

34
This question paper contains 4 printed pages]

Roll No.

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S. No. of Question Paper : 5774

Unique Paper Code : 2172011201

Name of the Paper : DSC : Chemistry of s- and p-Block Elements

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

Semester : II (UGCF-NEP)

Duration : 3 Hours

Maximum Marks : 90

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

Attempt any six questions out of eight questions.

All questions carry equal marks.

1. Explain any five of the following :

- Ionization energies of group 13 elements (B to Tl) show irregular trends.
- IF_7 is always stored in pyrex glass bottles.
- Oxygen exists as diatomic molecule while sulphur exists as S_8 .
- Behaviour of alkali metals in liquid ammonia.
- Carbon shows maximum Catenation tendency than other elements of group 14 elements.
- The increasing order of reducing character of Group 15 hydrides down the group.

5×3

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P.T.O.

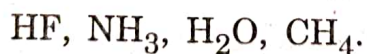
2. (a) What are interhalogen compounds ? Draw the structure of ClF_3 and ICl_3 in solid state.
- (b) Discuss Van Arkel-De Boer process for the purification of metals Ti, Zr, V and Th. Write the chemical equations involved.
- (c) Explain briefly :
- (i) Helium and Neon do not form Clathrate compounds.
- (ii) Why does Li form oxides whereas Na form peroxides and other elements of the 1st Group form superoxides on heating in air ? 3×5
3. (a) Describe the Hydrometallurgical process or cyanide process for the extraction of silver and gold. Write the chemical equations involved during extraction.
- (b) Discuss the structure and bonding behaviour in B_2H_6 molecule. Write the reactions of diborane with H_2O and NH_3 :
- (i) $\text{B}_2\text{H}_6 + \text{H}_2\text{O} \longrightarrow$
- (ii) $\text{B}_2\text{H}_6 + \text{NH}_3 \xrightarrow{\Delta}$
- (c) Nitrogen is chemically inert while phosphorus is quite reactive, explain. Discuss about the allotropes of phosphorus. 3×5
4. Attempt any *five* of the following :
- (a) Why F_2 is strongest oxidizing agent though electron affinity of Cl_2 is more ?
- (b) Describe the order of stability of hydrides of group 14 elements (CH_4 , SiH_4 , GeH_4 and SnH_4) towards water.

- (c) Arrange in the order of increasing oxidising power and acidic strength of HClO , HClO_2 , HClO_3 and HClO_4 ? Give reasons.
- (d) Explain the characteristic properties of alkali and alkaline earth metals towards flame colouration.
- (e) Explain the structure and bonding behaviour in basic beryllium acetate.
- (f) What are allotropes ? What is the basic difference between diamond and graphite ?

5×3

5. Attempt any *five* of the following :

- (a) H_2O is a liquid while H_2S is gas. Explain.
- (b) Give the structure and the name of the product formed when two molecules of H_3PO_4 (ortho phosphoric acid) condensed to each other.
- (c) Explain the structure of XeF_2 on the basis of MOT.
- (d) Beryllium shows anomalous behaviour and dissimilarities with other alkaline earth metals. Explain with *three* suitable examples.
- (e) Arrange the following in increasing order of their boiling points and justify :



- (f) BaO is more soluble than MgO but BaSO_4 is insoluble, however MgSO_4 is quite soluble in water. Explain.

5×3

6. (a) Explain the diagonal relationship between Boron and Silicon. Explain with the help of electronegativity concept and polarising power concept.

(b) What are Clathrates compounds ? What are the conditions for the formation of Clathrates compounds ? Discuss the type and preparation of Gas hydrate and quinol based Clathrates compounds.

(c) What are crown ethers ? Write the structure of crown-4 with lithium ion and crown-6 with potassium ion. 3×5

7. Attempt any *five* of the following :

(a) Draw the structure of Mg-EDTA complex.

(b) What is inert pair effect ? Sb^{3+} is reducing in nature and Bi^{3+} is stable. Explain.

(c) Arrange the following in increasing order of boiling points :



(d) Give the structure of peroxydisulphuric acid and also the products obtained on its hydrolysis.

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

(f) Why is SCl_6 not known but SF_6 is a known compound ? 5×3

8. Write short notes on any *three* :

(a) Allotropes of Sulphur

(b) Pseudo halogens

(c) Ellingham diagrams for the reduction of metal oxides

(d) 2, 2, 2-cryptand for potassium ion. 3×5

This question paper contains 5 printed pages]

Roll No.

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S. No. of Question Paper : 5795

Unique Paper Code : 2172011202

Name of the Paper : DSC : Haloalkanes, Arenes, Haloarenes,
Alcohols, Phenols, Ethers and Epoxides

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

Semester : II

Duration : 2 Hours

Maximum Marks : 60

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

Attempt four questions in all.

Question No. 1 is compulsory.

Each question carries 15 marks.

1. Answer the following (any five) :

(a) Arrange the following alkoxide nucleophiles in decreasing order of S_N2 reactivity giving reasons :



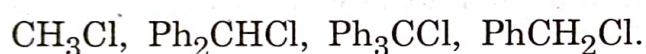
(b) Why is nitrobenzene a suitable solvent for the Friedel-Crafts alkylation of PhBr while benzene is not ?

(c) Which is a stronger base, RO^- or RS^- ? Which will be a better nucleophile in aqueous solution and DMSO ?

P.T.O.

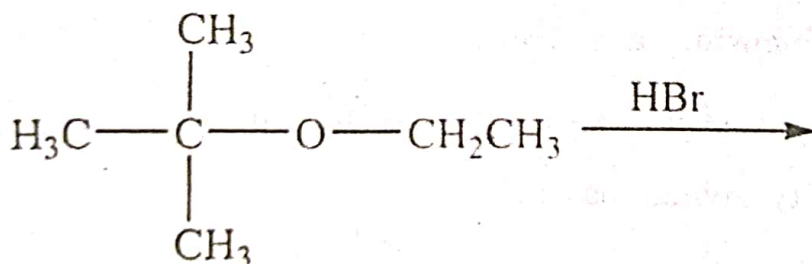
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- (d) How many mononitration products would be formed from each isomeric dibromobenzene ?
- (e) Comment on acidic properties of isomeric nitrophenols.
- (f) Why do aryl halides and vinyl halides show low reactivity towards nucleophilic substitution reactions compared to alkyl halides ?
- (g) How many molecules of HIO_4 would be consumed for oxidation of propane-1, 2, 3-triol and what are the products formed ?
- (h) Giving reasons, arrange the following in increasing order of reactivity towards alkaline hydrolysis by $\text{S}_{\text{N}}1$ reaction :



3×5=15

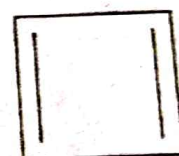
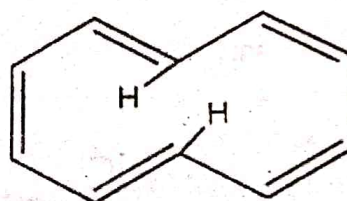
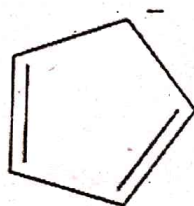
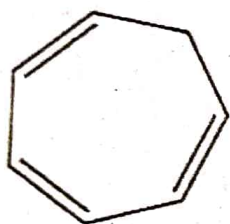
2. (a) Write the product of the following reaction with mechanism :



- (b) Why 2, 4, 6-trinitrochlorobenzene is easily hydrolysed in the presence of aq. NaOH solution but not chlorobenzene ?
- (c) The reaction of $(\text{CH}_3)_3\text{C}-\text{Cl}$ with CH_3O^- does not give of $(\text{CH}_3)_3\text{C}-\text{OCH}_3$.

5,5,5

3. (a) What happens when tertiary butyl bromide is treated with water ?
Give its mechanism with stereochemical aspect.
- (b) How would you distinguish between the following by a chemical reaction :
- (i) 1-butanol and diethyl ether
- (ii) tert-butyl alcohol and methanol.
- (c) Classify the following compounds as aromatic, antiaromatic and non-aromatic ?



