)

(e) Determine the number of components, number of phases and degrees of freedom for the following system:

$$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$$ (3)

(f) What is the role of salt bridge in an electrochemical cell? (2.5)

(g) Define the term ionic mobility. (1.25)

Q. 2 (a) Write short note on any two:

(i) Liquid junction potential

(ii) Moving boundary method

(iii) Nernst distribution law

(b) State Kohlrausch's law of independent migration of ions. The molar conductances at infinite dilution of HCl, HNO_3 and $AgNO_3$ are respectively, 426.0 $\times 10^{-4}$, 421.0$\times 10^{-4}$ and 133.0$\times 10^{-4}$ Sm^2mol^{-1}. Specific conductance of AgCl in water is 2.68 $\times 10^{-4}$ Sm^{-1} and that of water is 0.86 $\times 10^{-4}$ Sm^{-1}. Calculate the solubility of AgCl in g/dm^3. Mol. wt. of AgCl is 143.5 g/mol.

(c) Draw and discuss the well labelled phase diagram of sulphur.

(d) Explain briefly the principle underlying potentiometeric titrations and its advantages over conventional volumetric titration. (6,4.75,4,4)

Q.3 (a) What are the advantages of conductometric titrations over conventional titrations? Draw and discuss the titration curves obtained in the conductometric titration of:

(i) strong acid with strong base

(ii) strong acid with weak base

(b) $2Fe^{3+}(aq) + Sn^{2+}(aq) \rightleftharpoons 2Fe^{2+}(aq) + Sn^{4+}(aq)$

Construct the electrochemical cell having the above cell reaction and calculate the equilibrium constant for the reaction at 25°C.

Given: $2Fe^{3+}(aq) + 2e^- \rightleftharpoons 2Fe^{2+}(aq)$ $E^\circ_{el} = +0.77$ V

$Sn^{4+}(aq) + 2e^- \rightleftharpoons Sn^{2+}(aq)$ $E^\circ_{el} = +0.15$V

(c) Derive the Clapeyron-Clausius equation in the form $dP/dT = \Delta H_v /(TV_g)$. Under what conditions can this equation be integrated and how?

(d) What are reference electrodes? Write the electrochemical reactions that takes place at calomel electrode. (6,4.75,4,4)

Section B
(Organic Chemistry)
Attempt any two questions in this section

Q.1 (a) An organic compound A with molecular formula $C_3H_6O_2$ turns blue litmus red and gives a positive $NaHCO_3$ test. On treatment with PCl_5, the compound A gives the compound B. B when treated with NH_3 forms C. On reaction with Br_2/NaOH, C gives the compound D with the molecular formula C_2H_7N.Identify A, B, C, D. Name the reaction involved in the conversion of C to D and also give the mechanism.

(b) Explain the Edman's method of NTAA determination of peptides using ala-val-gly as example. (12.75,6)

Q.2 Complete the following reaction, give the mechanism involved and mention the name reaction if any. (6.25x3)

(a) Aniline + Benzoyl Chloride $\xrightarrow{NaOH}$

(b) Benzaldehyde + Acetic anhydride $\xrightarrow{CH_3COONa/\Delta}$

(c) Ethylamine + $CHCl_3$+ 3KOH $\longrightarrow$

Q.3 Write short note (on any three)

(a) Solid phase peptide synthesis

(b) Amylose and Amylopectin

(c) Gabriel Phthalimide synthesis

(d) Reformatsky reaction (6.25x 3)

Unique Paper Code	**:**	**32175916_OC**
Name of the Paper	**:**	**GE- Chemistry of d-Block Elements and Quantum Chemistry & Spectroscopy**
Name of the Course	**:**	**Generic Elective: Chemistry for Honours courses**
Semester	**:**	**I/ III**
Duration	**:**	**3 Hours**
Max marks	**:**	**75**

Instruction for candidates

1. Attempt **three** questions from **Section A** and **three** questions from **Section B.**
2. The questions should be numbered in accordance to the number in the question paper.
3. Calculators and log tables may be used.

SECTION – A
INORGANIC CHEMISTRY

*Attempt any **THREE** questions.*

1. Give brief reasons for ***any five*** of the following:
   (a) Transition metals usually show variable oxidation states differing in units of one.
   (b) CrO is basic, Cr_2O_3 amphoteric and CrO_3 acidic.
   (c) $[Ti(H_2O)_6]^{3+}$ is violet in colour whereas TiO_2 is white.
   (d) The atomic radii of Zirconium and Hafnium are quite similar.
   (e) Lanthanides show sharp bands in the absorption spectra.
   (f) 4d & 5d transition elements form low spin complexes.
   (g) Ce^{4+} act as oxidizing agent whereas Eu^{2+} as reducing agent. (5x2½)

2.a) Give IUPAC names for the following (***any three***)
   (i) $[Co(H_2O)_2(NH_3)_4]Cl_3$
   (ii) $K_2[Ni(CN)_4]$
   (iii) $[Pt(NH_3)BrCl(NO_2)]^-$
   (iv) $Fe_4[Fe(CN)_6]_3$

b) Write the formulae of ***any two*** of the following:
   (i) Calcium trioxalatochromate(III)
   (ii) Diamminedichloridobis(methylamine)platinum(IV) chloride
   (iii) Tetraaquapalladium (II) tetrachloridopalladate (II)

c) Write all the possible geometrical isomers of the complex $[MA_2X_2]$, where A, neutral ligand and X, anionic ligand. How can you distinguish between them? (6, 4, 2½)

3.a) Write the type of isomerism in the following:

(i) $[Co(NH_3)_5SO_4]Cl$ and $[Co(NH_3)_5Br]SO_4$
(ii) $[Cr(NH_3)_5NO_2]Cl_2$ and $[Cr(NH_3)_5ONO]Cl_2$

b) For the complex ion, $[Fe(H_2O)_6]^{2+}$, the mean pairing energy P is found to be 17600 cm^{-1}, the magnitude of Δ_o comes out to be 10,500 cm^{-1}. Calculate the CFSE for the complex configuration corresponding to high spin and low spin states. In which of the two states is the complex likely to exist?

c) Explain on the basis of valence bond theory that $[Ni(CN)_4]^{2-}$ ion with square planar structure is diamagnetic and the $[NiCl_4]^{2-}$ ion with tetrahedral geometry is paramagnetic.

d) The crystal field stabilization energy, Δ_o for $[Cr(NH_3)_6]^{2+}$ is 10,200 cm^{-1} while for $[Cr(NH_3)_4]^{2+}$ is 5,900 cm^{-1}. (2, 4, 4, 2½)

4.a) Define Jahn-Teller theorem. Which of the following high spin complexes will be distorted: $[Cr(H_2O)_6]^{2+}$ or $[MnCl_6]^{2-}$.

b) The Latimer diagram for manganese in acidic solution is given below at 25°C.

Acid: $MnO_4^- \xrightarrow{+0.56} MnO_4^{2-} \xrightarrow{+2.26} MnO_2 \xrightarrow{+0.95} Mn^{3+} \xrightarrow{+1.51} Mn^{2+} \xrightarrow{-1.18} Mn$

(i) Calculate skip step emf value, $E^o\ MnO_2/Mn^{2+}$.
(ii) Will Mn^{2+} change to Mn under normal conditions?

c) Write short notes on the following (***any two***)
(i) Separation of lanthanides by ion-exchange method.
(ii) Spectrochemical series.
(iii) Inner and Outer Orbital Complexes (3, 4½, 5)

SECTION-B

PHYSICAL CHEMISTRY

*Attempt any **THREE** questions.*

Physical constants

Planck's Constant, h =6.626 x 10^{-34} Js
mass of electron = 9.1 x 10^{-31} kg
Velocity of light, c = 3 x 10^8 ms^{-1}
Avogadro's Number = 6.023 x 10^{23}
Atomic mass unit = 1.661 x 10^{-27} kg

5. a) Define eigen value and eigen functions. Is the function $\exp(-x^2/2)$ an eigen function of the operator d^2/dx^2? Give reason.

b) State and explain Lambert-Beer law. What are its limitations?

c) Derive an expression for J_{max} for an arbitrary rotationally active molecule. (4, 4, 4½)

6. a) Under what conditions is a molecule said to be IR active? Arrange the following functional groups in the order of their increasing vibrational frequency:

C–Cl, C–I, C–F, C–Br, C–H.

b) A molecule AB is undergoing rotational motion under the rigid rotator approximation. What is this approximation? Explain the effect of isotopic substitution on the rotational spectrum of a diatomic molecule.

c) For a particle of mass m in a 1-D box of length L having wave function,

$$\Psi = A \sin(\frac{n\pi x}{L})$$

i) Normalize the wave function and find the value of constant *A*.
ii) Write the units of wave function (4, 4, 4½)

7. a) Define quantum yield of a photochemical reaction. What are the reasons for low and high quantum yield in a photochemical reaction?

b) The absorption of IR radiation by $^{12}C^{16}O$ molecule shows an absorption band at 2140 cm^{-1}. Calculate the force constant and zero-point energy for C-O bond, assuming harmonic potential.

c) State and explain Frank Condon Principle. Discuss the electronic spectrum obtained in the following cases using appropriate energy diagrams:

i) when the equilibrium internuclear distance in the ground state and excited state are the same.

ii) when the equilibrium internuclear distance in the excited state is much larger than that in the ground state. (4, 4, 4½)

8. Write short notes on ***any five*** of the following:

a) Born-Oppenheimer approximation

b) Fluorescence

c) Hermitian operators

d) Chemiluminescence

e) Chromophores and Auxochromes

f) Primary and Secondary processes

g) Free electron model (5 × 2½)

SET-A

Unique paper code	:	32495902
Name of the paper	:	GE - Proteins and Enzymes
Name of the course	:	B.Sc. (Hons) Biochemistry-(LOCF)
Semester	:	III
Duration	:	4 hours (including the time for downloading Question paper and uploading answer sheet)
Maximum Marks	:	75

Instruction for candidates

*Attempt **ANY FOUR** questions.*
All questions carry equal marks.

1(A). Differentiate between the following:

i. Simple and Conjugated proteins
ii. Acid-base and Covalent catalysis
iii. Coenzyme and Cofactor

(B). What are chaperones and how do they help in protein folding?

(C). Give an account of diseases caused by misfolding of proteins.

(6, 6.75, 6)

2(A). Write a short note on protein sequencing by Edman degradation method.

(B). Discuss the various non-covalent interactions involved in stabilizing a protein structure.

(C). Write a short note on Ramachandran plot and explain why Glycine exists in all the four quadrants of the Ramachandran plot?

(6.75, 6, 6)

3(A). Explain the principle of the following protein separation techniques:

i. Ion-Exchange Chromatography
ii. Ammonium Sulphate fractionation
iii. Centrifugation

(B). Describe in detail the effect of pH and 2,3-BPG on the oxygen dissociation curve of haemoglobin.

(C). Justify the statement that fetal haemoglobin has higher affinity for oxygen than adult haemoglobin.

(9, 6, 3.75)

4(A). Write briefly about enzyme classification with examples

(B). Derive Michaelis-Menten equation and show under what conditions $K_m=V_{max}$.

(C). Explain the mechanism of action of chymotrypsin

(6, 7, 5.75)

5(A). Differentiate between competitive and uncompetitive inhibition of enzymes and explain with the help of Lineweaver-Burk plot.

(B). What is allosteric regulation? Justify that Aspartate transcarbamoylase is an allosteric enzyme.

(C). Discuss three ways in which enzymes can be regulated by covalent modification.

(6, 6.75, 6)

6(A). Write three applications of enzymes in each – research, diagnostics and therapy.

(B). What is enzyme immobilisation and write any two methods for enzyme immobilisation.

(C). Comment on multienzyme complex with an example.

(9, 5, 4.75)

Unique Paper Code	**:**	**32175916_OC**
Name of the Paper	**:**	**GE- Chemistry of d-Block Elements and Quantum Chemistry & Spectroscopy**
Name of the Course	**:**	**Generic Elective: Chemistry for Honours courses**
Semester	**:**	**I/ III**
Duration	**:**	**3 Hours**
Max marks	**:**	**75**

Instruction for candidates

1. Attempt **three** questions from **Section A** and **three** questions from **Section B.**
2. The questions should be numbered in accordance to the number in the question paper.
3. Calculators and log tables may be used.

SECTION –A

INORGANIC CHEMISTRY

Attempt any **THREE** *questions*.

1.a) Give IUPAC names for the following (***any four***).

(i) $Na_3[Ag(S_2O_3)_2]$

(ii) $Ca[Fe(NH_3)_2(CN)_4]$

(iii) $[Co(NH_3)_3][Co(CN)_6]$

(iv) $[CrClBr(NH_3)_2(en)]NO_3$

b) Write the formula for the following (***any two***)

(i) Tetraamminecopper(II) dicyanidoargentate (I)

(ii) Calcium chloridopentacyanidoferrate (III)

(iii) Bromidochloridobis(ethylenediamine)cobalt (III) sulphate

c) What are flexidentate and ambidentate ligands? Give one example of each. (6, 3, 3½)

2.a) For the complex ion, $[Cr(H_2O)_6]^{2+}$, the mean pairing energy, P is 24500 cm^{-1}, the magnitude of splitting parameter, Δ_o is 13800 cm^{-1}. Find the value of CFSE for the complex configuration in both high spin and low spin states. Explain, which would be more stabilized.

b) The magnetic moment for $[MnBr_4]^{2-}$ and $[Mn(CN)_6]^{3-}$ are 5.9 and 2.8 B.M. respectively. Give the geometry of each complex on the basis of V.B. theory.

c) Given below is the Latimer diagram of Mn in acidic medium:

Acid: $MnO_4^- \xrightarrow{+0.56V} MnO_4^{2-} \xrightarrow{+2.26V} MnO_2 \xrightarrow{+0.95V} Mn^{3+} \xrightarrow{+1.51V} Mn^{2+} \xrightarrow{-1.18V} Mn$

(i) Find out the oxidation states which undergo disproportionation.

(ii) Calculate E^o (MnO_2/Mn^{2+}).

(iii) Which species act as strongest reducing agent?

OR

What is Jahn-Teller Theorem? Giving suitable reason explain, which of the following complexes will be distorted: $(t_{2g})^6 (e_g)^3$, $(t_{2g})^6 (e_g)^2$ and $(t_{2g})^2 (e_g)^0$. (4, 4, 4½)

3.a) Which complex ion would show greater crystal field splitting and why?

i) $[Fe(CN)_6]^{2-}$ or $[Fe(CN)_6]^{3-}$

ii) $[CrCl_6]^{3-}$ or $[Cr(CN)_6]^{3-}$

b) Explain, the principle behind the separation of lanthanides by ion exchange method.

c) Why is the crystal field splitting in tetrahedral complexes, Δ_t is only 4/9 of corresponding splitting in octahedral field, Δ_o? (5, 3, 4½)

4.a) Give brief reasons for ***any four*** of the following:

(i) Ttrahedral complexes do not show geometrical isomerism.

(ii) $TiCl_3$(aq) is violet, while TiO_2 is white.

(iii) Both $[NiCl_4]^{2-}$ and $[ZnCl_4]^{2-}$ are tetrahedral but they differ in their magnetic behaviour.

(iv) Transition metals readily form alloys.