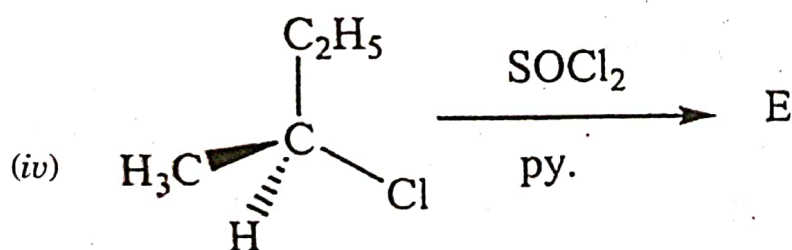
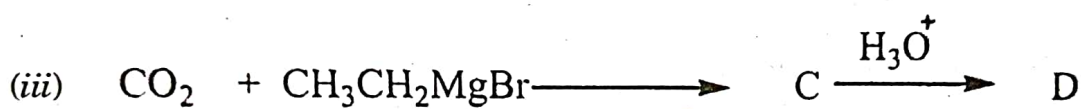
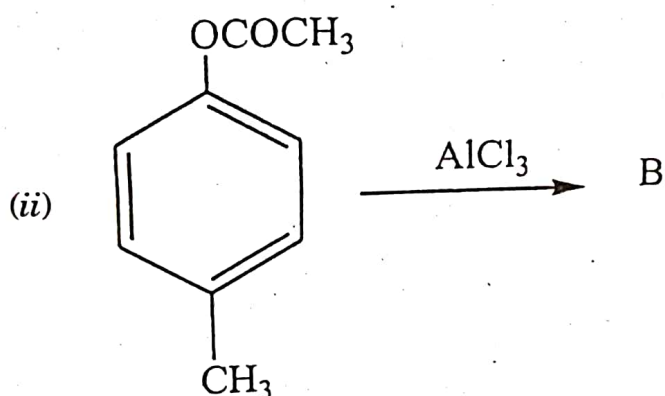
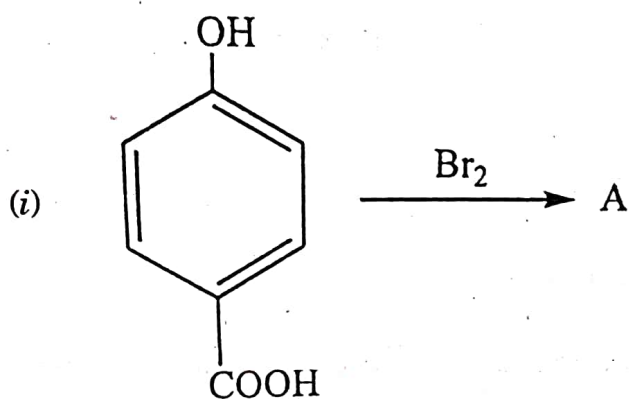
5,5,5

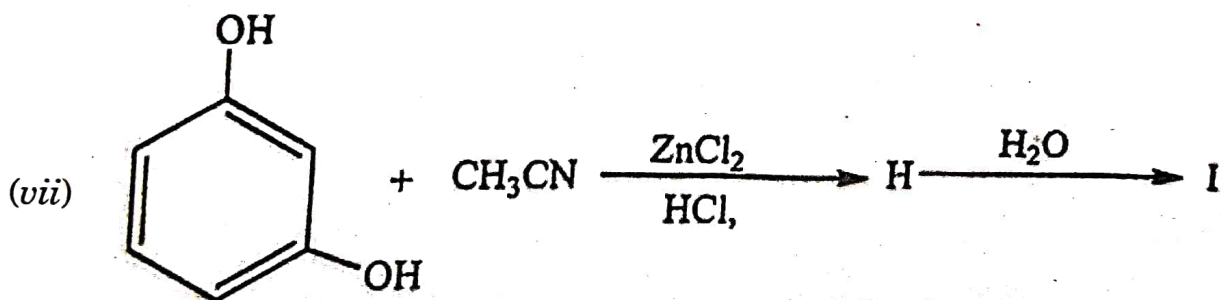
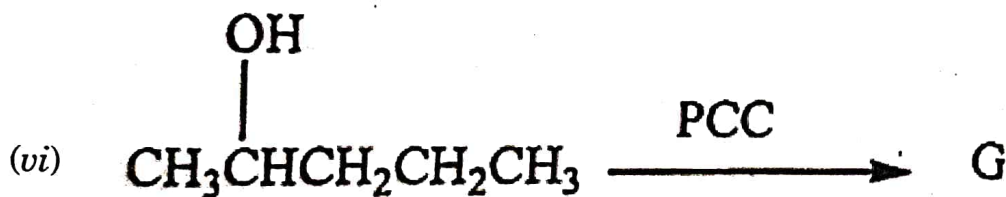
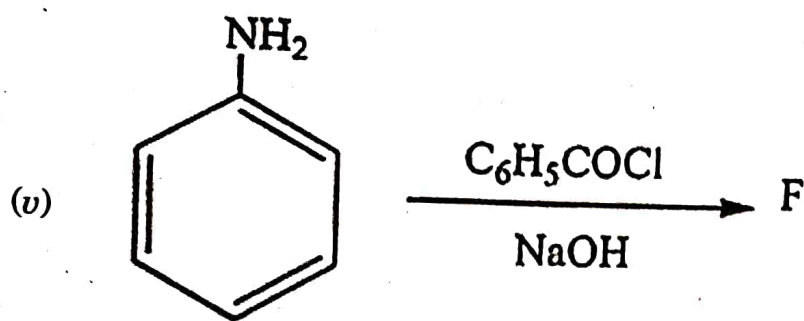
4. (a) Outline the following conversions (any *three*) :
- (i) Benzyl alcohol from methanal
- (ii) Salicylic acid from phenol
- (iii) Acetone from methyl bromide
- (iv) Benzene to *m*-bromobenzoic acid.
- (b) Both *o*-bromoanisole and *m*-bromoanisole give the same product on reaction with NaNH_2 in the presence of liquid ammonia.

9,6

P.T.O.

5. Complete the following reactions :





6. Write short notes on (any three) :

- (i) Oppenauer oxidation
- (ii) Claisen rearrangement
- (iii) Pinacol Pinacolone rearrangement
- (iv) Friedel-Crafts reaction.

5,5,5

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This question paper contains 7 printed pages]

Roll No.

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S. No. of Question Paper : 5815

Unique Paper Code : 2172011203

Name of the Paper : Chemical Thermodynamics and its Applications

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

Semester : II

Duration : 3 Hours

Maximum Marks : 90

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

Attempt six questions in all.

Question No. 1 is compulsory.

Use of scientific calculators and log tables is allowed.

1. Answer the following questions (any five) :

5×3=15

(a) The entropy of crystalline ice is not zero at 0 K. Explain.

(b) Giving suitable examples, explain the meaning of endergonic and exergonic reactions.

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P.T.O.

- (c) The enthalpy of neutralization of a strong monoprotic acid with a strong monoprotic base is always constant. Explain.
- (d) With the help of mathematical expressions, explain why ΔA is called "work function".
- (e) Classify the following as extensive/intensive— Kinetic energy, Pressure, entropy, molar heat capacity, chemical potential, Temperature.
- (f) To predict the spontaneity of a process both ΔS_{sys} and ΔS_{surr} are considered but ΔG alone is sufficient for the same. Explain.
- (g) Define integral enthalpy of solution and dilution.

2. (a) Derive cyclic rule

$$\left(\frac{\partial P}{\partial T}\right)_V \left(\frac{\partial T}{\partial V}\right)_P \left(\frac{\partial V}{\partial P}\right)_T + 1 = 0.$$

Prove it for $PV_m = RT$.

- (b) With the help of suitable mathematical expression, discuss under what conditions heating and cooling effects are produced in the Joule Thomson experiment involving real gases. Define Inversion temperature and write down its expression for a real gas.

- (c) Six moles of an ideal gas expands isothermally and reversibly from a pressure of 10 atm to 2 atm at 27°C. Calculate the values of q , w , ΔU and ΔH involved in the process. Will the values of heat and work be the same or different had the process been carried out irreversibly ? Why ?

5,5,5

3. (a) Write down the statement of Hess's law of constant heat summation and explain it with the help of an example. Is Hess's law valid for heat exchanged ' q ' in a process ? Is it valid for entropy change ' ΔS ' ? Give reason for your answer.

- (b) Using the given data, calculate the enthalpy of formation of acetic acid :

(i) Enthalpy of sublimation of graphite = 718.39 kJ mol⁻¹

(ii) Enthalpy of dissociation of hydrogen gas = 435.97 kJ mol⁻¹

(iii) Enthalpy of dissociation of oxygen gas = 495.04 kJ mol⁻¹

Bond Bond enthalpy

(kJ mol⁻¹)

C—C 347.69

C—H 413.38

C = O 728.02

C—O 351.46

O—H 462.75

P.T.O.

- (c) Derive an expression for determination of variation of enthalpy of reaction with temperature. 5,5,5
4. (a) Describe Carnot cycle. A Carnot engine operates between 500 K and 250 K. If it absorbs 1000 J of heat from the hot reservoir, calculate the work done and efficiency.
- (b) Define enthalpy of combustion. Calculate the enthalpy of formation of ethyl alcohol given the enthalpy of combustion of ethyl alcohol is $-1381 \text{ kJ mol}^{-1}$, and enthalpy of formation of $\text{H}_2\text{O} (l)$ and $\text{CO}_2 (g)$ are -287 kJ mol^{-1} and -395 kJ mol^{-1} respectively.
- (c) Show mathematically that the magnitude of the work involved in a reversible expansion of an ideal gas from volume V_1 and V_2 is larger than the corresponding work involved in an irreversible expansion against a constant pressure of P_2 . 5,5,5
5. (a) Derive :

$$(i) \quad \left(\frac{\partial S}{\partial P} \right)_T = - \frac{1}{\left(\frac{\partial T}{\partial V} \right)_P}$$

$$(ii) \quad \left(\frac{\partial U}{\partial V} \right)_T = T \left(\frac{\partial P}{\partial T} \right)_V - P.$$

- (b) State third law of thermodynamics. Absolute entropy of liquid water at 298 K has to be calculated. Write all the steps involved. Also write the final expression for calculation of entropy.
- (c) Calculate the $\Delta_{\text{mix}}G$, $\Delta_{\text{mix}}S$ and $\Delta_{\text{mix}}H$ when 20 mol of an ideal gas A is mixed in 20 mol of ideal gas B, at 298 K and 1 atm pressure. 5,5,5
6. (a) Calculate Δ_rG for the following process : $\text{H}_2\text{O} (\text{l}, 2 \text{ atm}, 373 \text{ K}) \rightarrow \text{H}_2\text{O} (\text{g}, 2 \text{ atm}, 373 \text{ K})$ where atm stands for atmospheric pressure.
- (b) Derive the expression for the entropy of mixing for two ideal gases and show how it contributes to the spontaneity of the mixing process.
- (c) Predict if ΔS_{sys} is positive, negative or zero in each of the following giving reason :
- (i) $\text{NH}_4\text{NO}_3 (\text{s}) + 3\text{H}_2 (\text{g}) \rightarrow 3\text{H}_2\text{O} (\text{g}) + \text{N}_2\text{H}_4 (\text{g})$
 - (ii) Crystallization of NaCl
 - (iii) Reversible adiabatic expansion of an ideal gas
 - (iv) $2 \text{SO}_2 (\text{g}) + \text{O}_2 (\text{g}) \rightarrow 2 \text{SO}_3 (\text{g})$
 - (v) $\text{C} (\text{graphite}) + \frac{1}{2}\text{O}_2 (\text{g}) \rightarrow \text{CO} (\text{g}).$

5,5,5

7. (a) Show that $\Delta_r H = \Delta_r U + \Delta \nu_g RT$ for a chemical reaction involving gases.

What will be the relation for condensed phases ?

- (b) Partial molar volume of a component in a solution depends on the nature as well as the amount of the other components. Explain qualitatively.

- (c) Derive the relations :

$$(i) \quad \left(\frac{\partial T}{\partial V} \right)_S = - \left(\frac{\partial P}{\partial S} \right)_V$$

$$(ii) \quad \left(\frac{\partial \mu_i}{\partial P} \right)_{T, n_j's} = V_{i, pm}$$

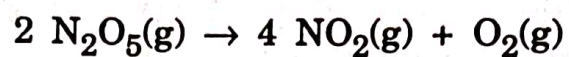
5,5,5

8. (a) Starting from $H = U + PV$ and first law of thermodynamics, derive the following expression for an ideal gas :

$$\Delta S = n C_{p,m} \ln \frac{T_2}{T_1} - n R \ln \frac{P_2}{P_1}$$

- (b) Explain the term escaping tendency. Prove that a substance will flow spontaneously from a region of higher chemical potential to a region of lower chemical potential.

- (c) Calculate $\Delta_r G^\circ$ for the following reaction at 300 K from the data provided :



	N_2O_5	NO_2	O_2
$\Delta_f H^\circ / \text{kJ mol}^{-1}$	11.3	33.18	0
$S^\circ / \text{J K}^{-1} \text{mol}^{-1}$	355.7	240.06	205.14

Is the reaction spontaneous ?

5,5,5

(3)
[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5526

J

Unique Paper Code : 2172012401

Name of the Paper : DSC 10: Coordination Chemistry
and Reaction Mechanism

Name of the Course : B.Sc. (Hons) Chemistry
(NEP-UGCFC-2022)

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions in all.
3. Question 1 is mandatory.
4. All questions carry equal marks.

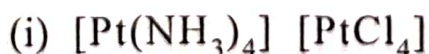
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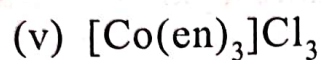
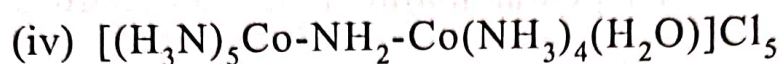
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1. Explain the following giving appropriate reasoning :
- (a) 4d and 5d elements form low spin octahedral complexes.
 - (b) Square planar complexes do not exhibit optical isomerism.
 - (c) $[\text{PtF}_6]$ is stable, whereas NiF_6 does not exist.
 - (d) Fe(II) and Fe(III) form complexes with CN^- but not with NH_3 .
 - (e) The crystal field splitting in tetrahedral complexes is smaller than in octahedral complexes.

(3,3,3,3,3)

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

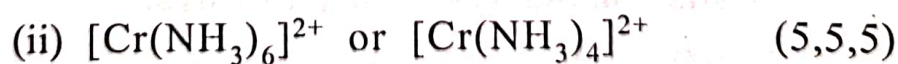
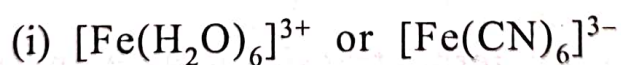




(b) What is the chelate effect? Chelate effect is predominantly due to entropy change.

Explain.

(c) Which of the following have higher Δ_0 value and why?



3. (a) Write the formulae of the following complexes according to the IUPAC system of nomenclature :

(i) pentaamminenitrito-O cobalt(III) sulphate

(ii) potassium amminedicyanidodioxidoperoxidochromate(VI)

(iii) μ -amido - μ -hydroxido bis[tetraamminecobalt(III)]

(iv) tetrapyridineplatinum(II) tetrachloridoplatinate(II)

(v) Potassium tetrafluoroargentate(I)

(b) Define the terms transition state and intermediate state using reaction pathways.

(c) What is the effect of π acceptor ligand and π donor ligands on Δ_0 ? Explain on the basis of ligand field theory. (5,5,5)

4. (a) Explain why square planar complexes of Pt(II) often undergo associative substitution mechanisms, while octahedral complexes of Cr(III) typically undergo dissociative mechanisms.
- (b) Draw and explain Crystal Field Splitting diagram for octahedral complexes.
- (c) How will you distinguish between the following pairs of isomers?
- (i) cis and trans $[\text{Pt}(\text{NH}_3)\text{Cl}_2]$
- (ii) $[\text{Co}(\text{NH}_3)_5\text{SO}_4]$ I and $[\text{Co}(\text{NH}_3)_5\text{I}] \text{SO}_4$
- (5,5,5)
5. (a) Predict and sketch all the possible isomers of $[\text{Cr}(\text{gly})_3]$.

- (b) Describe the factors responsible for strong distortion in the octahedral complexes. Square planar complexes are a special case of octahedral geometry. Justify your answer.
- (c) (i) I^- and CO have higher trans effects than Cl^- . Explain.
- (ii) Predict the products when $[PtCl_4]^{2-}$ is treated with NH_3 followed by C_2H_4 . (5,5,5)
6. (a) On the basis of VBT, account for the magnetic properties of $[Ni(NH_3)_6]^{2+}$ and $[Cr(CN)_6]^{3-}$.
- (b) Determine the CFSE of a d^6 octahedral complex having $10Dq = 25000\text{ cm}^{-1}$ and $P = 15000\text{ cm}^{-1}$ (mean pairing energy).

- (c) The formation of $[\text{CdBr}_4]^{2-}$ from $[\text{Cd}(\text{H}_2\text{O})_6]^{2+}$ exhibits the successive equilibrium constants K_1 , K_2 , K_3 and K_4 as 1.56, 0.54, 0.06 and 0.37, respectively. Explain why K_4 is larger than K_3 .

(5,5,5)

7. (a) Cr(II) fluoride and Mn(II) fluoride, both have a central metal ion surrounded by six F-ions. The Mn-F bond lengths are equidistant but four of the Cr-F distances are long and two are short. Explain.

- (b) What are labile and inert complexes? Explain giving one example each, on the basis of CFT.

- (c) Differentiate between inner orbital and outer orbital octahedral complexes. (5,5,5)

8. Write short notes on (Any three) :

- (a) Crystal Field theory and its limitations

(b) Macrocyclic Effect

(c) Werner's theory of Coordination Compounds

(d) Factors affecting stability of the complexes

(5,5,5)

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Your Roll No.....