(v) Sc^{3+} salts are diamagnetic.

b) Ce^{4+} is a good oxidizing agent whereas Sm^{2+} is a good reducing agent. Explain. (10, 2½)

SECTION-B

PHYSICAL CHEMISTRY

*Attempt any **THREE** questions.*

Physical constants

Planck's Constant, h =6.626 x 10^{-34} Js
mass of electron = 9.1 x 10^{-31} kg
Velocity of light, c = 3 x 10^8 ms^{-1}
Avogadro's Number = 6.023 x 10^{23}
Atomic mass unit = 1.661 x 10^{-27} kg

5. a) Define eigen value. Which of these functions are eigen functions of d^2/dx^2 :

(1) sin 2x (2) ax^2

Give the eigen value wherever appropriate.

b) The rotational constant for $H^{35}Cl$ is 10.5909 cm^{-1}. Calculate the rotational constants for $H^{37}Cl$ and $^3T^{35}Cl$.(atomic mass of ^1H = 1.673 × 10^{-27} kg)

c) What do you understand by the term *quantum yield* of a photochemical reaction? Explain the reasons for low and high quantum yield in a photochemical reaction? (4, 4, 4½)

6. a) Find whether the position operator (x) and momentum operator (p_x) commute with each other or not. Interpret your result.

   b) Classify the following molecules into rotationally active/ inactive. Give reason in support of your answer.

   CO_2, CH_4, HCl, N_2

   c) What are symmetric and asymmetric stretching and bending modes? Illustrate taking H_2O molecule as an example. (4, 4, 4½)

7. a) State and explain the two laws of Photochemistry.

   b) Write the characteristics of an acceptable/ well-behaved wave function.

   c) A strong absorption band is observed for $^{12}C^{16}O$ in the IR region at 2170 cm^{-1}. Assuming harmonic potential, calculate:
   (i) vibrational frequency in Hz.
   (ii) vibrational time period in s.
   (iii) zero-point energy in J. (4, 4, 4½)

8. Write short notes on ***any five*** of the following:

   a) Frank Condon Principle

   b) Phosphorescence

   c) Hermitian operators

   d) Condition of normalisation

   e) Bathochromic and Hypsochromic shifts

   f) Photoelectric cell

   g) Born-Oppenheimer approximation (5 × 2½)

Unique Paper Code	: 32175912_OC
Name of the Paper	: GE- Molecules of life
Name of the Course	: General Elective: Chemistry for Honours Courses
Semester	: III
Duration	: 3 Hours
Maximum Marks	: 75

Instructions for Candidates

Attempt any four questions

All questions carry equal marks

The questions should be numbered in accordance to the number in the question paper

1. Write a short note on any three of the following (6.25 X 3)
(a) Replication of DNA
(b) Secondary structure of proteins
(c) Steroids and their biological functions
(d) Allosteric inhibition

2. Differentiate between the following 6.25X3
(a) Globular and fibrous proteins
(b) DNA and RNA
(c) Holoenzyme and Apoenzyme

3. (a) Draw the structures showing specific H-bonding between guanine and cytosine; and adenine and thymine. (6 Marks)
(b) On partial hydrolysis, starch gives two polysaccharides. Give the name of both the polysaccharides and describe how both the compounds are different structurally. (6 Marks)
(c) What do you understand by epimers. Write the name and structures of C-2 and C-4 epimers of glucose. (6.75 Marks)

4. (a) Draw the structures of any three of the following (6 Marks)
(i) β-D-fructofuranoside
(ii) 2'-deoxyadenosine
(iii) Oleic acid
(iv) Aspargine

(b) What are the various possible catabolic fates of pyruvates formed in glycolysis. (6 Marks)

(c) Outline the synthesis of a dipeptide; alanylvaline by conventional chemical synthesis method. (6.75 Marks)

5. (a) Calculate the isoelectric point of lysine (pka_1 =2.19; pka_2 = 8.95; pka_3 = 10.79). Write the structure of lysine at its isoelectric point. (6 Marks)

(b) Write the three irreversible steps in Kreb cycle. Give structure of the compounds involved and the enzyme for each step. (6 Marks)

(c) What is hydrogenation of oils. How this process is useful at industrial level. (3 Marks)

(d) How many molecules of phenyl hydrazine are involved in the formation of osazone of glucose. Write the structure of glucosazone. (3.75 Marks)

6. (a) What is iodine number. Calculate the iodine number of glyceryl trioleate having molecular weight 884 g. (Atomic mass of iodine = 127g). (6 Marks)

(b) A tripeptide on partial hydrolysis gave two dipeptides containing Val, Ala and Tyr, Ala respectively. Treatment of Val, Ala with DNFB gave N-labelled valine and treatment of Tyr, Ala gave N-labelled Alanine. What is the sequence of amino acids in the tripeptide. (6 Marks)

(c) Write one example of each omega-3 and omega-6 fatty acids. (3 Marks)

(d) What are coenzymes. Explain their role in biological reactions with a suitable example. (3.75 Marks)

Unique Paper Code	: 32175912
Name of the Paper	: GE- Molecules of life
Name of the Course	: General Elective: Chemistry for Honours Courses
Semester	: I/ III
Duration	: 3 hours
Maximum Marks	: 75

Instructions for Candidates
Attempt all four question.
All question carry equal marks.

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

   (b) What are polysaccharides? What is the structural difference between starch and cellulose?
   (c) Explain Edman degradation method for the determination of N-terminal amino acid peptide.
   (d) Differentiate between anomers and epimers giving example?
   (e) Maltose and Sucrose are disaccharides, but sucrose is non reducing while maltose is not? Explain (4,4,4,3,3.75)

2. (a) Synthesize dipeptide Ala-Val by using t-BOC and DCC. Give the name and structure of protecting and activating groups.
   (b) Draw Haworth projection for: β-D-Glucopyranose and α-D-Fructofuranose.
   (c) Define isoelectric point. Calculate isoelectric point (pI) of valine. (pKa_1=2.32, pKa_2=9.62).
   (d) Outline the reactions of Krebs' cycle and give an account of the total ATPs generated.

   (6.75,4,2,6)

3. (a) Differentiate between (any three):
      (i) Nucleosides and Nucleotides.
      (ii) α-helix and β-pleated structure of protein.
      (iii)Competitive and non-competitive enzyme inhibition.
      (iv) Lecithins and Cephalins (3×3)
   (b) Write a short note on Merrifield solid phase synthesis.
   (c) Explain Chargaff's Rule. What is its significance? (6,3.75)

4. (a) Write the structures showing specific hydrogen bonding between the following pairs of base in nucleotides (i) Thymine and Adenine (ii) Guanine and Cytosine
   (b) Define iodine value of oil and what does iodine value indicate?
   (c) How does structure of DNA differ from RNA?
   (d) Differentiate between fats and oils, waxes.
   (e) What is denaturation of proteins? Explain what happens during denaturation?

(4,4,4,3,3.75)

5. (a) Outline the complete reactions with enzymes to show pyruvate is converted to the following:
      (i) Acetyl CoA
      (ii) Ethanol
   (b) What is the role of cholesterol in the body?
   (c) Name the different types of RNA and their biological roles?
   (d) Differentiate between fibrous and globular proteins.

(6, 3.75, 6, 3)

6. (a) A tetrapeptide on partial hydrolysis gave following dipeptides. Determine the structure and name of tetrapeptide by overlapping method.
      Ala-Gly + Gly-val + Leu-Ala
   (b) Draw structure of any three of the following:
      (i) ATP
      (ii) Cholesterol
      (iii) ω-3 fatty acid
      (iv) Deoxycitidine
   (c) Give the reaction pathway of conversion of glycerol to glyceraldehyde-3-phospahte after it is obtained during catabolism of fats.
   (d) Explain the terms Apoenzyme, Holoenzyme and Coenzyme.

(3, 3, 6.75, 6)

[This Question paper contains 2 printed pages]

Roll No. ……

Sr No. of Question Paper :

Unique Paper Code : 32175917

Name of the Paper : GE: Organometallics, Bioinorganic Chemistry, Polynuclear Hydrocarbons and UV, IR Spectroscopy

Name of the Course : Generic Elective: Chemistry for Honours

Semester : III

Duration : 3 hours Maximum Marks: 75

Instruction for Candidates

1. Write your Course, Name, Roll No., Title of the paper and Unique Paper Code on top of the answer sheet.
2. Attempt **any two** questions from each section.
3. Each Question carries equal marks.
4. Upload your answer sheet in PDF format.

SECTION-A

Q1.

(a) Is $B(OCH_3)_3$ considered as an organometallic compound?
Calculate Effective Atomic Number for the following compounds
(i) Fe2(CO)9
(ii) [Mn(CO)5(η2-C2H4)]
(iii) [Cr(η6-C6H6)(CO)2]

(b) Give the steps involved in the preparation of K2Cr2O7 from chromite ore of chromium.

(c) How does Na-K pump works? (0.75,6,6 6)

Q2.

(a) What is the magnetic behaviour of potassium ferrocyanide?

(b) Explain the synergistic effect in metal carbonyls diagrammatically. Give examples.

(c) How will you explain the binding of oxygen by hemoglobin by considering the change in magnetic behaviour of iron(II) in hemoglobin and oxyhemoglobin?

(d) Explain and draw the structure of methyl lithium. (0.75,6,6 6)

Q3.

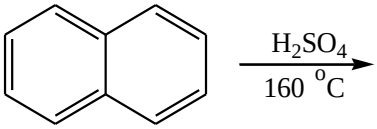
(a) Transition elements have variable oxidation states. Why?

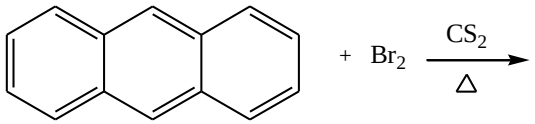
(b) Give stepwise description of the preparation of potassium permanganate.

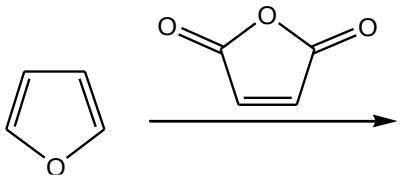
(c) On the basis of VBT, predict the shape of Cr(CO)6 which is found to be diamagnetic. Carbon monoxide acts as an electron donor and acceptor through carbon and not through oxygen in MOT. Justify? (0.75,6,6 6)

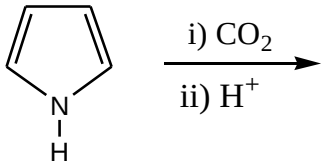
SECTION B
(Attempt any twoquestions)

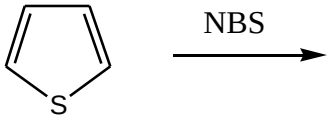
Q4. a) Complete the following reactions:

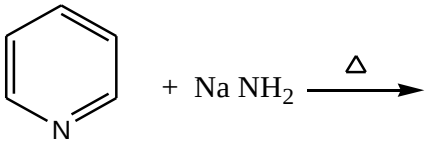
(i) 

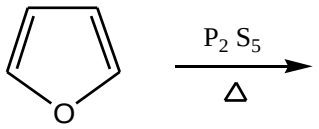
(ii) 

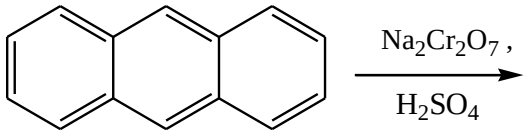
(iii) 

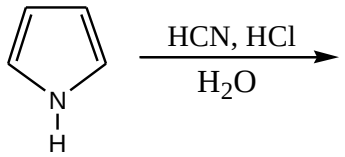
(iv) 

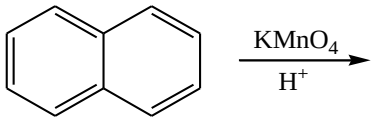
(v) 

(vi) 

(vii) 

(viii) 

(ix) 

(x) 

b) Write a short note on keto-enol tautomerism.

c) Differentiate between bathochromic effect and hypsochromic effect.

d) What are the limitations of Beer Lambert law?

(10, 4, 3, 1.75)

Q5. a) Starting with ethylacetoacetate synthesize the following compounds:

i) 3-ethyl pentane-2-one

ii) Butanone

iii) Cinnamic acid

iv) Succinic acid

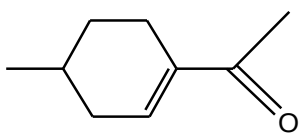
b) Give the preparation of naphthalene using Haworth's synthesis.

c) Why does a conjugated diene absorb at higher wavelength as compared to a diene with isolated double bonds?

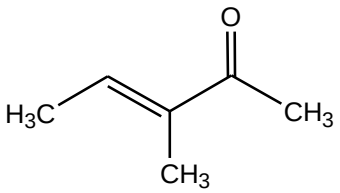
d) Give the order of reactivity of 5-membered heteroaromatic compounds for the substitution reactions.

(10, 4, 3, 1.75)

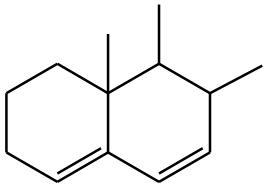
Q6. a) Calculate λ_{max} for the following compounds:

(i) 

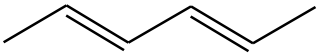
Base value = 215

(ii) 

Base value = 215

(iii) 

Base value = 215

(iv) 

Base value = 217

b) Explain the mechanism for the self-condensation reaction of ethyl acetate giving ethylacetoacetate as product.

c) Differentiate the following compounds based on only IR spectroscopy?

(i) *o*-hydroxybenzoic acid and *p*-hydroxybenzoic acid

(ii) maleic acid and fumaric acid

d) Give the increasing order of aromaticity in pyrrole, thiophene, furan and benzene. (Reason is not required).

(10, 4, 4, 0.75)

Unique Paper Code	:	32175901_OC
Name of the Paper	:	GE-1 Atomic Structure, Bonding, General Organic Chemistry & Aliphatic Hydrocarbons
Name of the Course	:	General Elective: Chemistry for Honours Courses
Semester	:	III
Duration	:	3 hours
Maximum Marks	:	75

Instructions for Candidates

Attempt any two questions from Section A and two questions from Section B.

SECTION A
(INORGANIC)

1 (a) Write Schrodinger's Wave Equation for single electron system explaining the terms involved in it.

(b) State and explain Hund's Rule. Write electronic configuration of Cr(24) and Ag(47).

(c) Draw radial probability distribution curve for 3s, 3p and 3d orbitals.

(d) Which of the following are permissible and why: 5g, 6h, 3d, 1p

(e) Why is 1s orbital spherically symmetrical?

(4, 4, 4, 4, 2.75)

2 (a) Write a short note on Fajan's rule.

(b) Calculate the lattice enthalpy of KBr. Given :

Enthalpy of sublimation for K = 8.24 KJ/mole, Enthalpy of dissociation of Bromine = 193 KJ/ mole, Ionization energy of K = 419 KJ/mole, Electron gain enthalpy of Bromine = -325 KJ/mole, Enthalpy of formation of KBr = -394 KJ/mole.

(c) Identify hybridization and discuss geometry of the following molecules (any two)

i) PCl_5

ii) XeF_6

iii) NH_4^+

(d) Draw MO Diagram of O_2 or CO. Write its bond order and magnetic property.

(e) Give reason why KI is soluble in ethyl alcohol whereas KCl is insoluble.

(4, 4, 4, 4, 2.75)

3 (a) i) Calculate the percent ionic character of HCl. Given that the observed dipole moment is 1.03 D and bond length of HCl is 1.275 Å.

ii) Why $BeCl_2$ has zero dipole moment while H_2S has some value?

(b) Using VSEPR theory, discuss the shapes of the following species (any two):

i) SF_4

ii) CO_3^{2-}

iii) XeF_6

iv) PCl_5

(c) Explain normalization and orthogonality of wave function.

(d) Write Pauli's exclusion principle. Why a maximum of two electrons can occupy the same orbital?

(e) Define Bent's rule. How does it help to decide the bond angles of CH_2F_2?

(4, 4, 4, 4, 2.75)

SECTION B
(ORGANIC)

Q.1 (a) Explain why peroxide effect is observed only in HBr and not in HF, HCl or HI ?

(b) What are carbanions? Discuss their structure and stability.