Sr. No. of Question Paper : 5586

J

Unique Paper Code : 2172012402

**Name of the Paper : DSC: Carbohydrates, Lipids
and Heterocyclic Compounds**

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

Semester : IV

Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions in all.
3. All questions carry equal marks.

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1. (a) An aldopentose(A) gives an optically active aldaric acid (B). (A) on Ruffs degradation gives an aldotetrose (C) which can be oxidised to an optically inactive aldaric acid (D). Give the reactions involved, structure and names of (A) (B) (C) and (D).
- (b) When crystals of pure α - D-glucose are dissolved in water, the specific rotation gradually changes from + 112.2 to + 52.7. When crystals of pure β -D-glucose are dissolved in water, the specific rotation gradually changes from + 18.7 to + 52.7. Name the phenomena involved and discuss its mechanism. Explain why this phenomenon is faster in 2-hydroxypyridine as compared to that in a mixture of phenol and pyridine.
- (c) Convert D-arabinose to D-glucose & D-mannose. Name the reaction involved in it. (5,5,5)

2. (a) Explain Inter-conversion of D-glucose, D-mannose and D-fructose in a basic solution.

(b) Give Haworth proof (using Fisher Projection) for cyclic structure of D-glucose.

(c) Carry out the following conversions (give complete reaction involved in it) :

(i) D-glucose to n-hexane

(ii) D-glucose to sorbitol

(iii) D-fructose to 2-methyl hexanoic acid

(5,5,5)

3. (a) An unknown disaccharide gives a positive Tollens' test. A glycosidase hydrolyses it to D-galactose and D-glucose. When the disaccharide is treated with methyl iodide (excess) and Ag_2O and then hydrolysed with dilute HCl , the products are 2,3,4,6-tetra-O-methylgalactose and 2,3,6-tri-O-methylglucose. Give structure and name of the disaccharide. Give complete reaction.

P.T.O.

(b) Compare the structure of sucrose & maltose based on composition, reducing nature, type of bonding, nature of anomeric carbon.

(c) What are polysaccharides? Give two differences between starch and cellulose based on monosaccharide units present & glycosidic linkage? Write the Haworth projection of cellulose.

(5,5,5)

4. (a) Define Iodine value of an oil. Draw the structure of glyceryl trioleate and calculate its iodine value.

(b) What are glycolipids? Write the structure of a glycolipid derived from one molecule each of spingosine, palmitic acid and α -D-glucose.

(c) Differentiate between :

(i) fats and oils

(ii) ω - 3 & ω - 6 fatty acids (give example)

(5,5,5)

5. (a) Explain electrophilic substitution in quinoline takes place more readily at the benzene ring rather than the pyridine ring. At which position electrophilic substitution take place.
- (b) Explain Why is pyridine more reactive towards nucleophilic substitution compared to benzene? What product forms when pyridine reacts with sodamide? Explain using chemical reactions.
- (c) Explain the following :
- (i) Why nitration and sulphonation reactions of furan are carried out under mild conditions.
- (ii) Why pyridine does not show Friedel-Craft reactions. (5,5,2.5×2)
6. (a) Arrange pyrrole, furan and thiophene in order of their reactivity towards electrophilic substitution reactions. Explain and justify by drawing suitable structures.

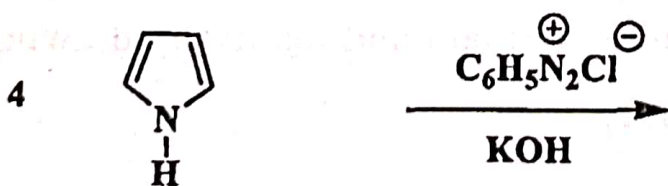
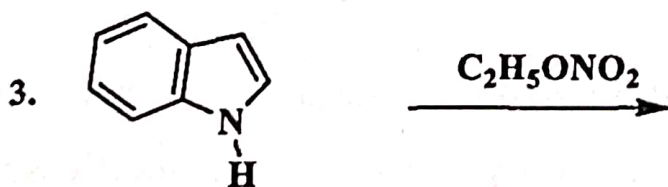
(b) How will you synthesise quinoline by Skraup synthesis? Explain with the help of a suitable mechanism.

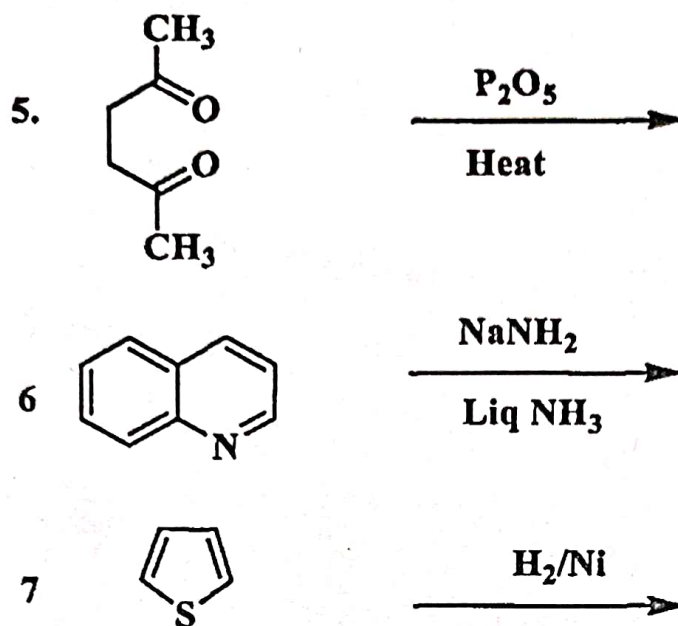
(c) Explain the following :

(i) Compare pyrrole and pyridine based on basicity.

(ii) Discuss the aromaticity of thiophene and compared it with benzene. (5,5,2.5×2)

7. (a) Complete the following reactions :





(b) How will you carry out the following conversions?

- (i) 3-Bromopyridine from pyridine
- (ii) Thiophane from acetylene
- (iii) Piperidine from pyridine
- (iv) Furfural from furan (1×7,2×4)

8. Write short notes on (Any three) :

(a) Paal-Knorr synthesis for thiophene

(b) Friedlander synthesis for Quinoline

(c) Hantzsch synthesis for pyrrole

(d) Doebner-Miller synthesis of quinoline (5,5,5)

(39)
[This question paper contains 8 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **5665 I**

Unique Paper Code : 2172012403

Name of the Paper : DSC : Electrochemical
Cells, Chemical
Kinetics and Catalysis

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

Semester : IV

Time : 3 Hours

Maximum Marks : 90

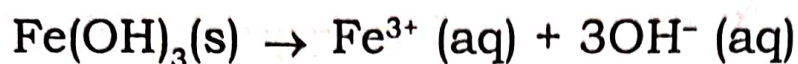
Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt **(SIX)** Questions in all. **First** question is Compulsory.
- (c) Use of a Scientific calculator is permitted.
- (d) Graph paper will be provided.

1. Attempt any Five parts.

- (a) What is liquid junction potential ? Why is NH_4NO_3 salt a good choice for making a salt bridge ?

- (b) Construct the cell in term of cell notation using the following cell reaction :



- (c) The standard redox potential of the water oxidation to dioxygen is -1.23 V.

$2\text{H}_2\text{O} \rightarrow \text{O}_2 + 4\text{H}^+ + 4\text{e}^-$. Calculate the redox potential of the same reaction at pH = 7

- (d) The acid hydrolysis of the same quantity of ester is done separately with equal normal solutions of HCl & H_2SO_4 , it is given

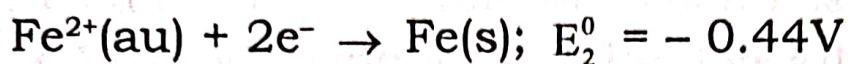
that $\frac{[\text{H}^+]_{\text{HCl}}}{[\text{H}^+]_{\text{H}_2\text{SO}_4}} = \frac{k_{\text{HCl}}}{k_{\text{H}_2\text{SO}_4}}$, explain whether the

value of $k_{\text{HCl}}/k_{\text{H}_2\text{SO}_4}$ is less than, equal or greater than one.

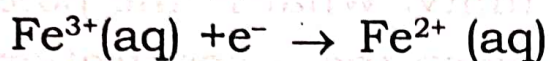
- (e) What are stationary and non-stationary chain reactions ? Discuss briefly.
- (f) Ionic reactions are fast while molecular reactions are slow. Why ?
- (g) Discuss, using potential energy barrier graph, the effect of catalyst on rates of the reaction.

5×3=15

2. (a) Given that :



Determine the potential of the following half-cell reaction.

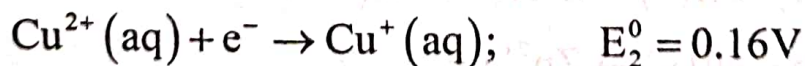
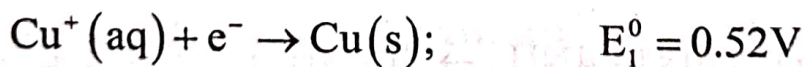


(b) What is the basic principle of potentiometric titration ? How is it applied to acid - base titration ?

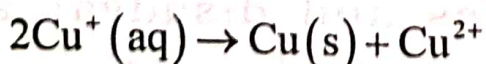
(c) The standard potential of a cell "Pt | H₂(g) | HBr(aq) | Ag" was found to vary as $E^{\circ}(\text{volt}) = 0.01 - 1 \times 10^{-4}(T - 298) - 2 \times 10^{-6}(T - 298)^2$. Calculate the standard reaction entropy, ΔS° and enthalpy, ΔH° at 25°C.

$$3 \times 5 = 15$$

3. (a) Given that the standard potential of the following half - cell reaction at 25°C



Calculate ΔG° (in kJ) for the following reaction :



(b) A platinum electrode is immersed in a solution containing 0.1 M Fe^{2+} and 0.1 M Fe^{3+} . Its potential is found to be 0.77 V against SHE. Under standard conditions, the activity coefficient is unity. What is the potential of the electrode when the concentration of Fe^{3+} is increased to 1 M at 25°C .

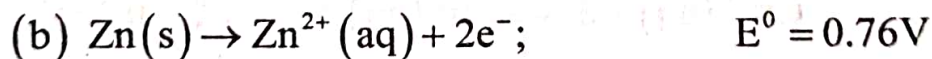
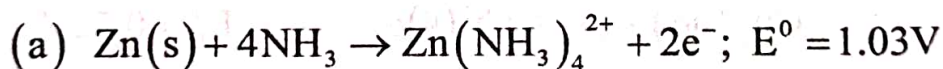
(c) The cell constructed by the half cells.

$$E^\circ_{(\text{Cd}^{2+}|\text{Cd})} = -0.403\text{V} \quad \& \quad E^\circ_{(\text{I}^-|\text{AgI}|\text{Ag})} = -0.152\text{V}$$

has the potential of 0.29V at 25°C . Determine the activity of CdI_2 solution.

$$3 \times 5 = 15$$

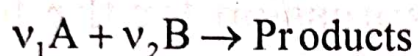
4. (a) Determine the formation of the complex, $\text{Zn}(\text{NH}_3)_4^{2+}$, Provided that



(b) How do we use quinhydrone electrode for determination of pH of a given solution? What are advantages and disadvantages of quinhydrone electrode?

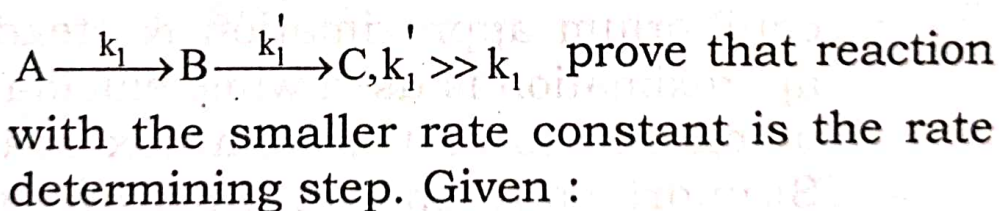
- (c) Construct a concentration cell without transference using silver – silver chloride electrode and derive the equation for determination of cell potential of the concentration cell. $3 \times 5 = 15$

5. (a) The reaction



is a first order reaction with respect to A & B. Write down its differential rate law & deduce from it the Integrated rate law. What is the unit of rate constant in this case ?

(b) Suppose that in a consecutive reaction



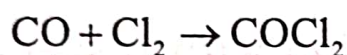
$$[C] = [A]_0 \left\{ 1 - \frac{1}{k'_1 - k_1} \left(k'_1 e^{-k_1 t} - k_1 e^{-k'_1 t} \right) \right\}$$

- (c) Write a short note on Lindemann Mechanism. $3 \times 5 = 15$

6. (a) Compare the rate constants as given by Arrhenius equation & the collision theory and there by show that

$$E_a = E_0 + \frac{RT}{2} \quad \& \quad A = pN_A \frac{Z_{AB}}{N_A^* N_B^*} e^{1/2}$$

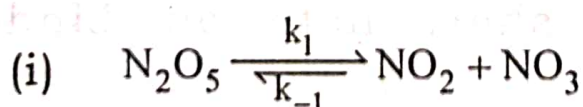
- (b) Using the following data, obtain the differential rate expression for the following reaction & the value of rate constant

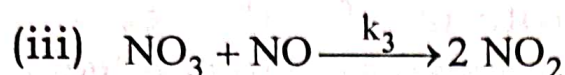
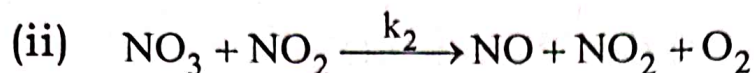


Experiment No.	1	2	3	4
$[\text{COCl}_2]_0 / \text{mol dm}^{-3}$	0.16	0.16	0.04	0.04
$[\text{Cl}_2]_0 / \text{mol dm}^{-3}$	0.16	0.04	0.16	0.04
$r_0 / \text{mol dm}^{-3} \text{ s}^{-1}$	1.92×10^{-2}	9.6×10^{-3}	4.8×10^{-3}	2.4×10^{-3}

- (c) Discuss the conditions under which the equilibrium approximation & steady state approximation is used while elucidating the mechanisms of the complex reactions. Support your answer with any general reaction in each case 3×5=15

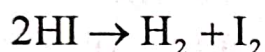
7. (a) The following mechanism has been proposed for the decomposition of N_2O_5 :





Show that rate law is $\frac{d[\text{O}_2]}{dt} = k[\text{N}_2\text{O}_5]$

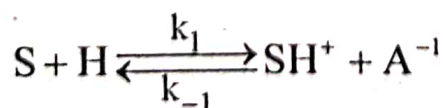
- (b) The bimolecular decomposition of Hydrogen Iodide is given by the equation

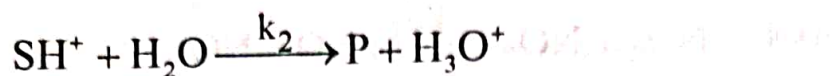


Assuming a collision diameter of 0.35×10^{-8} cm and an activation energy of $183.90 \text{ kJ mol}^{-1}$ for the reaction, calculate (i) the collision rate, (ii) the rate of reaction and (iii) the rate constant for the above reaction at 500 K and one atmosphere pressure.

- (c) Write a short note on Theory of Absolute Reaction rates. 3×5=15

8. (a) An acid, HA catalyses the substrate, S to products as follows :





Derive the rate law for the reaction. State when it becomes an example of "general acid catalysis" and it is "*specific hydrogen ion catalysis*".

- (b) Describe any five characteristics of catalyst.
- (c) The reaction rate of enzyme – catalysed reaction changes from first – order to zero – order as the substrate concentration is increased. Discuss the reason on the basis of active sites & Explain using the graph of rate versus substrate concentration.

3×5=15

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39
[This question paper contains 7 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **5697 I**

Unique Paper Code : 2173012011

Name of the Paper : DSE: Reactions,
Reagents and chemical
Process

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

Semester : IV

Time : 3 Hours

Maximum Marks : 90

Instructions for Candidates :