(c) Arrange the following in increasing order of acidic strength, give reason:

CH_3COOH, $CH_2ClCOOH$, $CHCl_2COOH$, CCl_3COOH

(d) Why is chair conformation of cyclohexane more stable than boat conformation ?

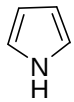
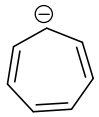
(e) Why alkynes are less reactive than alkenes towards electrophilic addition reaction?

(4, 4, 4, 4, 2.75)

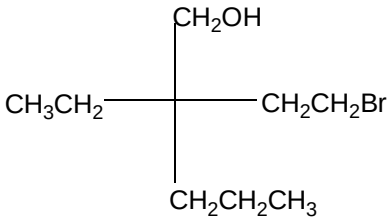
Q.2 (a) Draw Newman projection for different conformations of butane. Which of the conformation is more stable and Why?

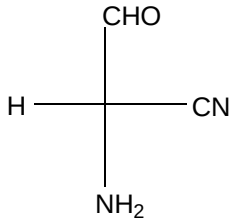
(b) Draw the Fischer Projection for all possible stereoisomers of 2,3-dibromobutane and give their relation amongst each other.

(c) Define aromaticity. Which of the following compounds are aromatic & why ?

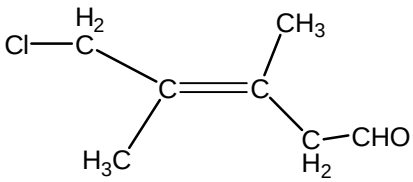
(i)  (ii)  (iii)  (iv) 

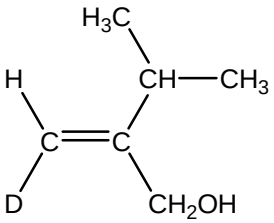
(d) (1) Assigning priority order, explain how you will designate R/S to the following :

(i) 

(ii) 

(2) Assigning priority order, explain how you will designate E/Z to the following :

(i) 

(ii) 

(e) What is Saytzeff's rule ? Explain with suitable example. (4, 4, 4, 4, 2.75)

Q.3 (a) Write short note of the following:

(i) Enantiomers and Diastereoisomers

(ii) Oxymercuration and demercuration reaction

(iii) Wurtz reaction

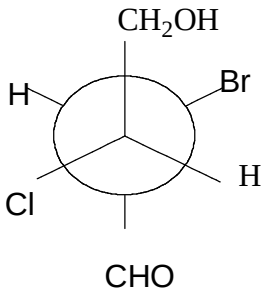
(iv) Racemic and meso compounds

(b) Discuss the trans addition of bromine to ethylene with mechanism.

(c) Arrange the following carbocations in increasing order of stability. Give reasons for their stability:

$(CH_3)_2HC^+$, $CH_3H_2C^+$, $(CH_3)_3C^+$, $^+CH_3$

(d) Convert the following Newman projection in to sawhorse and Fischer projection:



(8, 4, 4, 2.75)

32175915 III Set A Solution, Conductance, Electrochemistry and Functional Group Generic Elective

Name of Course	: General Elective: Chemistry for Honours Courses
Semester	:III
Name of the Paper	:GE-3: Solutions, Phase Equilibrium, conductance, Electrochemistry and Functional Group Organic Chemistry-II
Unique Paper Code	:32175915_OC

Maximum Marks: **75**

Instructions for Candidates:

- Use separate answer sheets for **Section – A** and **Section – B**.
- Both sections carry equal marks.
- Attempt **four** questions in all, **two** questions from each section.
- Each question carry **18.75** marks further, equally distributed among each parts.

Section A: Physical Chemistry

(Attempt any two questions)

Q. 1 Explain the following:

a) In phase diagram of water, the fusion curve is inclined towards pressure axis.
b) Equivalent conductance increases while conductivity decreases with dilution of solution of electrolyte.
c) KCl salt bridge used to eliminate liquid junction potential.
d) Limitations of quinhydrone electrode.

Q. 2

a) Draw and discuss the well labelled phase diagram of Sulphur.
b) What are azeotropic mixtures? Is it possible to separate the components of an azeotropic mixtures using distillation? Explain.
c) Discuss Nernst Distribution law and its limitations.

Q. 3

a) Define transference number and explain any one method to determine it.
b) Calculate the E_{red} of the following electrode: Pt | Cl_2 (1.5 atm) | $2Cl^-$ (0.01 M) where $E°_{Cl2|2Cl^-} = 1.36$ V.
c) Calculate the solubility product of AgBr in water at 298 K from the electrochemical cell:

$$Ag \mid AgBr_{(satd.\ soln.)} \mid AgBr_{(s)} \mid Ag$$

The standard potentials are $E°_{AgBr,\ Ag} = 0.07$ V ; $E°_{Ag^+,\ Ag} = 0.80$ V

Section B: Organic Chemistry

(Attempt any two questions)

5. a) What happens when benzaldehyde is heated with acetic anhydride in the presence of sodium acetate? Name this reaction and give mechanism.

   b) Giving reasons, arrange the following in increasing order of reactivity towards nucleophilic substitution reactions:

   CH_3COCl, CH_3COOCH_3, $(CH_3CO)_2O$, CH_3CONH_2

   c) Give the mechanism of alkaline hydrolysis of ester. Why alkaline hydrolysis is generally preferred over acidic hydrolysis?

   d) A white solid organic compound A, C_7H_7NO when heated with aq. NaOH solution forms B with the evolution of a pungent smelling gas. A also undergoes reaction with Br_2 in the presence of KOH to form a compound C. Compound C is soluble in conc. HCl solution. Deduce the structure of A, B and C.

6. a) Give a visible test (with equations) to distinguish between
   i) Aniline and methylamine
   ii) Ethylamine and diethylamine
   iii) Aniline and N-methylaniline

   b) Arrange the following in increasing order of basic strength giving proper justification.

   NH_3, CH_3NH_2, $(CH_3)_2NH$, $(CH_3)_3N$ (in polar solvent like ethanol)

   c) How D-arabinose can be converted into D-glucose? Clearly write all the steps involved.

   d) Write a short note on merrifield solid phase synthesis of polypeptide emphasizing its advantages over solution/liquid phase synthesis.

7. a) Give an overview of primary, secondary, tertiary and quaternary structure of proteins.

   b) Sucrose and lactose both are disaccharide but sucrose is a non-reducing sugar while lactose is a reducing sugar. Explain on the basis of their structures.

   c) Give the chemistry of ninhydrin test used for the detection of amino acids in laboratory?

   d) Write the structures of products in the following reactions:
   i) Glucose + $Br_2/H_2O \rightarrow$?
   ii) Glucose + conc. $HNO_3 \rightarrow$?
   iii) Glucose + $PhNHNH_2$ (excess) $\rightarrow$?

Unique Paper Code	:	32175913
Name of the Paper	:	GE-4: Chemistry of s-and p-block elements, States of Matter and Chemical Kinetics
Name of the Course	:	General Elective: Chemistry for Honours Course
Semester	:	I/III
Duration	:	3 hours
Maximum Marks	:	75

Instructions for candidates

Write your roll no. on the top immediately on receipt of this question paper.

Section A and B are to be attempted on separate answer sheets.

Indicate the section at the top of the answer sheet.

All questions carry equal marks.

Use of Scientific calculator and logarithm tables are allowed.

Section A

(Inorganic Chemistry)

Attempt any 2 questions from this section.

1. Attempt all parts:

a) Define ionization energy. What are the factors affecting it? [4]

b) What is an electron deficient compound? discuss the structure of diborane. [4]

c) Draw the structure of Caro's and Marshall's acid and suggest one reaction by which the two acids can be distinguished from each other. [4.75]

d) Arrange the following sets of cations in order of increasing radii: [3]

i. Li^+, Rb^+, Cs^+, Na^+, K^+

ii. Na^+, Mg^{2+}, Al^{3+}

iii. Na^+, Cs^+, Be^{2+}, Ga^{3+}

e) Arrange the following sets of anions in order of increasing radii: [3]

i. F^-, I^-, Cl^-, Br^-

ii. O^{2-}, N^{3-}, F^-

iii. S^{2-}, Cl^-, P^{3-}

2. a) Many metal oxides are reduced by carbon, if required temperature is provided. Explain it with the help of Ellingham diagram. [4.75]

b) Write notes on any two of the following: [4, 4]

i. Mond's Process for extraction of Nickel

ii. Zone Refining process

iii. Calcination and Roasting

c) Why do the periods in the periodic table have different number of elements? [3]

d) Account for the fact that the ionic radius of K^+ is smaller than that of Cl^- even though they are isoelectronic. [3]

3. a) What is inert pair effect? Explain with suitable examples. [4.75]

b) What does the first member of each group show anomalous behaviour. Explain by taking lithium as an example. [4]

c) Arrange the following oxo acids: HClO, $HClO_2$, $HClO_3$, $HClO_4$ in the increasing order of their oxidizing power & Justify the order. [4]

d) Arrange the following species in order of increasing size: [3]

i. Si, P, S, Cl

ii. Ca^{2+}, Cl^{2-}, S^{2-}, K^+

iii. F+, Mg^+, Na^+, O^{2-}

e) Alkaline earth metal in aqueous medium are as strong reducing agents as the alkali metals. [3]

Section - B

(Physical Chemistry)

Attempt any 2 questions from this section.

$R = 8.314\ J\ K^{-1}\ mol^{-1}$ $k = 1.381 \times 10^{-23}\ J\ K^{-1}$ $N_A = 6.023 \times 10^{23}$

1. Explain the following:

a) The positions of hydrogen atoms cannot be deduced from X-ray diffraction. [3]

b) Glycerol has higher coefficient of viscosity than ether/water. [3]

c) The higher order reactions are rare? [3]

d) Discuss the effect of temperature on surface tension of water. [3]

e) What do you mean by the defects in crystals? Explain with one example. [3]

f) Explain the term mean free path? What is the effect of temperature and pressure on mean free path? [3.75]

2. a) Derive the Bragg's equation: $n\lambda = 2d \sin \theta$ for the reflection of X-rays from the face of a crystal and show that it can be written as: $\lambda = 2d_{hkl} \sin \theta$. [6]

b) At 20°C time taken by equal volumes of water and toluene to flow through a capillary tube are 102 and 69 seconds, respectively. Densities of water and toluene are 998 and 866 kg m^{-3}. Viscosity of water at this temperature is 1×10 N m^{-2} s. What is the value of absolute viscosity of toluene? [4]

c) What is the half-life (in minutes) of the first order reaction having rate constant of 1.98×10^{-3} s^{-1}? [2]

d) Define Critical Constants Tc, Vc, and Pc. Derive the expressions for the Vander Waal's constant a and b in terms of critical constants. [6.75]

3. a) Starting with postulates of Kinetic theory of gases derive the kinetic gas equation. [6]

b) Define surface Tension. What is its SI unit? Why do certain liquids fall and rise in the capillary tube? [6]

c) Define law of rational indices. [3]

d) The rate constant of a reaction at 303 K is 1.2×10^{-3} s^{-1} and at 313 K is 4.8×10^{-3} s^{-1}. Find the energy of activation of the reaction. [3.75]

Your Roll No: ……..

S. No. of Question Paper :

Unique Paper Code : 32175903

Name of the Paper : GE-Green Chemistry: Designing Chemistry for Human Health and Environment

Name of the Course : Generic Elective for Honours: Chemistry

Semester : I/III

Duration: 3 hours **Maximum Marks: 75**

Instructions for Candidates:

(i) Attempt any FOUR questions

(ii) All questions carry equal marks

1. (a) Describe some problems caused by chemical waste.

(b) Explain the following two green chemistry principles with the help of examples.

(i) Use renewable feedstocks

(ii) Avoid chemical derivatives.

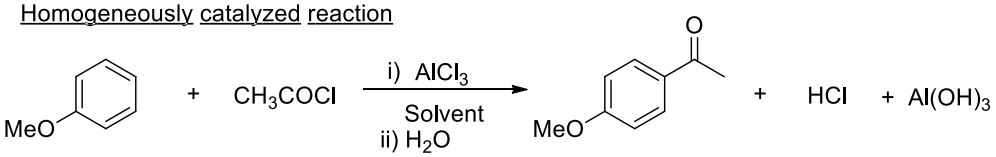
(6.75, 12)

2. (a) What are catalysts? Explain why catalyst is important in green chemistry.

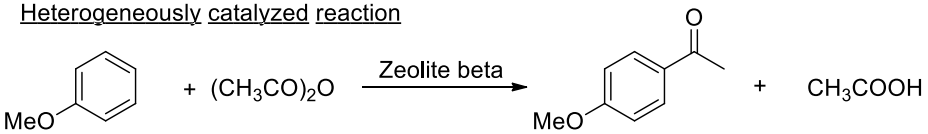
(b) Differentiate between heterogeneous and homogeneous catalysis.

(c) Discuss and compare the following two catalyzed reactions in green chemistry point of view.

Homogeneously catalyzed reaction

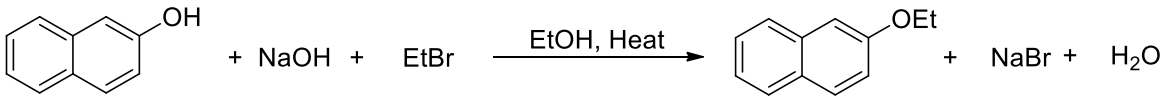


Heterogeneously catalyzed reaction



(6, 6, 6.75)

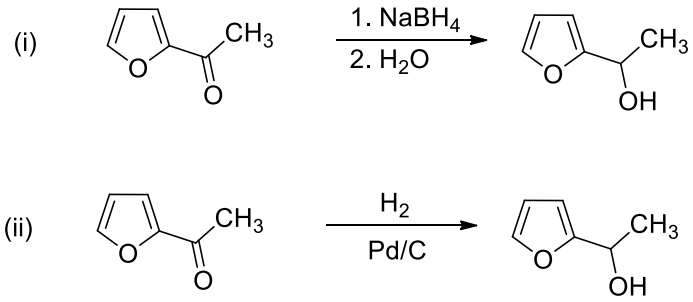
3. (a) Calculate the percentage intrinsic, and experimental atom economy, yield, overall reaction efficiency and E-factor for the reaction given below.



2.0 g 1.1 g 2.3 g 2.2 g

(Atomic Mass: C = 12.01, H = 1.01, O = 16.00, Na = 22.99, Br = 79.90)

(b) Explain which is a greener route to synthesis the following compound from a green chemistry viewpoint.



(12, 6.75)

4. (a) Explain the various inorganic water pollutants. Give examples with side effects of inorganic pollutants.

(b) What is photooxidation technology? How it is used in waste water treatment? Write the general mechanism of photooxidation by TiO_2 in waste water treatment.

(c) Explain the biological water pollution with examples.

(5, 8.75, 5)

5. (a) What is bio-based economy? Why is it important?

(b) Explain the conventional and green synthesis of Ranitidine drug. Write the advantages of green procedure.

(c) Who was the recipient of the Green Chemistry Challenge Awards in 2019 under category 2, "Greener Reaction Conditions"? Write the summary of the technology developed under this category.

(4, 8.75, 6)

6. Write short notes on the following:

(a) Industrial case study of Celecoxib

(b) Phase transfer catalyst in pharmaceutical industries

(c) Circular economy and its importance.

(8.75, 5, 5)

[This question paper contains 2 pages]

Your Roll No. : …….

Sl. No. of Q. Paper :

Unique Paper Code : **32173912_OC**

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

Name of the Paper: SEC: Fuel Chemistry

Semester : III

Time : 3 Hours **Maximum Marks : 38**

Instructions for Candidates

This question paper contains **4** questions.

Attempt **2** questions in all.

1. Write short notes on the following:
   (a) Aniline point.
   (b) Non fuel coal
   (c) Water gas
   (d) Producer gas.
   (e) Cetane number
   (f) Propylene oxide

   $2.5 \times 6 = 15$ marks

   (g) Fractional distillation

   4 marks

2.
   (a) Describe the different anti-knocks used for petrol and diesel engines with examples.

   4 marks

   (b) What are the salient features of synthetic lubricants?

   3 marks

   (c) What is the Otto Hoffmann method of formation of metallurgical coke? Explain.

   4 marks

   (c) What do you mean by proximate analysis of coal?

   4 marks

   (d) What do you mean by HCV and LCV of a fuel? Derive the expression of HCV and LCV of a fuel using bomb calorimeter.

   4 marks

3.
   (a) What are the uses of butadiene and isoprene? Explain in detail.

   3 marks

   (b) Describe the working of a four-stroke petrol engine with a neat diagram.

   4 marks

(c) Describe the industrial manufacturing of water gas using diagrams.

4 marks

(d) What do you understand by the term 'Reforming'? Explain in detail the different types of Reforming used industrially.

4 marks

(e) What are the fuels derived from waste? Explain their potential as future fuels.

4 marks

4.

(a) Describe the working of redwood viscometer in detail.

4 marks

(b) Why is coke but not coal used as a fuel in metallurgical process?

3 marks

(c) How is the coal liquefaction process carried out? What are its advantages and disadvantages?

4 marks

(d) What is Beehive's oven method?

4 marks

(e) What is a Boy's gas calorimeter? Explain its working using a proper diagram.

4 marks

SET II

Roll No……..

S. No. of Question Paper :

Unique Paper Code : **32173909**

Name of the Paper : **Pharmaceutical Chemistry**

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

Semester : III

Duration: 1.30 Hours Maximum Marks: 38

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper
2. Attempt any **two** questions

1. Answer the followings

(i) Differentiate between Narcotic and Non-narcotic analgesics with examples? (4)

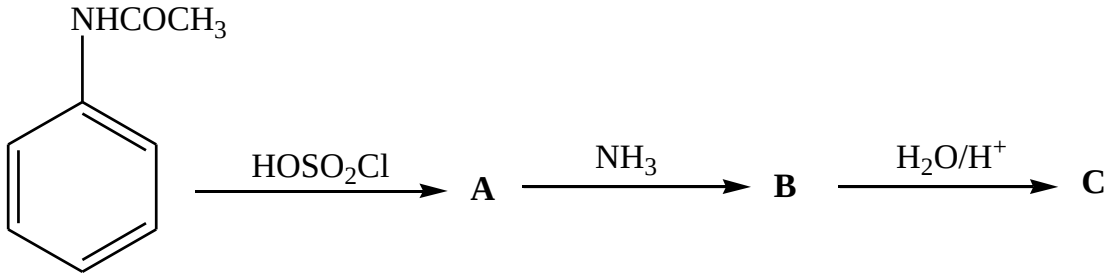
(ii) What do you understand the term 'Pharmacophore'? (3)

(iii) How gelatin and natural colours are used as pharmaceutical aids? (3)

(iv) What are the medicinal uses of phenobarbitone? Give its structure? (3)

(v) Discuss the causes of side effects of cetirizine and ibuprofen? (3)

(vi) Complete the following reaction: (3)



2 (i) Write down the laboratory preparation of aspirin with its uses and adverse effects? (5)

Or

Give the laboratory preparation of acyclovir with its uses and adverse effects?

(ii) Discuss with suitable examples the importance of the following in relation to biological activity of drugs: (3x2)

(a) Stereoisomerism

(b) Bioisosterism

(iii) Explain Retrosynthetic approach in drug discovery. Write down retrosynthesis of paracetamol? (5)

(iv) Discuss the production of ethyl alcohol using fermentation process? (3)

3 (i) Write down short note on the followings: (3x3)

(a) Drug Discovery

(b) Hypnotics

(c) Sedative

(ii) Name of microorganism used in preparation of the following: (1x4)

(a) Ethanol (b) Lysine (c) Streptomycin (d) Citric acid

(iii) How classified the drugs and what is the role of SAR studies in drug development? (4)

(iv) What is the meaning of 'High Therapeutic Index'? (2)

4 (i) How fermentation could be useful for the industrial production of Vit-B_2? (5)

(ii) Define following terms with suitable examples: (2x3)

(a) HIV-AIDS

(b) Analgesic

(iii) How target specificity and selectivity is a crucial factor in modern medicinal chemistry? (4)

(iv) Differentiate between narrow-spectrum and broad-spectrum antibiotics? (4)

Unique Paper Code	: 32173904
Name of the Paper	: SEC: Chemoinformatics
Name of the Course	: B.Sc. (H) Chemistry/ B.Sc.(Prog)
Semester	: III/V
Duration	: 1hour 30 minutes
Maximum Marks	: 38

Instructions for Candidates

1. Answer **three questions** in all.
2. **Question No. 1 is compulsory**. Attempt two from the rest
3. Each part of the rest of the questions carries 4 marks.
4. Attempt all parts of a question together.

1. Answer the following:

   a) Differentiate between Cheminfomatics and Bioinformatics. (3)

   b) How is a 0D QSAR different from 3D QSAR? (3)

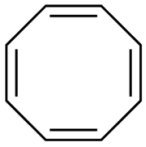
   c) In the Principal Component Analysis, how are the number of Principal components calculated? (3)

   d) Deabbreviate the following:

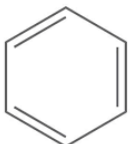
   (i) QSPR (ii) TPSA (iii) IC_{50} (iv) .sdf (3)

   e) What are connection tables used for? List any two features. (2)

2. a) Draw the Ullmann (Adjacency) Matrix for :



(i) Cyclooctatetraene



(ii) Benzene

b) Write down the SMILE code for the following molecules:

(i) 5-amino-4 methylpentanamide

(ii) Dinitrogen,

(iii) Methyl isocyanate,

(iv) Dimethyl ether

c) Explain the importance of CT files with the help of suitable examples.

3. a) The MOL file is a widely-used chemical structure file format. Give a brief description of its structural representation.

b) Explain the significance of geometry optimization. How is it different from the cleaning of the structure?

c) How is quantification of toxicity done in drug discovery process?

4. a) Explain the term 'log P'. How does log P value influence the following:

(i) Binding of enzyme and receptor
(ii) Aqueous solubility
(iii) Absorption through memberane
(iv) Binding to blood to tissue proteins
(v) Binding to heart ion channel

b) A 33 year old man weighing 55 Kg took **six** 300 mg pills of Chloroquine without consulting a doctor. If the Oral LD_{50} value for rats is 330 mg/kg, calculate the lethal dose for the man. What are the chances of his survival?

c) Give a brief explanation of any two of the followings:

(i) Charge-related Topological Index (CTI)
(iii) Wiener index
(iv) AutoNom

Sr. No. of Question Paper: …… **Roll No.** …….

Unique Paper Code : **32173906_OC/42173910_OC**

Name of the Paper : SEC – Intellectual Property Rights (IPR)

Name of the Course : **B.Sc. (Hons.) Chemistry/B.Sc. Physical Science/ B.Sc. Life Science**

Semester : III/V

Duration: 3 Hours Maximum Marks: 75

Instruction for Candidates:

- Attempt **Four** questions in all
- Question 1 carries 21 marks and rest of the questions carry 18 marks each

1. (a) List all the types of Intellectual Property Rights on which protection is available. Write the act with year under which patent, copyright and trademarks are protected in India.
   (b) Giving explanation correlate the following with various IPRs:
   i. Kohlapuri Chappal
   ii. SONY LED TV
   iii. A ball pen with a golden nib
   iv. 'Tom and Jerry' series
   v. Use of ginger and honey for cough
   vi. A new chemical compound for treating a disease

   (9, 12)
2. (a) What are the advantages of filing an international patent application through PCT? Define prior art in relation to patents.
   (b) How does patents help in the growth of a country? Explain 'Patents are negative rights. What is compulsory licensing, give an example?

   (9, 9)
3. (a) Describe the important requirements for copyright protection. List and give an example of the rights protected under copyright?
   (b) Which of the following are allowed under copyright law and under what conditions:
   i) Translating a published book
   ii) Sound recording of any musical work
   iii) Using content of a book for teaching or research
   iv) Drawing a picture from another picture

   (10, 8)
4. (a) Differentiate 'deceptiveness' and 'distinctiveness' in relation to Trademarks. Can the following words be registered as trademark? Explain.
   i. 'Fruity' for juice

ii. ‘Flowers’ for laptop

iii. ‘Best’ for Washing powder

(b) Giving a flow chart, explain the procedure for registration of a trademark.

(9, 9)

5. Differentiate between the following:
   (a) Process Patent and Product Patent
   (b) Tangible and Intangible Property
   (c) Certification mark and Collective mark

(6, 6, 6)

6. Write short notes on ***any three*** of the following:
   (a) Trade Secret
   (b) Protection of layout of integrated circuits
   (c) Budapest Treaty
   (d) GATT

(6, 6, 6)

SI. No. of Q. Paper :
Unique Paper Code: 32173910_OC
Name of the course: **B.Sc.(H)/ (Prog) Chemistry-SEC**
Name of the Paper: Chemistry of Cosmetics and Perfumes
Semester: V
Time: **3 hours** **Maximum Marks: 38**

Instructions for Candidates

a) Attempt any **two** questions.

1. (a) What are essential oils? Describe one method of extraction of essential oils from natural sources. 5

   (b) Give the structure of geraniol and list its uses in cosmetic industry. 5

   (c) How are hair dyes classified? Discuss permanent hair dyes in detail. 5

   (d) What are the ideal characteristics of a good lipstick? 4

2. (a) What is the difference between a deodorant and an antiperspirant? 4

   (b) What are the various ingredients used in the formulation of a hair shampoo? Discuss the role of surfactants in a hair shampoo. 5

   (c) Write a short note on any two: 5x5
   i) Nail polish and nail polish remover
   ii) Artificial flavors
   iii) Hair spray

3. (a) How do you classify cosmetics? 4

   (b) What are various ingredients used to manufacture sunscreen? Discuss the role of these. 5

   (c) Differentiate between cold cream and vanishing cream. Discuss preparation of cold cream. 5

(d) What are the ideal characteristics of raw material used for synthesis of face powder. 5

4. (a) What are the characteristics of a good shaving cream? 4

(b) What is the role of boric acid in powder preparations? 2

(c) Discuss the structure of skin. 5

(d) What are cosmetics? How are they different from drugs? 4

(e) How is baby powder different from talcum powder? 4

Unique Paper Code	:	32177902
Name of the Paper	:	DSE-2: Inorganic Materials of Industrial Importance
Name of the Course	:	B.Sc. (H) Chemistry
Semester	:	V
Duration	:	3 hours
Maximum Marks	:	75

Instructions for Candidate

1. Attempt **four** questions in all.

2. Question **1** is compulsory.

3. Attempt any **Three other** questions. **All** questions carry equal marks except question no**:1**.

1. (a) Fill in the blanks or mark **True / False** as required(**any nine**)::

i) ---------- paints can be considered ecofriendly because they have water as thinner.

ii) ---------- is a white clay used in the manufacture if white ceramic ware.

iii) There are _____ pentagons and _____ hexagons in C_{60}.

iv) Excessive addition of chemical fertilisers to soil has no adverse effect on water bodies.

v) The principle behind optical fibres is ……

vi) Fillers are high refractive index materials which are added to paint formulation to increase its volume.

vii) The phosphatic fertiliser called _____ of lime is prepared from phosphate rock and _____ acid.

viii) Polyacrylonitrile is a precursor for the manufacture of carbon fibers.

ix) _____ catalysts are substances that retard a reaction.

(b) Give one word/phrase for the following (**any Six**):

i) The process of gradually cooling hot glass articles to room temperature.

ii) Adsorption in which the adsorbed substance is held by chemical bonds

iii) Paints which can with stand high working temperatures.

iv) Notation on a bag of fertiliser signifying that it contains 12% N, 12% P_2O_5, and 10% K_2O

v) A carbon allotrope which can be obtained by using common tape.

vi) A substance which hinders the activity of a catalyst without changing it chemically

vii) Substances which completely destroy the activity of a catalyst. (1½×9,1×6)

2. (a) Describe properties and uses of three different types of silicate glasses.

(b) How is lithium battery different from a lithium ion battery? With the help of a suitable diagram explain the charging and discharging process of a lithium ion battery.

(c) What is the role of a pigment in a typical paint formulation? Define pigment volume concentration (PVC). What is its significance? (7½,6,5)

3. (a) Differentiate between (**any two**)

i) Wet process and Dry process for the manufacture of cement.

ii) Galvanizing and Tinning

iii) Primary battery and Secondary battery

(b) What are ceramics? Describe briefly two methods of moulding shapes in the manufacture of ceramic ware.

(c) What leads to flaking of a paint film? What are the preventive measures that can be taken against flaking? (4×2,5,5½)

4. (a) Discuss electroless plating with an example. What are its advantages and disadvantages compared to electroplating?

(b) What are carbon nanotubes? Briefly describe the different types of carbon nanotubes and their uses.

(c) Explain the various steps involved in manufacturing process of cement by rotary kiln technology.
(6½,6,6)

5. (a) Differentiate between the following **(ANY TWO)**

i) Mixed and straight fertilisers

ii) Homogeneous and heterogeneous catalysis

iii) Direct and indirect fertilisers

(b) Draw and explain briefly the cycle for the Wilkinson hydrogenation of propene.

(c) i) What are the characteristics of a good catalyst?

ii) Why do we need fertilisers for our crops? (2½×2,7½,3×2)

6. (a) What are superphosphates of lime and how are they synthesized?

(b) What are zeolites? Give two examples. Why are natural zeolites not preferred as catalysts for commercial applications?

(c) Differentiate between the following **(ANY TWO)**

i) Physisorption and Chemisorption

ii) Poison and inhibitor

iii) Complete and incomplete fertilisers

(7½, 6,2½×2)

SET-A

Name of the Course:	B.Sc. (H) Biomedical Science
Semester:	V
Name of the Paper:	Medical Biochemistry (DSE)
Unique Paper Code:	32587904
Duration:	03 Hours
Maximum Marks:	75

Instruction for the candidates

- Write your Course Name, Examination Roll No., Paper Name and Unique Paper Code on the answer sheet.
- Attempt **Four** questions in all. All questions carry equal marks (18.75).
- Give Diagrams and examples wherever required.

Q1. Isoenzymes are differentially distributed in our body to carry out organ-specific functions How are isoenzymes implicated in the diagnosis of certain human diseases? Give a detailed account and explain creatine kinase enzyme and its application in diagnosis of Myocardial Infarction.

Q2. Deficiency of a vitamin can cause poor vision as it plays a significant role in visual cycle. Identify the vitamin and give a schematic representation to illustrate its role. What are the dietary precursors of the Vitamin?

Q3. Glycobiology is the study of glycoconjugates, the ever evolving and exciting area of biology. Name and explain the significance of a cell surface glycoconjugates that plays important roles in the pathogenesis of several human diseases. Illustrate giving any two examples in details.

Q4. While studying obesity, a peptide hormone secreted by adipocyte has been demonstrated to play an important role. Mice mutant in gene coding for this hormone were found to be obese. Identify the hormone and with the help of suitable drawings, illustrate how is the hormone connected to the feeding behaviour?

Q5. Lipids are transported in lipoprotein molecules in the blood circulation. “HDL is called a good lipoprotein, while LDL is called a bad lipoprotein”. Justify the statement and also give a detailed account on various lipoproteins, their composition and functions.

Q6. “A clinician always depends on the results provided by a biochemist to look into biochemical functioning of a subject”. State two relevant examples of biochemical parameters giving their clinical significance, to justify the statement. Giving reasons, discuss any two biomolecules whose elevated levels in the blood cause diseases in humans.