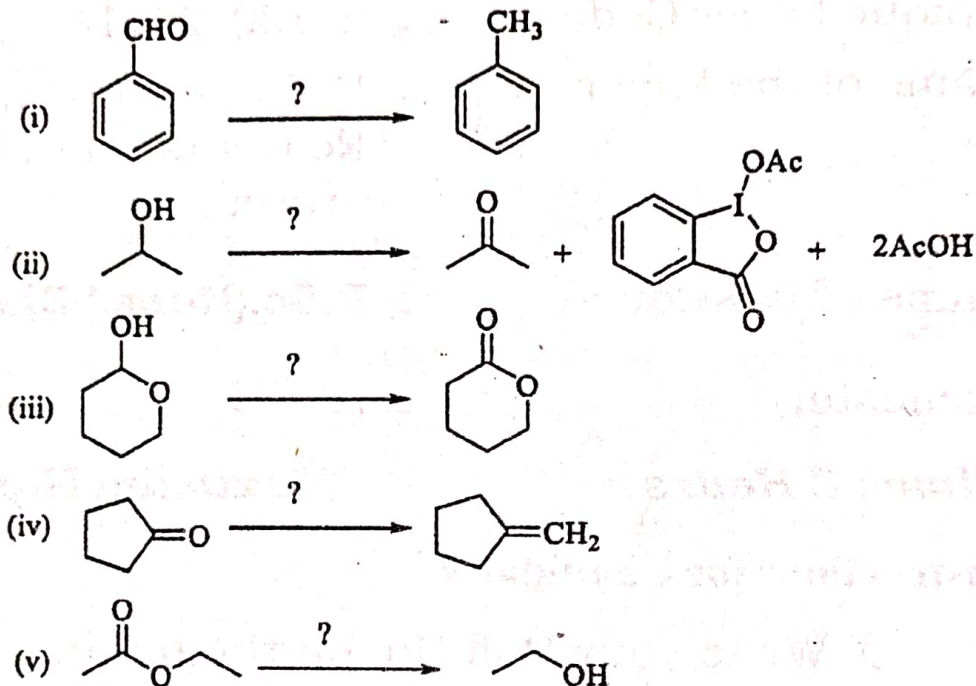
- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **six** questions. **All** parts of a question should be attempted together.
- (c) Each question carries **15** marks.
1. Explain any **three** of the following reactions with suitable mechanisms :
 - (a) Appel Reaction
 - (b) Prevost Reaction
 - (c) Wittig Reaction
 - (d) Corey Kim OXidation

5,5,5

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P.T.O.

2. (a) Identify the most suitable reagents required to accomplish the following chemical transformation:

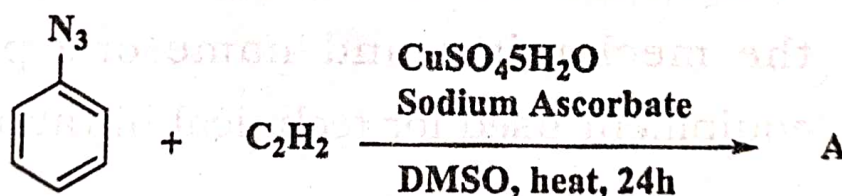


- (b) Write the chemical structure and mention one application of the following reagent:

- (i) ABNO
- (ii) DIBAL-H
- (iii) DEMS
- (iv) 3-Mercaptopropionic acid
- (v) Fetizon's reagent

5,10

3. (a) What is the synthetic utility of Sodium borohydride and PMHS in organic synthesis? Explain with suitable example.
- (b) Write the structure and synthetic application of following reagents:
- (i) Fenton's Reagent
- (ii) TRAP 10,5
4. (a) Identify and write the product (A) of the given Name Reaction. Mention the name of the reaction and provide a detailed mechanism to support your answer.



- (b) Which reagent/catalyst is used in the following reactions?
- (i) Darken West Reaction
- (ii) Mitsunobu Reaction

(iii) Barbier Reaction

(iv) Damjanov Reaction

(v) maukaiyama Aldol Reaction

(c) Explain the Birch Reduction of aromatic Compounds with a suitable mechanism.

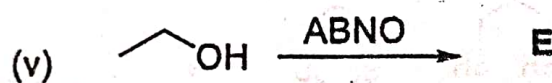
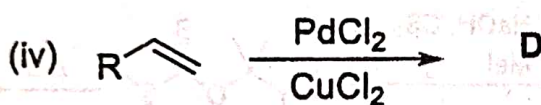
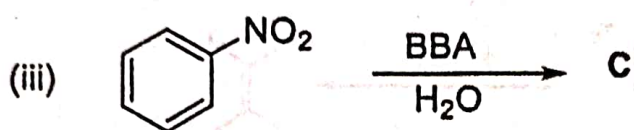
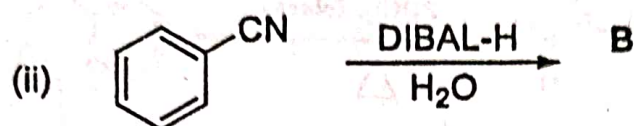
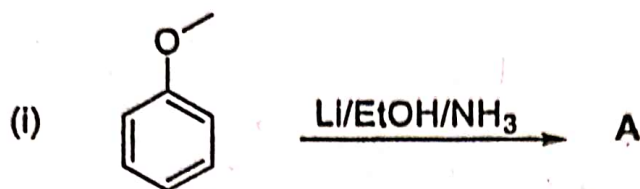
5,5,5

5. (a) Explain the various stages involved in the scale-up process of chemical reactions, highlighting the roles of bench, pilot, and large-scale processes.

(b) define nitration as a unit process, Describe the mechanism and name one process equipment used for technical nitration.

(c) What are catalytic halogenations? Differentiate between types of halogenations with suitable examples. 5,5,5

6. (a) Complete the following reactions by giving the product.



(b) Write the reaction and mechanism of Julia Olefination Reaction.

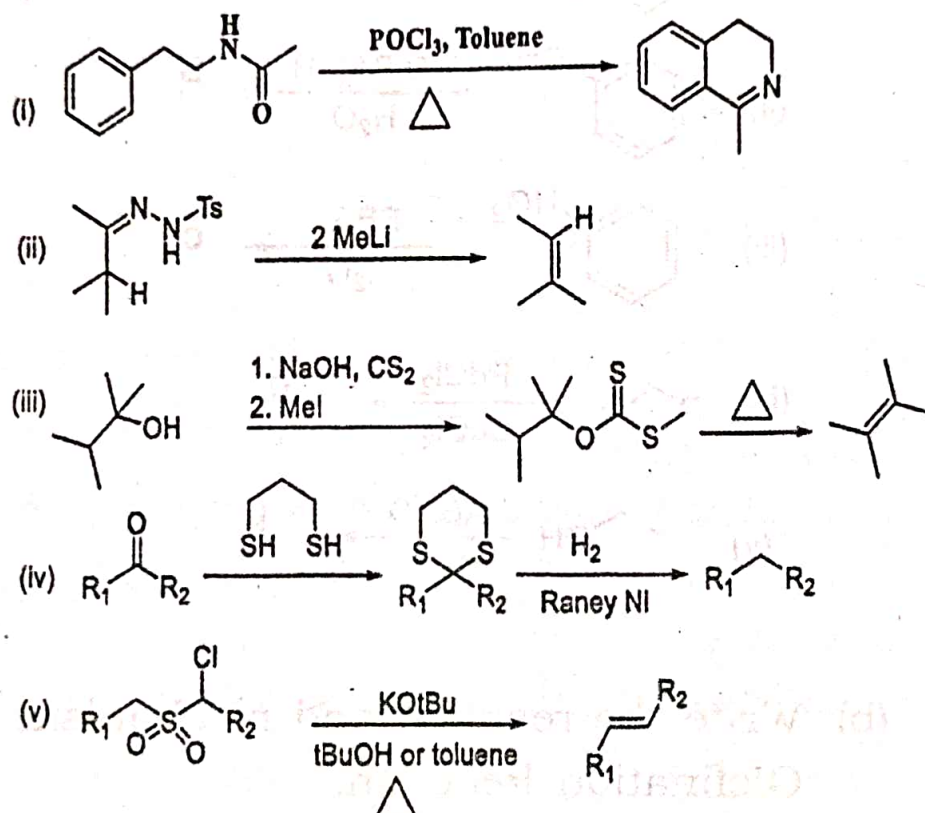
(c) Discuss the structure and oxidizing property of AZADO reagent. 5,5,5

7. (a) What a Suzuki coupling Reaction? Write the steps involved in the mechanism.

(b) Describe the Heck Reaction and show how it works step by step.

(c) Write the name of the following reactions:

5,5,5



8. (a) What is Schwartz's reagent? Describe its structure and specific application in organic chemistry.

(b) Write the mechanism of Swern oxidation and discuss its advantages over other oxidation methods.

5697

- (c) Explain the use of sodium bismuthate and sodium perborate in organic oxidations.

5,5,5

41
This question paper contains 4 printed pages]

Roll No.

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S. No. of Question Paper : 5619

Unique Paper Code : 2173012017

Name of the Paper : DSE : Basic Principles of Food Chemistry

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

Semester : IV/VI

Duration : 3 Hours

Maximum Marks : 90

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

Attempt any six questions.

All parts of a question should be attempted together.

Each question carries 15 marks.

1. (a) "What is relatively small inorganic molecule, but organic left is highly dependent on this tiny molecule"
 - (i) What do you understand by free water ?
 - (ii) Draw a general moisture sorption isotherm (MSI), characteristic of most of the food.
 - (iii) Differentiate between the structure of water and ice.

P.T.O.