Unique Paper Code	:	32177903
Name of the Paper	:	DSE-3: Applications of Computers in Chemistry
Name of the Course	:	B.Sc. (H) Chemistry
Semester	:	V
Duration	:	3 hours
Maximum Marks	:	75

Instructions for Candidates

1. Each question carries equal marks.
2. Attempt any ***four*** questions.

Q1

(a) Convert the following numbers
(i) $(17.25)_{10}$ to binary number
(ii) $(111.01)_2$ to decimal number

(b) Express the following as BASIC expressions
(i) $x = n(x_1^2 - x_1.x_2)/2(a+b)$
(ii) $V = nRT/(P + an^2/ V^2)+nb$

(c) Distinguish between Interpreter and Compiler.

(d) Explain the following commands
(i) DEF FNA(x)
(ii) DIM A (3, 3)
(iii) RESTORE

(e) Write a program in BASIC to calculate the mean and standard deviation for following observations obtained in the determination of the lead content in a soil sample
0.152 ppm, 0.176 ppm, 0.142 ppm, 0.161 ppm, 0.160 ppm

(2, 3, 4, 4, 5.75)

Q2

(a) Identify the errors in the following statements:
(i) Y= aSinX
(ii) LET B+C =40

(b) What is the purpose of the following Library functions?
(i) ABS (X)
(ii) FIX (X)

(c) Explain the use of **SCREEN**, **VIEW** and **PSET** commands in BASIC language.

(d) Write the output of the following program

```
10 DIM A$(5), A(5)
20 FOR I= 1 TO 5
```

```
30 READ A$(I), A(I)
40 NEXT I
50 FOR I= 5 TO 1 STEP -1
60 PRINT A(I); A$(I)
70 NEXT I
80  DATA AJAY,17,SANJAY, 22,RANI,23,RAMESH,19, VIBHA, 21
90 END
```

(e) Write a program in BASIC to find the number of times the letter 'e' occurs in the following sentence: ***Chemistry is the scientific discipline involved with elements and compounds.***

(2, 3, 4, 4, 5.75)

Q3

(a) Explain the following terms
   (i) Debugging
   (ii) Syntax error

(b) Describe the following error messages with examples:
   (i) DATA out of range
   (ii) FOR without NEXT

(c) Indicate the errors in the following program. Write the corrected program.

```
10 PRINT A
20 INPUT A,B
30 FOR I = 1 TO 10
40 FOR J = I+1 TO 10
45 C= 0: D = 0
50 C = A + I + C
60 D= B + J + D
70 NEXT I
80 NEXT J
90 PRINT C, D
100 END
```

(d) Write a program in BASIC to draw three concentric circles with centre (160,100) and radii 20, 30 and 40 respectively.

(e) Write a program in BASIC to evaluate the following series:

$$\cos(x) = 1 - \frac{x^2}{2!} + \frac{x^4}{4!} - \frac{x^6}{6!}$$

The value should be accurate till 4^{th} place after decimal.

(2, 3, 4, 4, 5.75)

Q4

(a) Identify the error in the following constants if any and correct them.
   (i) +732
   (ii) PERIODIC "TABLE"

(b) Identify error in following variable name if any and correct them.
   (i) VOL%
   (ii) 1 Day

(c) Differentiate between pre-defined and user-defined functions.

(d) Write a program in BASIC to input a number and print whether it is integer or not.

(e) The concentration of H^+ in a dilute solution of HCl is given by the expression

$$[H^+]^2 - [HCl]_0\,[H^+] - K_w = 0$$

Write a program in BASIC to calculate the pH of 10^{-7} M HCl solution at 25^0C.

(2, 3, 4, 4, 5.75)

Q5

(a) What is the difference between GOTO and ON....GOTO statement?

(b) Write a program in BASIC to Print "CHEMISTRY" in a vertical line using FOR – NEXT command.

(c) What is the output of the following program?

```
SCREEN 1
PSET (40, 40)
FOR J = 5 TO 25 STEP 5
CIRCLE (40, 40), J
NEXT J
END
```

How would the output change if the same program is written in SCREEN 2? How will you change colour of the circle.

(d) Write a program in BASIC to read a matrix and print its transpose.

(e) Explain Binary Bisection method for finding root of a function. Write a program in BASIC to find the root lying between 0 and 1 for the following equation using binary bisection method.

$$x^4 - x - 10 = 0$$

(2, 3, 4, 4, 5.75)

Q6

(a) Differentiate between Defined Function and Subroutine.

(b) Under what situation **LET**, **INPUT** and **READ** statements are used? Give examples.

(c) Write a program to calculate ${}^nC_r$. Where n=6 and r=0 to 4. Output should be printed in three columns with heading n, r and ${}^nC_r$.

(d) Write output from the following statements:

```
10 A = 3
11 B = 16.9
12 C = 123456789
```

```
13 D = 0.00001234
14 E$ = “Delhi”
15 F = B/A
16 PRINT A, B, C, D, E$, F
17 PRINT
18 G = B\A
19 PRINT A; B; C; D; E$; F; G
```

(e) Write a program in GRAPHICS to select a viewport with diagonally opposite points as (150, 5) and (600,180) and to draw a SQUARE in any graphics mode with a SIDE of 50 pixels.

(2, 3, 4, 4, 5.75)

Sr of the question paper:

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

Semester: **V**

Name of the paper: **DSE-8: Green Chemistry**

Unique Paper Code: **32177908**

Duration: 3 hrs **Maximum Marks: 75**

Instruction for the candidates

1. Write your Roll no on the top immediately on the receipt of the question paper
2. Attempt ***four*** questions. All parts of a question should be attempted together
3. Each question carries 18.75 marks

Ques 1 (a) The catalytic reagents are superior to stoichiometric reagents? Discuss giving one example.

(b) List any four goals of green chemistry.

(c) What are fluorous biphasic solvents? Give two valuable applications of flourous biphasic solvents.

(d) With the help of a labeled phase diagram, show all the phases of CO_2? What makes CO_2 a solvent of choice over other supercritical liquids? Solubility is a limiting factor in using $ScCO_2$ as a green solvent. Suggest a methodology to modify its solubility pattern.

(4,4,4,6.75)

Ques 2 (a) (i) Explain giving mechanism how CFCs are responsible for depletion of ozone layer in stratosphere.
(ii) Explain : Risk = Function (Hazard × exposure)

(b) Green chemistry and sustainable development are inter-related. Explain. Also highlight any two business benefits of Green Chemistry.

(c) Compare homogeneous catalysis and heterogeneous catalysis giving example.

(d) What is Marine biofouling? What are the environmental impacts of biofouling? What was conventional antifoulant? What are the advantages of Sea Nine 211 over this conventional antifoulant? (4,4,4,6.75)

Ques 3 (a) What are the advantages of the enzymatic interesterification process over chemical interesterification?

(b) Discuss green of synthesis of ***any two*** of the following:

i) Adipic acid
ii) Catechol
iii) Disodium diiminodiacetate

(c) "What you don't have cannot harm you" is referred to which principle of green chemistry? Explain?

(d) Why ionic liquids are called "Designer Solvents"? What are their structural characteristics? List two advantages and two limitations of ionic liquids.

(4,4,4,6.75)

Ques 4 (a) Write down the reaction involved in the carbaryl synthesis at UCIL factory. Also, suggest a greener alternative to the synthesis.

(b) Classify the following types of reactions as atom economical and atom uneconomical reactions. Also justify your answer.

(i) addition reaction
(ii) elimination reaction

(c) Discuss any two of the following microwave assisted reactions:

(i) Hofmann elimination
(ii) Oxidation of toluene.
(iii) Diels Alder reaction

(d) Why the greener alternative to conventional dyes or heavy metal pigments were named "Rightfit"? What were the key technologies applied while synthesizing Rightfit pigments? Give one example each of any two. (4,4,4,6.75)

Ques 5 (a) Fill in the blanks

(i) Green chemists reduce risk by .....
(ii) E-Factor is .....
(iii) The use of solar power is covered within Green Chemistry Principle 6 which is .....
(iv) The science of mimicking enzymes present in natural systems to synthesize the target molecule is called as .....

(b) What are photo catalysts? Discuss the application by taking a suitable example.

(c) What do you understand by the Greenness of a solvent? How it can be screened

(d) What are green plastics? How these can be prepared? Also discuss, which principles of green chemistry are referred here? (4,4,4,6.75)

Ques 6 (a) Write short note on any three of the following:

(i) Sonochemical Simmon Smith Reaction
(ii) Combinatorial chemistry
(iii) Polyethylene glycol as green solvent
(iv) Cocrystal controlled solid state synthesis

(b) What do you understand by waste prevention hierarchy? Discuss each level briefly (4X3, 6.75)

Roll No……..

Sl. No. of Q. Pager :

Unique Paper Code : 42171103

Name of the Paper : C-1 Atomic Structure Bonding, General Organic Chemistry and Aliphatic Hydrocarbons

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

Semester : I

Duration : 3 hours **Maximum marks: 75**

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

Attempt SECTIONS A & B on the SAME Answer Script.
Use of a scientific calculator is permitted

SECTION A
(INORGANIC CHEMISTRY)
Attempt ANY THREE questions

Gas constant, R= 8.314 JK^{-1} mol^{-1} = 0.08206 dm^3 atm K^{-1} mol^{-1}
Avogadro's number, N_A= 6.022x10^{23} mol^{-1} n_m: 1.6726 x 10^{-27} kg.
p_m: 1.6726 x 10^{-27} kg. e_m: 9.1 x 10^{-31} kg e: 1.6022 x 10^{-19} Coulomb

1. (a) Write the time independent Schrodinger equation of hydrogen atom and explain various terms in it.
   (b) Why the dipole moment for NF_3 is lower than for NH_3?
   (c) Define: Fajan's rule and
   Which of the following ions will exhibit the greater polarizing power? i) Ti^{2+} or Ti^{4+}, ii) Cu^{2+} or Ca^{2+}, iii) Li^+ or Be^{2+}, iv) K^+ or Ag^+
   (d) Why we transfer cartesian co-ordinates (x, y, z) to polar coordinates (r, ɵ, ɸ)? (3.5,3,3,3)

2. (a) Calculate the de Broglie wavelength of a body of mass 1 kg moving with a speed of 2000 m s^{-1}.
   (b) Explain: Why is CH_4 not in square planar geometry?
   (c) Why are ionization energy, $\Delta H_{sublimation}$ and $\Delta H_{disociation}$ positive, whereas lattice energy values and electron affinity values negative?
   (d) State Heisenberg's uncertainty principle and explains its significance. (3.5,3,3,3)

3.

(a) Calculate the percentage of ionic character of HCl? The inter-nuclear distance of HCl is 1.284×10^{-10} m and its actual dipole moment is 3.689×10^{-30} cm .

(b) Write down limitation of VSEPR and MO theory.

(c) Make short notes about the following:

i) Significance of quantum numbers

ii) Significance of ψ and ψ^2

(d) Give a short answer for the following (3 Marks)

i) How many radial nodes do a 6f orbital have?

ii) Sketch the angular nodes in a $3d_{xy}$ orbital

iii) Sketch the angular part of the wave function for the 5d orbitals (3.5,3,3,3)

4. (a) Calculate the lattice energy of Cesium Chloride using following data:

$Cs(s) \rightarrow Cs(g)$	$\Delta H_S = +79.9$ kJ mol^{-1}
$Cs(g) \rightarrow Cs+(g)$	$\Delta H_{I.E} = +374.05$ kJ mol^{-1}
$Cl_2(g) \rightarrow 2Cl(g)$	$\Delta H_A = +241.84$ kJ mol^{-1}
$Cl(g) + e^- \rightarrow Cl^-(g)$	$\Delta H_{EA} = -397.90$ kJ mol^{-1}
$Cs(s) + ½\ Cl_2 \rightarrow CsCl(s)$	$\Delta H = -623.00$ kJ mol^{-1}

(b) Why O_2 is paramagnetic whereas O_2^{2+} diamagnetic. Explain briefly

(c) What are three rules that govern the filling of electrons in atomic orbitals?

(d) What is Bohr's theory of atomic structure and what are its limitations? (3.5,3,3,3)

SECTION B
ORGANIC CHEMISTRY
Attempt ANY THREE questions

5. (a) Draw a Fischer projection for the enantiomers of 2-bromopentane.

(b) Explain the following reactions:

i) Ozonolysis.
ii) Markovnicov's rule.

(c) Which of the following will show aromatic character? Justify your answer on the basis of Huckel's rule: 1,3,5-Hexatriene, Naphathalene and [10]-annulene.

(a) An alkyl halide "A" (C_4H_9Br) reacts with alcoholic KOH and gives alkene (B), which reacts with bromine to give dibromide (C). The compound (C) forms a compound (D) on treatment with sodamide, which forms a precipitate when it is passes through an ammonical $AgNO_3$ solution. Assign the structure to the A-D compounds and explain the reaction(s). (3,3,3,3.5)

6. (a) Assign E/Z to the 1,1-Dichloroethene, 2-pentene and 1-chloro-2-methyl-2-butene
(b) How to prepare:
(i) Isobutane from *tert*-butylbromide
(ii) Ethyne from 1,2-dibromoethene
(c) Draw a Fischer projection of 2-choloro-3-bromopentane and assign absolute configuration (R/S) at each chiral center
(d) Arrange the following molecules in the decreasing order of their acid strength: CH_3CH_2OH, CH_3COOH, HCOOH, C_6H_5OH (3.5,3,3,3)

7. (a) Write short notes on the following:
(i) Hyperconjugation (ii) Tautomerism (iii) Resonance effect.
(b) Draw all the staggered conformations of *n*-butane. Which of them has the most stability? Give reasons for your answer.
(c) What is the reaction product of *n*-BuMgBr (Grignard reagent) with H_2O and CH_3OH.
(d) How do you generate the following intermediates?
(i) Carbocation (ii) Carbanion (iii) Carbene (3.5,3,3,3)

8. (b) Giving the reasons, arrange the following carbanions in the decreasing order of stability:
(i) *tert*-Butyl anion, (ii) Methyl anion, (iii) Triphenyl anion

(c) Which of the following compounds, Maleic acid or Fumaric acid is expected to have the higher boiling point and why?

(d) Write is an example of each of the following types of compounds?
(i) Aromatic (ii) Anti-Aromatic (iii) Non-Aromatic

(e) Explain the following reactions
(i) Kolbe's reaction
(ii) Wurtz reaction
(iii) Birch reduction

(3.5,3,3,3)

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Unique Paper Code	: 42177919
Name of the Paper	: DSE: Applications of Computers in Chemistry
Name of the Course	: B.Sc. Prog
Semester	: V
Duration	: 3 Hours
Maximum Marks	: 75

Instructions for Candidates

1. Attempt only **Four** Questions.
2. **Question Number 1 is compulsory**. Attempt any three questions out of remaining five questions.
3. Attempt all parts of a question together
4. Use of Non-programable scientific calculator is allowed.

1. Attempt all parts:

(a) Write the BASIC equivalent of the following expressions:

(i) $f = 4\pi(\frac{M}{2\pi RT})^{3/2} c^2 e^{-mc^2/2RT}$

(ii) $\lambda = \frac{h}{(2meV)^{1/2}}$

(iii) $N=N_0e^{kT}$

(b) Explain the syntax of the following strings

(i) MID$ (ii) INSTR (iii) LEN

(c) Debug the following statements

(i) LET LETTER$=MID(WORD$, N, 1)
(ii) FOR A$=N$ TO 10
(iii) DIM X$=20

(d) Convert the binary number $(111001)_2$ to decimal and octal number.

(e) Explain the following terms:

(i) Hardware (ii) Nibble (iii) Operating system

3×5=15

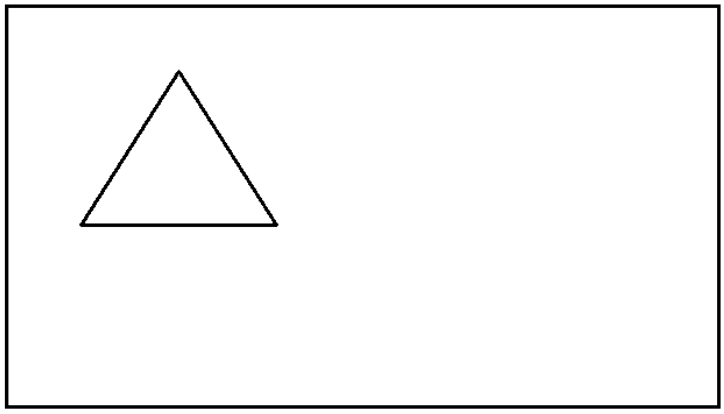
2. Attempt all parts:

(a) Correct the syntax error in the following statements (if any):

(i) LINE(100,50)-(20,30), B, 3
(ii) PAINT (100,200), 4, 1
(iii) LOCATE(5,8)
(iv) CIRCLE (100,100), 3, 80

(v) PRESET 15,30
(vi) WINDOW 0,0 - 100,100

(b) Write a program in BASIC to display the following output



(c) How GOSUB statement is different from GOTO statement. Identify the errors in the following program and rewrite the corrected program.

```
10 REM THIS PROGRAM PRINTS "OK" IF N=1; "KO" IF N=2
20 REM
30 INPUT N
40 ON GOSUB 300,200
50 REM
60 PRINT "OK"
70 REM
80 PRINT"KO"
90 RETURN
100 END
```

6,6,8

3. (a) Write a user friendly program in BASIC for generating the transpose of a given matrix (d)

$$\begin{matrix} 1 & 3 & 9 \\ 4 & 2 & 7 \\ 5 & 8 & 0 \end{matrix}$$

(b) Explain the Regula-Falsi method of finding roots of polynomial. Write a program in BASIC using user defined function for finding the root of the following polynomial equation using Regula-Falsi method within the tolerance limit of 10^{-5}. Given equation is

$$x^3-x^2-2x+1=0$$

10, 10

4.

(a) Explain the principle behind finding the area under the curve using Simpson's rule. Write a program in BASIC to find the value of the integral using Simpson's rule with n=10

$$\int f(x)dx = \int_0^1 (5x - 2x^2)dx$$

(b) Write a program in BASIC to fit Λ_m and $\sqrt{c}$ to a straight line using method of least square fit and equation: $\Lambda_m = \Lambda_m^o - k\sqrt{c}$ and calculate Λ_m^o.

Concentration(c)/M	17.68	10.8	2.67	1.28	0.83	0.19
Molar Conductance Λ_m (Sm^2/mol)	42.45	45.91	51.81	54.09	55.78	57.42

Given that

$$Slope = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2}$$

$$Intercept = \frac{\sum_{i=1}^{n} x_i^2 \sum_{i=1}^{n} y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} x_i y_i}{n\sum_{i=1}^{n} x_i^2 - (\sum_{i=1}^{n} x_i)^2}$$

10,10

5.

(a) In the following given BASIC program to plot the cooling curve for naphthalene , find the errors and rewrite the corrected program

```
10 REM TO DRAW COOLING CURVE FOR NAPHTHALENE
20 CLS: SCREEN 0
30 WINDOW 0,0-15,150
40 LINE 0,0-0,190
50 LINE 0,15-100,15
60 LOCATE 6,1: PRINT ”TEMP”
70 I=0.5
80 DIM T20
90 WHILE I<=12
    100 FOR J=1 TO 20
    110 TIME =I
    120 READ T(J)
    130 TEMP=T(J)
    140 PSET (TIME/2, TEMP)
```

```
150 LINE-(TIME/2, TEMP)
160 I=I+0.5
170 NEXT I
170 DATA 120, 117, 106, 101, 96, 92, 90, 88, 87, 86, 75, 75, 75, 68
180 DATA 62, 59, 57, 53 50
190 WEND
200 END
```

(b) Write a program in BASIC to print the following output in the middle of screen using FOR……NEXT loop.

```
#
###
#####
#######
#####
###
#
```

10,10

6.

(a) Write the output of the following program:

```
SCREEN 2
WINDOW (0,0)-(100,100)
R=5
FOR I= 1 TO 5
CIRCLE (40,60), R
R=R+1
NEXT I
END
```

(b) Indicate the error in the following program and re-write the corrected progam

```
10 PRINT A
20 INPUT A, B
30 FOR I= 1 TO 10
40 FOR J=1 TO 10
45 C=0: D=0
50 C=A+I+C
```

```
60 D=B+J+D
70 NEXT I
80 NEXT J
90 PRINT C,D
100 END
```

(c) Write the output of the following:

```
PRINT "NAME", "ROLL NUMBER", "MARKS"
PRINT
PRINT N$, R1, M2
PRINT A+B*C, N$, A/C
```

Where N$="PETER", R1=60, M2=359, A=15, B=2, C=3

(d) Write the BASIC statement to produce the following effect

(i) 1D array to hold 40 items of data.

(ii) Assign the value of 46 to a variable PI.

(iii) Assign a string APPLICATION OF COMPUTERS to the variable

(iv) If P has a value greater than 150, then transfer control to the statement number 70, otherwise execute the next statement.

(v) Print "CHEMISTRY" in column 8^{th}.

5,5,5,5

42174304_III_set1_ Sol., Phase Equlibria -functional group Org. chem. B.Sc(Program)

This paper contains 3 pages

Your Roll. No. : …….

S.No. of Q. Paper :

Unique Paper Code :42174304

Name of the Course :B.Sc(Program) – Core -Chemistry

Name of the Paper :Solutions, Phase Equlibria, conductance, electrochemistry and functional group organic chemistry-II

Semester :III

Time: 3 Hours Maximum Marks: 75

1. Write your Roll number, User ID, UPC of paper on the top of first Answer sheet.
2. Attempt four questions.(Do all parts of a question together).
3. Attempt any two question from each SECTION A and SECTION B.
4. Use Graph Sheet wherever required.
5. Use of non-programmable scientific calculator is allowed.
6. Use the internet only for Downloading/Uploading of your Q-paper/Answer sheets.
7.

Questions

SECTION-A

Q1.

a) The following temperature composition data were obtained for a mixture of two liquids A and B at one atmosphere, where x is the mole fraction of A in the liquid and y is the mole fraction of A in the vapour, at equilibrium.

t/ ^{o}C	125	130	135	140	145	150
x_A	0.91	0.65	0.45	0.30	0.18	0.098
y_A	0.99	0.91	0.77	0.61	0.45	0.25

the boiling points are 124 ^{o}C for A and 155 ^{o}C for B. Plot the temperature-composition diagram for the mixture on a graph sheet. What is the composition of the vapour in the equilibrium with the liquid of composition i) $x_A = 0.50$ and ii) $x_B = 0.33$

b) In the systems given below determine the number of phases, number of components with names and degrees of freedom using the Gibbs Phase rule.

I. S(rhombic) ⇆ S(monoclinic) ⇆ S(liquid) ⇆ S(gas)

II. PCl_5 (g) ⇆ PCl_3 (g) + Cl_2 (g)

i) $P_{PCl3} = P_{Cl2}$

ii) $P_{PCl3} \neq P_{Cl2}$ (P_A – is partial pressure of A)

12, 6.75

Q2.

a) Write the electrode half-reactions, cell reaction and write Nernst equation for each of the following cells:

i) $Zn|ZnSO_4(aq)||AgNO_3(aq)|Ag$

ii) $Cd|CdCl_2(aq)||HNO_3(aq)|H_2(g)|Pt$

iii) $Pt|K_3[Fe(CN)_6](aq), K_4[Fe(CN)_6](aq)||CrCl_3(aq)|Cr$

b) The conductivity of saturated solution of of BaSO4 is 3.48 x 10^{-4} S/m and the conductivity of pure water is 0.50 x 10^{-4} S/m at 298 K. Calculate the solubility product of BaSO4. (limiting molar conductance of BaSO4 is 287.3 x 10^{-4} S m^2 mol.)

c) Why is it necessary to measure the cell potential under zero-current?

12, 4, 2.75

Q3.

a) A Hittorf cell fitted with silver-silver chloride electrodes is filled with HCl solution that contains 0.3856 x 10^{-3} g HCL per g of water a current of 2 mA is passed for exactly three hours. The solutions are withdrawn, weighed and analysed. Total weight of the anode solution weighs 52.0461 g and contains 0.0133 g of HCl. Calculate the transference number of the H^+.

b) Distribution of I_2 between H_2O and CCl_4 at 298 K, at equilibrium the following results were obtained

$[I_2]$ (in water layer /mol dm^{-3}) x 10^4 :	2.35	4.69	7.03	9.30
$[I_2]$ (in CCl_4 layer/mol dm^{-3}) x 10^2 :	2.00	4.00	6.00	8.00

Show that these results obey the distribution law. Evaluate the distribution coefficient of I_2 between carbon tetrachloride and water.

c) What is the cause of liquid-junction potential?. How it can be eliminated?

d) Explain why H^+ and OH^- have exceptionally high ionic mobility in Aqueous media. Show schematically.

6, 6, 4, 2.75

SECTION B

Q4.

a) How can you carry out the following transformations using diazonium salt formation as one of the steps?

i) Benzene ⟶ 1,2,4,6-tetrabromobenzene

ii) Toluene ⟶ 1,3-benzenedicarboxylic acid (Isophthalic acid)

b) Glucose and fructose give identical osazone with phenylhydrazine. Explain this fact.

c) Glycine is a low-molecular weight organic compound, yet it is a high-melting crystalline solid and more soluble in water than in benzene. Justify.

d) Write down the three isomeric amines represented by the molecular formula C_3H_9N. Give a chemical method to distinguish them.

e) What happens when aqueous solution of glucose is kept for some time? Name the phenomenon and discuss the mechanism involved.

6, 3, 2, 4, 3.75

Q5.

a) Outline the solid phase synthesis of Val-Gly.

b) Answer the following:

i) Convert fructose to glucose

ii) Convert Glucose to mannose

c) N-ethyl-N-methylamine is chiral but non resolvable. However, $C_6H_5N^+(CH_3)(C_2H_5)(C_3H_7)Cl^-$ is
resolvable. Explain with the help of suitable structures.

e) Between acrylic acid and propionic acid, which one is more acidic and why?

f) How can you use the method of Gabriel phthalimide synthesis to synthesize alanine? Give the reactions with the mechanism. Define isoelectric point.

4, 3, 3, 3, 2, 3.75

Q6.

a) How can a mixture of arginine and aspartic acid be separated by electrophoresis using a buffer solution having a pH=6.0?

b) Coupling reactions of diazonium salts occur in mildly alkaline or mildly acidic conditions only. Explain giving all the involved structures.

c) How ethylacetoacetate is synthesized using Claisen condensation? Give the mechanism.

d) Write short note on the following:
   i) Secondary structures of proteins
   ii) Hell-Volhard-Zelinsky reaction.

e) Explain why D-fructose reduces Fehling's solution although it is a ketohexose.

3,3,3,5,4.75

S. No. of Question Paper :

Unique Paper Code : **4217430_OC**

Semester : **III**

Set : **I**

Name of the Paper : **Quantitative Methods of Analysis**

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

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

Attempt *Four* questions in all. Question no. 1 is compulsory.

Note: Use of calculator is allowed

1. (a) Explain the difference between nucleation and particle growth.

   (b) Explain the difference between occlusion and mixed-crystal formation.

   (c) An ore is analyzed for the manganese content by converting the manganese to Mn_3O_4 (228.8 g/mol) and weighing it. If a 1.52 g sample yields Mn_3O_4 weighing 0.126 g, what would be the percent Mn_2O_3 (157.9 g/mol) and Mn (54.94 g/mol) in the sample?

   (6+6+6)

2. (a) What is digestion of a precipitate and why is it necessary?

   (b) What is coprecipitation? List the different types of coprecipitation and indicate how they may be minimized or treated.

   (c) An iron ore was analyzed by dissolving a 1.1324 g sample in concentrated HCl. The resulting solution was diluted with water, and the iron (III) was precipitated as the hydrous oxide $Fe_2O_3.xH_2O$ by the addition of NH_3. After filtration and washing, the residue was

ignited at a high temperature to give 0.5394 g of pure Fe_2O_3 (159.69 g/mol). Calculate (a) the % Fe (55.847 g/mol) and (b) the % Fe_3O_4 (231.54 g/mol) in the sample.

(5+6+8)

3. (a) Calculate the pH during the titration of 50 mL of 0.0500 M NaOH with 0.1000 M HCl at 25^{o}C after the addition of the following volumes of reagent:

   (i) 24.50 mL (ii) 25.00 mL (iii) 25.50 mL

   (b) Why does the typical acid/base indicator exhibit its color change over a range of about two pH units?

   (c) Sketch a titration curve for change in pH versus volume of strong base added for a strong acid with a strong base, then sketch for a weak acid and a strong base.

   (i) Compare the two shapes.

   (ii) How do the inflexion points differ?

   (7+5+7)

4. (a) Derive the Henderson-Hasselbalch equation to calculate the pH of a buffer solution.

   (b) What is a buffer solution? With the help of two suitable examples explain how a buffer solution resists the change in pH?

   (c) A 50.0 mL portion of an HCl solution required 29.71 mL of 0.01963 M $Ba(OH)_2$ to reach an end point with bromocresol green indicator. Calculate the molar concentration of the HCl.

   (d) Differentiate between temporary hardness and permanent hardness of water.

   (5+5+5+4)

5. (a) Discuss the basic principles of sedimentation.

   (b) Write short notes on water sampling methods and analysis.

   (c) Explain different types of centrifuges and their use.

   (6+7+6)

6. (a) What is Density gradient technique? Explain.

   (b) Describe swinging bucket rotor and its applications.

   (c) What are the structural characteristics of a chelation agent in gravimetric analysis?

   (d) What are greenhouse gases? Explain environmental issues associated with them.

(5+4+6+4)

Roll No…….

Unique Paper Code : 42177918

Name of the Paper : DSE: Industrial Chemicals and Environment

Name of the Course : B.Sc. (Prog.) with Industrial Chemistry

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. Answer any four questions in all. All questions carry **18.75** marks each.

Q1. (a) Draw a labelled diagram of biogeochemical cycle of nitrogen.

(b) Explain the Non-dispersive IR spectroscopy technique for estimation of CO.

(c) What are the major sources of SOx? Give the method of controlling the amount of SOx in the atmosphere.

(3x6.25)

Q2. (a) What is BOD? Explain the procedure of BOD determination in a water sample.

(b) What are the advantages of hydel energy, how can it be harnessed?

(c) Liquid nitrogen needs careful handling and storage, why?

(3x6.25)

Q3. (a) Explain a method for the preparation of sodium thiosulphate and describe its applications.

(b) Describe fallowing water treatment process (*any two*):

(i) Trickling Filters

(ii) Reverse Osmosis

(iii) Ion exchange process

(3x6.25)

Q4. (a) Define biocatalyst. Explain two industrial applications of the biocatalysts.

(b) What is geothermal energy? What are the various forms by which geothermal energy is harnessed?

(c) What is solid waste management? Explain any one method used for solid waste management.

(3x6.25)

Q5. (a) How do we treat the effluents from the following industries (any two)?

(i) Dairy Industry

(ii) Petroleum Industry

(iii) Fertilizer Industry

(b) Discuss the manufacturing process of nitic acid.

(3x6.25)

Q6. Write short notes on any **three** of the following:

(i) Van Arkel de Boer's process

(ii) Disposal of sludge

(iii) Lagooning

(iv) Electrostatic Precipitator

(3x6.25)

Roll No. …….

Unique Paper Code	: 42171111
Name of the Paper	: Inorganic Chemistry – I
Name of the Course	: Applied Life Science
Semester	: I
Duration	: 3 Hours
Maximum Marks	: 75

Instructions for Candidates

1. Attempt any **four** questions in total.
2. All questions carry 18.75 marks each.
3. Attempt all parts of a question together.

Set A

1. (a) Answer the following questions **3 x 5 =15**

i) Define electronegativity. How is it different from electron affinity?

ii) To which element beryllium shows diagonal relationship and why?

iii) LiCl is relatively covalent while NaCl is ionic. Explain.

iv) Explain why the ionization energy decreases down the group in alkali metals?

v) Name and explain the Quantum Numbers which give information about the energy and shape of an orbital respectively?

(b) Draw the Molecular Orbital Diagram and calculate the bond order for O_2 molecule. **3.75**

2. (a) Explain the following briefly **4 x 4=16**

i) Write down all the possible values of quantum numbers for the orbitals having electrons in 2s, 2p, 3d and 4f orbitals.

ii) Explain why large number of transition metal complexes are coloured? Give an example of any coloured transition metal complex.

iii) Explain the term lanthanide contraction. Write any of its two consequences.

iv) Write down any three postulates of Bohr's theory.

(b) Discuss the Mond's process for the purification of Nickel metal. **2.75**

3. a) Write short notes on the following **4x4=16**

i) Transition elements as catalyst

ii) Heisenberg's Uncertainty Principle

iii) Anomalous Configurations

iv) VSEPR Theory

(b) Why lanthanides show sharp line like bands in the absorption spectra while transition elements show broad bands. Explain. **2.75**

4. a) Discuss the structure and bonding in diborane molecule. **4**

b) Define Lattice energy. Write the expression for Born Lande's equation for the calculation of lattice energy. Write and explain the terms involved. **4**

c) Explain the reducing action of carbon as a reducing agent for the reduction of metal oxides. **4**

d) Calculate the magnetic moment for the following ions and explain which one will have higher value and why? Also suggest the magnetic behaviour of the two. **4**

a) Mn^{2+} (b) Zn^{2+}

e) Which is more planar BF_3, NH_3 and CH_4? Explain **2.75**

5. a) Explain why alkaline earth elements prefer divalent state even when their second ionization energy is higher than the first one? Give an example also. **4**

b) Explain the concept of Hybridization and suggest the hybridization and shape of CH_4 molecule. **4**

c) Compare and explain the solubility of NaCl and $BaSO_4$ in water? **4**

d) Predict and draw the shapes of the following molecules: **4**

1) PCl_5

2) SF_6

e) Why sulphide ores are firstly converted to oxides before reduction by carbon? **2.75**

6. a) Draw the structure of the following and explain any one application for each one of them. **3x3=9**

(i) Hydrazine (ii) Ammonia (iii) Hydroxylamine

b) Explain with example Hund's Rule of maximum mulitiplicity. **4**

a) Arrange the following in the increasing order of bond angle and explain the trend. **2.75**

H_2O, H_2S, H_2Te, H_2Se

b) Discuss electrolytic method of purification employed for the purification of copper metal. **3**

***Your Roll No*: ……..**

Unique Paper Code : 42177915

Name of the Paper : DSE: Analytical Biochemistry

Name of the Course : B.Sc. (Prog.) with Analytical Chemistry/ Industrial Chemistry

Semester : V

Duration : 3 Hours

Maximum Marks : 75

Instructions for candidates:

(a) Write your ROLL NO. on the top immediately on receipt of this question paper.
*(b) This question paper contains SIX questions, of which **FOUR** questions should be answered.*
(c) Attempt any TWO questions from SECTION I and TWO from SECTION II.
*(d) **USE** separate answer sheets (with the section HEADING) for section **I** and section **II**.*
(e) The questions should be numbered in accordance to the number in the question paper.

SECTION I

Question No.* 1 *is compulsory

1. a) Indicate whether each of the following pairs of sugars consists of anomers, epimers, or an aldose-ketose pair:

i. D-glyceraldehyde and dihydroxyacetone

ii. D-glucose and D-mannose

iii. D-glucose and D-fructose

iv. α-D-glucose and β-D-glucose

v. D-galactose and D-glucose **5**

b) Explain reducing and non-reducing sugar on the basis of chemical reactions. **5**

c) Describe glycosaminoglycans and their biological functions. **4**

d) What is mutarotation? **3.5**

2. a) What are lectins? How are they important in biological system? **4**

b) Describe α-helix and its structural features. **6**

c) Describe myoglobin and its structure. **4**

d) What are phospholipids and their functions? **6**

3. a) Describe steroidal hormones and their biological significance. **5**

b) Drive Michaelis-Menten kinetics. **5**

c) List factors which affects enzyme activity. **5**

d) Describe lipoproteins and their biological functions. **5**

SECTION II

Question No. 4 is compulsory

4. a) Describe the composition and physical characteristics of whole blood. Explain why it is classified as a connective tissue. **6**

b) What is Van-den-Bergh reaction? How it is used to determine the bilirubin level? **6**

c) How cholesterol is estimated by Libermann-Burchard method and what are the factors that affect color formation during the reaction? **5.5**

5. a) Explain the process of hemostasis. List the factors that limit clot formation and prevent undesirable clotting. **7.5**

b) Briefly explain about the venous method for collection and preservation of blood samples. **7.5**

c) Discuss the Brethelot's method used for the determination of blood in urea. **5**

6. a) Describe the structure, function and production of erythrocytes. **5**

b) Write a short note on (any three)

(i) Creatinine
(ii) Leucocytes
(iii) Blood Coagulation
(iv) Bilirubin **(5×3)**

***Your Roll No*: ……..**

Unique Paper Code : 42177915

Name of the Paper : DSE: Analytical Biochemistry

Name of the Course : B.Sc. (Prog.) with Analytical Chemistry/ Industrial Chemistry

Semester : V

Duration : 3 Hours

Maximum Marks : 75

Instructions for candidates:

(a) Write your ROLL NO. on the top immediately on receipt of this question paper.
*(b) This question paper contains SIX questions, of which **FOUR** questions should be answered.*
(c) Attempt any TWO questions from SECTION I and TWO from SECTION II.
*(d) **USE** separate answer sheets (with the section HEADING) for section **I** and section **II**.*
(e) The questions should be numbered in accordance to the number in the question paper.

SECTION I

Question No.* 1 *is compulsory

1. a) Define epimers and anomer with suitable examples. **3.5**

b) Why do D-glucose and D-fructose form same osazone? Draw the mechanism involved. **5**

c) Draw the following sugars as pyranose using Haworth projection.

(i) ß-D-glucose
(ii) α-D- galactose **4**

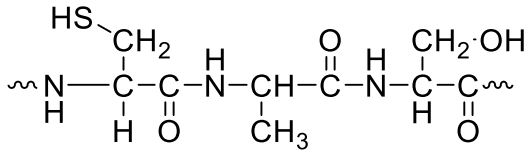
d) Describe glycoproteins and their biological functions. **5**

2. a) What is the importance of Ramachandran plot in protein structure? Explain with suitable structure. **6**

b) Match each amino acid in the left-hand column with the appropriate side-chain type in the right-hand column. **6**

(i) Leu	(1) hydroxyl-containing
(ii) Glu	(2) acidic
(iii) Lys	(3) basic
(iv) Ser	(4) sulfur-containing
(v) Cys	(5) nonpolar aromatic
(vi) Trp	(6) nonpolar aliphatic

c) Name those components. Examine the segment of a protein **8**



(i) What are three amino acids present?

(ii) Of the three, which is the N-terminal amino acid?

(iii)Identify the peptide bonds.

(iv)Identify the α-carbon atoms.

3. a) Discuss the saturated and unsaturated fatty acids of biological importance, along with their structures. **5**

b) What are lipoproteins? Discuss the general structure, classification and functions of lipoproteins. **5**

c) How are parallel and antiparallel β-sheets formed? Explain with chemical structures. **5**

d) What are enzymes? Classify them according to their functions. **5**

SECTION II

Question No. 4 is compulsory

4. a) Describe briefly the formation of urine process. What is proteinuria and glycosuria? **6**

b) What is Bence Jone's protein and how they are estimated. **5.5**

c) Describe the intrinsic pathway of blood clotting with flow chart. **6**

5. a) Describe the structure, functions and production of platelets. **7.5**

b) Briefly explain about the venous method for collection and preservation of blood samples. **7.5**

c) How does hemolytic and obstructive jaundice occur? Explain briefly **5**

6. a) What is Tinder's method used for the estimation of glucose present in the blood? **5**

b) Describe briefly types of leukocytes with their structure and functions. **7.5**

c) What happens when urine preserved carelessly? Give precautions to prevent these changes. **7.5**

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Unique Paper Code	: 42177919
Name of the Paper	: DSE: Applications of Computers in Chemistry
Name of the Course	: B.Sc. Prog
Semester	: V
Duration	: 3 Hours
Maximum Marks	: 75

Instructions for Candidates

1. Attempt only **Four** Questions.
2. **Question Number 1 is compulsory**. Attempt any three questions out of remaining five questions.
3. Attempt all parts of a question together
4. Use of Non-programable scientific calculator is allowed.

1. Attempt all parts.

(a) Write the following algebraic expressions in BASIC.

(i) $pH = pK_b + log_{10}\left(\frac{[salt]}{[base]}\right)$

(ii) v= $\frac{F^2}{3\pi\eta}\left(\sqrt{\frac{2}{RT}}\right)$

(iii) $P = \frac{e^{-2/KT}}{2V_r - 1}$

(b) Convert the following
(i) $(1101.011)_2$ to decimal
(ii) $(67.125)_{10}$ to binary

(c) Identify the errors in the following BASIC constants (if any) and correct them
(i) 750,000.0
(ii) LAMBDA-MAX
(iii) 38.5E-4.5

(d) Identify the errors in the following BASIC variables (if any) and correct them
(i) LET$
(ii) 8PRESSURE
(iii) KELVIN

(e) Explain the meaning of following error messages in BASIC.
(i) Out of DATA
(ii) Overflow
(iii) FOR without NEXT

3×5

2.

(a) The following program illustrates the use of looping statement

```
INPUT P, Q, M
FOR I = P TO Q STEP M
FACT = FACT * I
PRINT FACT
NEXT I
END
```

Give three conditions under which this loop will be executed.

(b) Explain the purpose of DIM statement. Write a user-friendly program in BASIC to carry out product of two matrices **A** and **B**.

(c) Differentiate between relational and logical operators.
Let R = 1 and S = 2. Determine whether the following relational expressions is true or false. Justify.

(i) 2*R+S^2 > S+3

(ii) R > S OR R > 0 AND S < 0

6,6,8

3.

(a) Explain the binary bisection method to find the root of a polynomial.
Write a program in BASIC to find volume of one mole of real gas obeying van der Waals equation using binary bisection method.

Given equation of state:

$$\left(P + \frac{a}{V^2}\right)(V - b) = RT$$

the physical constants are
a = 3.640 L^2 atm mol^{-2}
b = 0.04267 L mol^{-1}
R= 0.0821 atm L mol^{-1} K^{-1}

(b) Differentiate between
(i) low level and high level language
(ii) SCREEN 1 and SCREEN 2

(c) Write a program to calculate average (u_{avg}), root mean square (u_{rms}) and most probable (u_{mp}) velocities of oxygen gas at 298 K.
$u_{rms} = \sqrt{\frac{3RT}{M}}$, $u_{avg} = \sqrt{\frac{8RT}{\pi M}}$ and $u_{mp} = \sqrt{\frac{2RT}{M}}$
where R= 8.314 J K^{-1} mol^{-1}

10,5,5

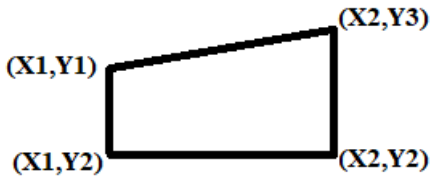
4.

(a) Write BASIC statements to produce the following results:

(i) If P has a value less than equal to 150, then transfer control to the statement number 50, otherwise execute the next statement
(ii) A two-dimensional array to hold 25 items of data.
(iii) Print the word COMPUTERS beginning in the 8th column.
(iv) Clear output screen
(v) Decrease the value assigned to a variable Y by 0.5
(vi) Assign the string CLASS 4 to a variable.

(b) Identify and correct the syntax error in the following statements
(i) DIMENSION A(3,3)
(ii) PRINT LEN$(TEXT$)
(iii) FOR K$= 1 TO L STEP2
(iv) LET A = LEFT$(Q$,3)
(v) DEF FN(Y)= Y^4
(vi) ON X-1 GOTO 10, Y

(c) What is a purpose of DRAW statement?
Write a program in BASIC to obtain a trapezoid using DRAW statement as per the dimensions shown in the figure below and label the dimensions also.



X1 = 60; X2 = 80
Y1 = 40: Y2 = 50: Y3 = 20

6,6,8

5.
(a) For the distribution of Iodine between CCl_4 and water the following data of concentration in organic (C_{org}) and water (C_{aq}) layers was obtained. Write a program in BASIC to fit it to a straight-line using method of least square fit.

Given $K_d = \frac{C_{org}}{C_{aq}}$

Corg /M	0.0274	0.0430	0.0650	0.1010	0.1200	0.130	0.140
Caq/M	0.00032	0.0005	0.00076	0.0011	0.0014	0.0015	0.0017

Obtain the best fit line. Calculate and print K_d.

Given:

(Slope) m= (N∑XY - ∑X ∑Y)/(N∑X^2- (∑X)^2)
(Intercept) c=(∑X^2 ∑Y - ∑X ∑XY)/(N∑X^2- (∑X)^2)

(b) Write the output of the following:
(i) 10 READ A, B, C$, D$
…….

```
50 RESTORE

60 READ C, D, A$, B$
……..
80 PRINT C, D, A$, B$

90 DATA 50, 20, "BLACK", "WHITE", "RED", "GREEN"
```

(ii)
```
10 SCREEN 1

20 WINDOW (10,10) - (100-100)

30 LINE (20,20) – (30,30), B

40 LINE –(50,50)

50 END
```

10,10

6.

(a) Explain Simpson's one-third rule of integration. Write a program to calculate enthalpy for C (s, graphite) from 298K to 500K using Simpson rule.

$$\int dH = \int_{T_1}^{T_2} C_p dT$$

Given that $C_p = a + bT + \frac{c}{T^2}$ where, a= 16.86, b= 4.77 x 10^{-3}& c= -8.54 x 10^5.

(b) Write the purpose of the following program? Explain each BASIC statement.

```
10  INPUT X
20  E= 0
30  B$ = STR$(X)
40  L= LEN(B$)
50  FOR I = L TO 1 STEP-1
60  C$ = MID$ (B$, I, 1)
70  C= VAL (C$)
80  E= E + C*2^(L-1)
90  NEXT I
100  PRINT E
110 END
```

What will be the output of the program if input is 10101? Explain your answer.

10,10

Unique Paper Code: 42177925

Name of the Paper: DSE: Chemistry of d-block Elements, Quantum Chemistry and spectroscopy

Name of the Course: B.Sc. Prog.

Semester: V

Duration: 3 hours Maximum Marks: 75

Instruction for Candidates

1. Following details to be written on first page:
   University. Roll. No.
   Name:
   Class:
   Course:
   Semester:
   Paper Name:
   Unique paper code:
2. Put page numbers on every page of the answer script
3. Attempt **any two** questions from each section.
4. Each Question carries equal marks.
5. First part of each question carries 0.75 marks.
6. Remaining parts of each question carry 6 marks
7. Attempt all parts of a question together.

SECTION A

Q1.

(a) The relation between Δ_t and Δ_O is ……...

(b) Explain with reasons any three:
(i) Transition elements are good catalyst
(ii) Fe^{3+} is more stable than Fe^{2+}.
(iii)$KMnO_4$ is a strong oxidizing agent whereas MnO is weak reducing agent.
(iv)NH_3 readily form complexes but NH_4^+ does not

(c) Write the IUPAC name of the following (any six):

(i) $[Cr(NH_3)_6][CoF_6]$
(ii) $[Co(NH_3)_4(NO_2)Cl]NO_3$
(iii)$[(NH_3)_5 Cr OH Cr(NH_3)_4(H_2O)]^{5+}$
(iv)$(NH_3)_4[Pt(NCS)_6]$
(v) $Na_3[Fe(C_2O_4)_3]$
(vi)$[Cr(H_2O)_4Cl_2]NO_3$
(vii) $[Mn_3(CO)_{12}]$

(d) Why ions of d- block elements are coloured? How is colour of ions of d-block elements related with magnetic properties? Explain

Q2.

(a) $[Cu(NH_3)_4]^{2+}$ has ……..geometry.

(b) Why don't we come across geometrical isomers in tetrahedral complexes? Name the type of isomerism shown by the following isomers

(i) $[Co(NH_3)_5SO_4]Br$ and $[Co(NH_3)_5Br]SO_4$
(ii) $[Pt(NH_3)_4][PtCl_6]$ and $[Pt(NH_3)_4Cl_2][PtCl_4]$
(iii)$[Co(NH_3)_5(ONO)Cl_2$ and $[Co(NH_3)_5(NO_2)Cl_2$

(c) How does Valance Bond Theory explain the following complexes (Z for Ni=28):

(i) $[Ni(CN)_4]^{2-}$ is diamagnetic and square planar
(ii) $[NiCl_4]^{2-}$ is paramagnetic and tetrahedral
(iii)$[Ni(CO)_4]$ is diamagnetic and tetrahedral

(d) Discuss magnetic properties in tetrahedral complexes on the basis of crystal field theory. Calculate spin magnetic moment of the following complexes according to V.B. theory as well as C.F. theory

(i) $[Cr(H_2O)_6]^{3+}$
(ii) $[Fe(NH_3)_6]^{3+}$

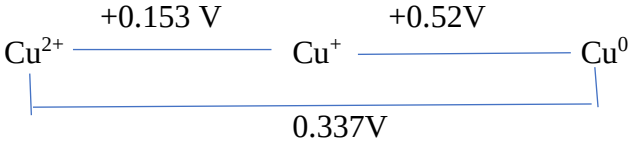
Q3.

(a) Tetragonal geometry is distorted octahedral geometry. Energy of …….. orbital decreases with increase in distortion.

(b) Describe the ion exchange method to separate lanthanides from the mixture of lanthanides.

(c) Explain Jahn Teller effect on the ground state of transition metal complexes with example Ti^{3+}. How is this effect related to the geometry of complexes? Explain the role of this effect in the complex of Cu^{2+} metal ion.

(d) A. With the help of reduction potential diagram



Find out, if
(i) Cu^{+} will undergo disproportionation into Cu^{2+} and Cu^{0}
(ii) Cu^{+} will readily change into Cu^{0}.

B. Distinguish between the following (any one):
(i) Inner orbital and outer orbital complexes
(ii) Linkage isomers and coordination isomers

Section B

Physical Constants

Planck's constant 6.626 x 10^{-34} *Js*

Velocity of light 3 x 10^{8} *m/s*

Atomic mass unit 1.661 x 10^{-27}*kg*

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

Mass of electron 9.109 x 10^{-31} *kg*

Q4

(a) The mathematical relationship between absorbance and %transmittance is _____.

(b) In the photochemical reaction B →C, 1.00 x 10^{-5} mole of C is formed as a result of the absorption of 6.00 x 10^{7} ergs at 3600 Å. Calculate the quantum yield.

(c) Name and explain the theory which forms the basis for the electronic spectra of conjugated systems. What is the minimum excitation energy for linear molecule hexatriene, given that the average C-C bond distance is 140 pm?

(d) Explain why in the compound $C_6H_5 – (CH=CH)_n – C_6H_5$, the $\pi \leftarrow \pi^*$ transition shifts from UV to the visible region as *n* increases. Do you observe any change in the form of the absorbance bands while moving from non-polar to polar solvents? Explain.

Q5

(a) The ratio of the energy of the second energy level to the first energy level of a particle in one-dimensional box is equal to ___.

(b) What important aspect is signified by the property of commutation? Find the commutator $[\hat{x}, \hat{p}_x]$. Determine the result when $\hat{x}$ and $\hat{p}_x$ operate on $\psi_n(x) = N \sin\left(\frac{n\pi x}{L}\right)$ where *N* and *n* are constants.

(c) Which of the following mathematical functions are acceptable wavefunctions in the intervals given?

(i) $\psi = tanx$ $(0, 2\pi)$

(ii) $\psi = e^{-x}$ $(0,\infty)$

(iii) $\psi = \frac{\sin x}{x}$ $(0,\infty)$

(d) Solve Schrödinger wave equation for a particle of mass 'm' moving in 1-D box of length 'l'. Can "zero-point energy" of particle in 1-D box be zero? Explain.
Calculate the percentage change in the energy of a particle of mass m in a one-dimensional box of edge length L when the edge length is decreased by 10%.

Q6

(a) Number of vibrational degrees of freedom in CO_2 is _____.

(b) The rotational constant of $^{127}I\ ^{35}Cl$ is 0.1142 cm^{-1}. Calculate the ICl bond length. (m(^{35}Cl) = 34.9688 amu, m(^{127}I) = 126.905 amu.)

(c) A diatomic molecule AB undergoes vibrational motion according to the harmonic oscillator model. Write the mathematical expression for the Hamiltonian, Schrödinger's equation and the vibrational energy E_{vib} associated with this system. On what factors does the vibrational frequency of a molecule depend? What is order of decreasing vibrational frequency for C-Cl, C-Br, C-C,C-O,C-H? Justify your answer.

(d) The fundamental vibrational frequency of HF is 4141.3 cm^{-1}. Calculate the force constant of the H-F bond. Also, predict the fundamental vibrational frequency of DF.

Unique Paper Code	:	**42357932**
Name of the course:		**B.Sc. (Prog.) Analytical Chemistry**
Name of the Paper	:	**DSE-Mathematics 2: Calculus and Geometry**
Semester	:	**V**
Duration to attempt the paper:		**3 Hours**
Maximum Marks	:	**75**

Attempt any four questions. All questions carry equal marks.

1. Describe the graph of the conic

$$x^2 - 9y^2 - 36y + 6x - 63 = 0.$$

Sketch it. Find an equation for the parabola that has its vertex at (2, 3) and its focus at (4, 3).

2. Find the asymptotes of the curve

$$7xy - 2x^2 + 4y + 3 = 0.$$

Find the position and nature of multiple points of the curve given by

$$x^3 + y^3 + 3x^2 + 3y^2 - 3xy - 1 = 0.$$

Also, find the equation of the tangent at each multiple point, if any.

3. Let $f(x)$ be a function defined as

$$f(x) = x^5 + 5x^4.$$

Determine the intervals in which this function is increasing or decreasing. Further, determine the points of local maxima and local minima. Find the open intervals in which $f(x)$ is concave up and concave down. Also, determine the point of inflexion, if any.

4. Find the volume of the solid generated when the region enclosed by $y^2 = x$, $x + y = 6, x$-axis is revolved about x-axis. Further, find the arc length of the curve

$$3x = (y^2 + 2)^{\frac{3}{2}}$$

from $y = 0$ to $y = 1$.

5. Let $\phi(x, y, z) = x^2 + yz$ be a scalar field and

$$\vec{F}(x, y, z) = 7y^3z^2i - 8x^2z^5j - 3xy^4k$$

be any vector field. Find $\nabla \times (\nabla\phi)$, $\nabla \times \left(\nabla \times \vec{F}\right)$, $\nabla.(\nabla \times \vec{F})$. Verify $\nabla.(\phi\vec{F}) = \phi(\nabla.\vec{F}) + \nabla\phi.\vec{F}$

Sketch the graph of ellipsoid given by $\frac{x^2}{4} + \frac{y^2}{25} + \frac{z^2}{16} = 1$.

6. Discuss the continuity and derivability of the function f defined below at $x = 1$ and $x = 2$

$$f(x) = \begin{cases} x, & x < 2, \\ 4 - x, & 2 \le x \le 3, \\ 1 + 3x - x^2, & x > 3. \end{cases}$$

Verify mean value theorem for the function $f(x) = x^3 - 3x^2 + 1$ in the interval $[1,3]$.

Unique Paper Code: 42177925

Name of the Paper: DSE: Chemistry of d-block Elements, Quantum Chemistry and spectroscopy

Name of the Course: B.Sc. Prog.

Semester: V

Duration: 3 hours Maximum Marks: 75

Instruction for Candidates

1. Following details to be written on first page:
   University. Roll. No.
   Name:
   Class:
   Course:
   Semester:
   Paper Name:
   Unique paper code:
2. Put page numbers on every page of the answer script
3. Attempt **any two** questions from each section.
4. Each Question carries equal marks.
5. First part of each question carries 0.75 marks.
6. Remaining parts of each question carry 6 marks
7. Attempt all parts of a question together.

SECTION-A

Q1.

(a) The effective atomic number of platinum in $[Pt\ (NH_3)_4]^{2+}$ is ……

(b) Define Jahn Teller theorem. Which of the following high spin complexes would be expected to exhibit a Jahn Teller distortion? Explain.

(c) Write all possible geometrical isomers of the following and explain.
   (i) $[Co(en)_2Cl_2]^+$
   (ii) $[Rh\ (NH_3)_3Br_3]$

(d) Why $[Ni\ (H_2O)_6]^{2+}$ is a green solution while a solution of $[Ni(CN)_4]^{2-}$ is colourless.

Q2.

(a) ……transition is spin forbidden.

(b) Using VBT (i) assign electronic configuration to the central metal ion, (ii) predict and justify the type of hybridization involved, (iii) explain geometry, (iv) calculate magnetic moment for the following:

(i) $[Cr\ (H_2O)_6]^{2+}$
(ii) $[Ni\ (CO)_4]^{2+}$
(iii) $K_2\ [NiCl_4]$

Q3.

(a) The absorption spectra of lanthanoids are sharp due to ……..

(b) Define electronic transition. Describe different types of electronic transitions in metal complexes. Explain allowed transitions of $[Mn\ (H_2O)]^{2+}$.

(c) Explain the structure of the following complexes on the basis of CFT

(i) Hexa aquo iron (III) ion
(ii) Hexa amino cobalt (III) ion
(iii) Hexa chloro cobalt (III) ion

(d) Which ions will be colourless among the following and why?
Fe^{2+}, Mn^{2+}, Cu^{+}, Cr^{3+}, MnO_4^-, Ti^{4+}

Section B

Physical Constants

Planck's constant 6.626×10^{-34} *Js*
Velocity of light 3×10^{8} *m/s*
Atomic mass unit 1.661×10^{-27} *kg*
Avogadro's number 6.023×10^{23} mol^{-1}
Mass of electron 9.109×10^{-31} *kg*

Q4. (a) The value of the commutator $[\hat{x}, \hat{p}_x]$ is _____.

(b) Determine whether each of the following wavefunctions are acceptable or not as a state function over the indicated intervals.

(i) e^{-x} $(0, \infty)$
(ii) e^{-x} $(-\infty, \infty)$
(iii) sin x $(0, 2\pi)$

(c) Calculate the probability that a particle in a one-dimensional box of length 'a' is found to be between 0 and a/2. (Wave function for particle in one dimensional box is given by $\sqrt{\frac{2}{a}}\ \mathrm{Sin}\frac{n\pi x}{a}$, where 'a' is length of the box)

(d) An electron is constrained to move in a one-dimensional box of length 0.15 nm. Calculate:

(i) the energy corresponding to the levels n= 1, 2, 3
(ii) the energy absorbed when this electron undergoes a transition from E_1 to E_2 and E_2 to E_3.
(iii)if this is emitted as a single photon, calculate the wavelength associated with the lower energy transition.

Q5.

(a) In general, $n \rightarrow \pi^*$ transitions are _____in intensity than those due to $\pi \rightarrow \pi^*$ transitions.

(b) Calculate the number of translational, rotational and vibrational degrees of freedom for (i) CO_2 (ii) H_2O (iii) Benzene .

(c) Indicate with the help of the Jablonski diagram, the various processes by which the excited electronic states get deactivated. What is the difference between fluorescence and phosphorescence?

(d) An isolated C=C chromophore causes absorption at 190 nm whereas lycopene which has 11 bonds in conjugation absorbs at 1361 nm, Explain. Also, explain the effect of increasing polarity of solvent on $n \rightarrow \pi^*$ and $\pi \rightarrow \pi^*$ transitions.

Q6.

(a) The degeneracy of a rotational energy level is equal to _____.

(b) The internuclear distance of HCl molecule is 1.29 Å. Calculate the energy (in cm^{-1}) and the angular frequency of this molecule in first, second and third rotational level. The atomic masses of H and Cl are 1.673×10^{-27} kg and 58.06×10^{-27} kg.

(c) The force constant for $^1H^{19}F$ is 966 Nm^{-1}. Calculate:

(i) The zero-point vibrational energy of this molecule when it follows harmonic motion.
(ii) The frequency of the electromagnetic radiation to excite this molecule from the ground state to the first excited state.

(d) What is meant by the term "rigid rotator"? From classical mechanical considerations, show that the total energy of a rigid rotator is $L^2/2I$ where L is the angular momentum and I is the moment of inertia. How does this result differ from the quantum mechanical result? Why is it not possible to obtain the rotational constant of H_2 molecule from microwave spectroscopy?

Roll No…….

Unique Paper Code	:	42177918
Name of the Paper	:	DSE-Industrial Chemicals & Environment
Name of the Course	:	B.Sc.(Prog.) Chemistry
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. Answer any four questions in all. All questions carry **18.75** marks each.

Q1. (a) Draw and explain labelled diagram of nitrogen cycle.

(b) Explain how fertilizers cause water pollution. Suggest some preventive measures to control this pollution. State "Liebig's law of minimum" and give its significance.

(c) What is Photochemical Smog? Give the chemistry of Photochemical Smog and its consequences.

(3x6.25)

Q2. (a) Draw a labelled diagram of different regions of atmosphere with altitude, temperature variation and the chemical species prevailing in each layer.

(b) Give a method of production and usages of bleaching powder. How is the strength of bleaching powder estimated in the laboratory?

(c) Name four different Greenhouse gases and how are they responsible for global warming? How are they affecting global warming?

(3x6.25)

Q3. (a) Explain by giving reactions how chlorofluorocarbons deplete ozone. What are the safer substitutes of chlorofluorocarbons and how safer are they?

(b) Give an account of inorganic and organic particulate matter in the atmosphere. Discuss the method of controlling emission of particulate matter.

(c) Using a suitable example, explain the refining of metals by Mond's process.

(3x6.25)

Q4. (a) How do we treat the effluents from the following industries (any two)?

(i) Dairy Industry

(ii) Textile Industry

(iii) Fertilizer Industry

(b) What are major sources and sinks of different NOx. Suggest any one method to estimate the amount of NOx in an air sample.

(3x6.25)

Q5. (a) Differentiate between BOD and COD. Which will be higher for surface waters and why? Give method of determination of BOD.

(b) What are the advantages and disadvantages of geothermal energy? How can it be harnessed?

(c) What are the different ways of liquefying gases.

(3x6.25)

Q6. Write short notes on the following: **(*Any three*)**

(a) Oil spills as water pollutant.

(b) Different types of iron.

(c) Tertiary treatment of water.

(d) Cracking and reforming of petroleum

(3x6.25)