- (b) What do you understand by browning of food ? Explain some of the factors responsible for it and how can it be prevented ?
- (c) Differentiate between :
- (i) Nutritive and Non-Nutritive Sweetners
 - (ii) Acidulants and Humectants. 5,5,5
2. (a) Explain the functional properties of protein in context of food chemistry. How are conjugated proteins different from simple proteins ?
- (b) What do you understand by lipid hydrolysis ? How can it be prevented ?
- (c) Write short notes on :
- (i) Fat-Soluble Vitamins and their physiological importance
 - (ii) Trace Elements. 5,5,5
3. (a) Explain the classification of different polysaccharides on the basis of structure. Differentiate between Pectin and Agar.
- (b) Give the structure and uses of any *two* of the following food dyes in food industry :
- (i) Tartrazine
 - (ii) Indigo Carmine.

- (c) Define food fortification and elucidate its significance in food chemistry. Give *one* example each of food fortifying agents used in salt, orange juices and infant formulas. 5,5,5
4. (a) What are nature identical food colorants ? How are they different from natural food colorants ?
- (b) Write their sources, functions and importance in food chemistry (any *two*) :
- (i) Hemicellulose
- (ii) Cyclodextrin.
- (c) Explain the molecular mechanism of flavour perception. 5,5,5
5. (a) Explain the impact of heat on protein structure and functionality in food. Include examples of both beneficial and detrimental effects.
- (b) Classify lipids on the basis of their structure.
- (c) Write short notes on :
- (i) Food toxins
- (ii) Antioxidants. 5,5,5
6. (a) Explain the role of cholesterol in the body and explain how can it be affected by dietary choices.

P.T.O.

- (b) Give the structure, colour and sources of anthocyanins.
- (c) Discuss the impact of pH on protein behaviour in food. Explain the concept of isoelectric point (pI) and its importance. 5,5,5
7. (a) What do you understand by 'taste inhibition' ? Give *two* examples of additives used as taste inhibitors ? How is it different from taste enhancement ?
- (b) What do you mean by preservation of food. Explain any *two* methods of food preservation.
- (c) Flavour additives can be categorized under natural and artificial. Justify with the use of relevant examples. 5,5,5
8. (a) Describe any method used for quantification of ascorbic acid in food samples such as lemon juice.
- (b) Write short notes on the following :
- (i) Betalains
- (ii) Vitamin deficiencies.
- (c) How are carotenes different from xanthophylls ? Discuss giving examples. 5,5,5

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[This question paper contains 4 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5506

J

Unique Paper Code : 2172013601

**Name of the Paper : DSC: Principles in Qualitative
Analysis & Bioinorganic
Chemistry**

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

Semester : VI

Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. Attempt **FOUR QUESTIONS** in all.
3. All Questions carry **equal** marks.

1. (a) Elements such as Silicon, Aluminium, and Titanium are abundant in the Earth's crust but play only a marginal role in biological systems. Explain why.

(b) How is the unequal concentration of Na^+ and K^+ ions in extracellular and intracellular fluids regulated in the human body? Provide a diagrammatic representation of the process and explain the mechanism involved.

(c) Explain the working mechanism of the calcium pump using ATP. What would happen if the calcium pump stops functioning in muscle cells?

(5,5,5)

2. (a) A mixture of salts, when heated with ethanol and concentrated H_2SO_4 , gives a gas (A), which burns with a green-edged flame when ignited. The mixture also gives a red gas (B) when heated with potassium dichromate and concentrated H_2SO_4 . The pungent gas evolves on heating the mixture with NaOH solution, gives a brown precipitate (C) with potassium tetraiodomercurate (II). The residue left after boiling the mixture with dilute HCl is soluble in hot water. The hot solution gives a white precipitate (D) with dilute sulphuric acid and a yellow precipitate (E) with potassium chromate solution. Identify (A)-(E) and name the ions present.

(b) A test tube contains an aqueous solution of Fe^{3+} , Al^{3+} , and Cr^{3+} . Suggest the reagents used to

separate the three cations from each other. Discuss one confirmatory test of each cation with a chemical reaction.

(c) Identify the ion for which the following reagents are used. Write down the chemical reaction between the ion and the reagent.

(i) Sodium nitroprusside

(ii) Zirconyl nitrate

(iii) Ammonium thiocyanate

(iv) Sodium bismuthate (5,5,5)

3. (a) Explain the mechanism of action of carbonic anhydrase in converting carbon dioxide to bicarbonate. Draw a diagram of its active site.

(b) What are the toxic effects of lead? Give the reasons for its toxicity. How can it be treated?

(c) Draw and label the dose-response curves for an essential element and a toxic element. (5,5,5)

4. (a) How does cytochrome c oxidase contribute to ATP synthesis? Discuss its role in oxidative phosphorylation.

- (b) Describe the cooperative effect in hemoglobin. Is this effect present in myoglobin? Explain.
- (c) Inability to synthesize transferrin may result in anemia as well as an overload of iron. Do you agree? Justify your answer. (5,5,5)
5. (a) Name the reagent used to distinguish the II A group from the II B group in qualitative analysis. Explain its role. How will you identify copper in the presence of cadmium in qualitative analysis?
- (b) Both group II and group IV cations precipitate out as their sulphides, but some cations are placed in group II and others in group IV. Explain.
- (c) When both NO_3^- and Cl^- are present, sometimes no brown vapours are evolved. Explain. How will you confirm when these two ions are present together? (5,5,5)
6. (a) Discuss the health effects caused by the excess and deficiency of any two trace metals in the human body.
- (b) How will you identify sulphite and carbonate ions when present together? Write down the chemical reactions involved in it.
- (c) Why is it necessary to test Group V ions in the order: Ba^{2+} , Sr^{2+} , Ca^{2+} ? (5,5,5)

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5546

J

Unique Paper Code : 2172013602

Name of the Paper : DSC : Polynuclear
Hydrocarbons,
Photochemistry, Pericyclic
reactions, and Spectroscopy
of Organic Compounds

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

Semester : VI

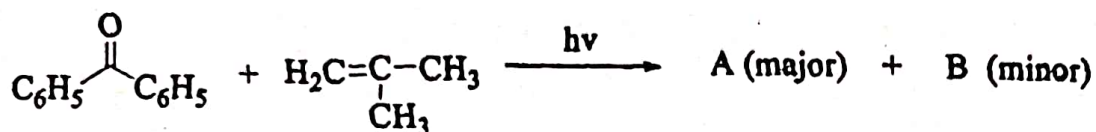
Duration : 3 Hours

Maximum Marks : 90

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt six questions. All parts of a question should be attempted together.
3. Each question carries 15 marks.

1. (a) Complete the following reaction

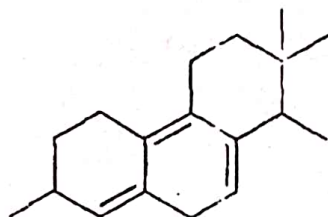


(i) Write the name of the reaction.

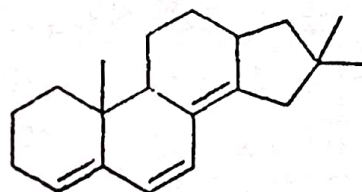
(ii) Explain the formation of products.

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

i)



ii)



Base value for homo annular diene = 253 nm,
Base value for heteroannular diene = 215 nm; Alkyl
group or Ring residue = 5 nm, Exocyclic double
bond = 5 nm, Double bond extended conjugation =
30 nm

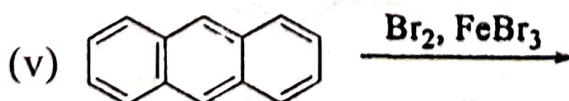
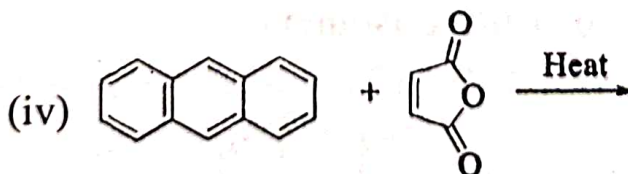
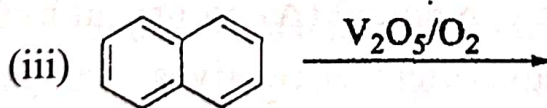
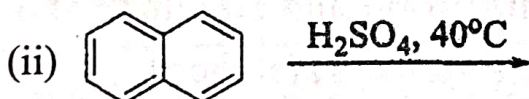
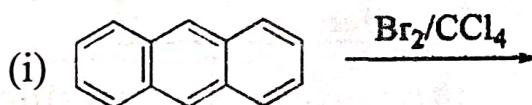
(c) Acetylenic protons are more shielded as compared to ethylenic protons. Explain. (5,5,5)

2. (a) An organic compound with molecular formula $\text{C}_6\text{H}_{12}\text{O}$ showed the following spectral data:

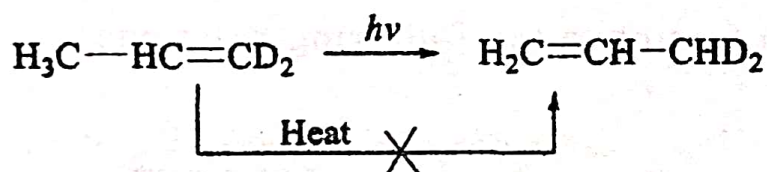
UV: $\lambda_{\max} = 288 \text{ nm}$, $\epsilon = 24$; IR: A very strong band at 1715 cm^{-1} ; ^1H NMR: δ values 2.0 (3H, s) and 1.0 (9H, s)

- (i) Calculate the double bond equivalence
- (ii) Deduce the structure of the compound
- (iii) Explain (a) UV transition (b) IR absorption band (c) NMR peaks along with splitting patterns

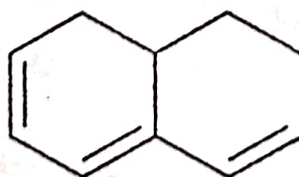
(b) Complete the following reactions :



- (c) Explain giving reason. Why IR spectrum of liquid *t*-butyl alcohol shows a strong absorption at 3360 cm^{-1} ? Whereas a very dilute solution of the same compound in CCl_4 shows a strong absorption band at 3620 cm^{-1} instead of 3360 cm^{-1} . (5,5,5)
3. (a) Using the Frontier Molecular orbital approach, explain why [1,3] sigmatropic hydrogen shift is photochemically allowed and thermally forbidden.



- (b) Write the full form and structure of TMS. Why it is used as internal reference?
- (c) An organic compound (A) on partial hydrogenation with one equivalent of H_2 gives three isomers with molecular formula $\text{C}_{10}\text{H}_{14}$. Show how UV can distinguish these isomers.

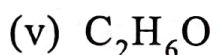
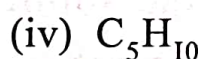
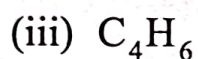
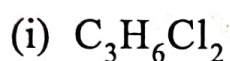


(5,5,5)

Compound (A)

4. (a) How will you establish that in naphthalene two benzene rings are fused at *ortho* positions.

(b) Write the structural formula for the compounds with the following molecular formula that shows only one signal in their PMR spectra



(b) A carbonyl compound shows the following data:

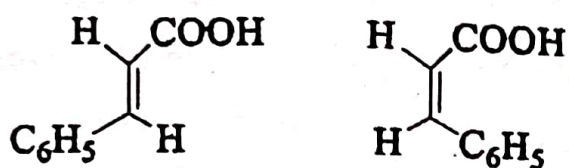
Solvent	$\lambda_{\max}$ (ϵ)	$\lambda_{\max}$ (ϵ)
Hexane	230 (12,600)	327 (98)
Water	245 (10,000)	305 (60)

Assign the various transitions. Explain the shift when the solvent is changed from hexane to water.

(5,5,5)

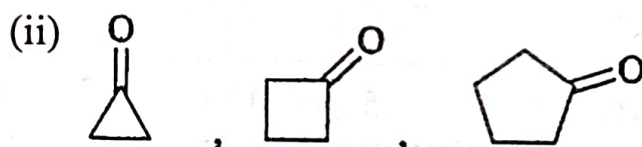
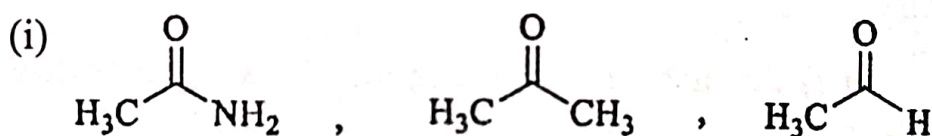
5. (a) Explain, why electrophilic substitution in anthracene occurs at C-9 and C-10 position.

(b) Explain, which one is having higher $\lambda_{\max}$ (in UV spectroscopy) and higher value of $\nu_{C=O}$ (in IR spectroscopy)

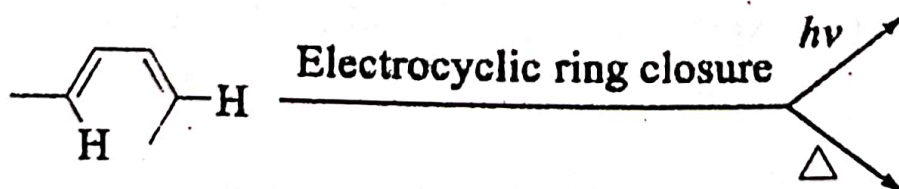


(c) Draw the PMR of pure and impure ethanol. Give reasons for the difference.

6. (a) Arrange the following compounds in order of increasing order of carbonyl absorption frequency in IR spectroscopy. Give reasons.



(b) Complete the following reaction and explain the formation of products



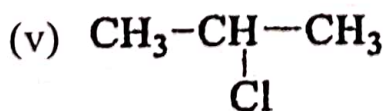
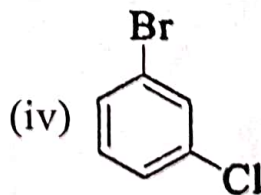
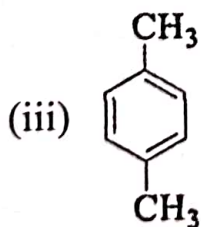
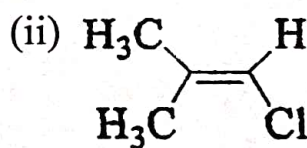
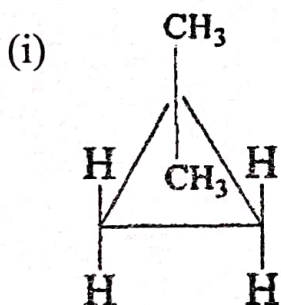
(2E,4Z) 2,4-Hexadiene

- (c) In an organic compound, three kinds of protons appear at 60, 100 and 180 Hz when the spectra are recorded at 60 MHz spectrometer.

(i) Determine the chemical shift.

(ii) Relative position (in Hz) when 90 MHz spectrometer is used. (5,5,5)

7. (a) Give the number of PMR signal in each of the following :



- (b) Differentiate between 1-butene and 1-butyne using IR spectroscopy.
- (c) Explain, why [2+2] cycloaddition reaction are photochemically allowed and thermally forbidden.
(5,5,5)

8. Write short notes on (Any three) :

- (a) Haworth synthesis of naphthalene
- (b) Norrish Type II reaction
- (c) Witt's theory of colour
- (d) Claisen rearrangement (5,5,5)

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5566

J

Unique Paper Code : 2172013603

Name of the Paper : DSC-PHOTOCHEMISTRY
AND SPECTROSCOPY

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

Semester : VI

Duration : 2 Hours

Maximum Marks : 60

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **FOUR** questions in all. Question No. 1 is compulsory.
3. The questions should be numbered in accordance to the number in the question paper.
4. Use of Scientific Calculator is permitted.

Planck's Constant: 6.626×10^{-34} Js : Mass of Electron:
 9.1×10^{-31} Kg

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1. Answer any 5 of the following :

- (a) Zero-point energy in vibrational spectra is never zero. Comment.
- (b) Why electronic transitions are said to be vertical transitions.
- (c) Why the symmetric stretching mode of vibration of CO_2 molecule is Raman active and asymmetric mode of vibration is Raman inactive?
- (d) What are the laws of photochemistry?
- (e) Explain the terms chromophore and auxochrome. Give one example of each.
- (f) As the number of conjugated atoms in a molecule increases, red shift is observed. Explain with help of one example. (5×3=15)

2. (a) What is the essential condition for a molecule to be microwave active? Which of the following molecules are expected to be microwave active: SF_6 , H_2O , N_2 , HCN , NO , and CO_2 . Give reason.

(b) The HCl molecule shows pure rotational lines at the following frequencies (cm^{-1})

20.7, 41.4, 62.1, 82.8

Assign these lines to the corresponding $J \rightarrow J+1$ rotational transitions. Calculate the bond distance of HCl .

The atomic masses are : $\text{H} = 1.673 \times 10^{-27} \text{ kg}$;

$\text{Cl} = 58.06 \times 10^{-27} \text{ kg}$.

(c) (i) Explain, why many of the lower rotational levels are thickly populated.

- (ii) Show that the rotational level whose quantum number is given by the expression has a maximum population :

$$J = \sqrt{\frac{kT}{2Bhc}} - \frac{1}{2} \quad (5,5,5)$$

3. (a) Discuss how a simple harmonic oscillator system differs from a homonuclear diatomic molecule undergoing anharmonic oscillations in terms of energy relation and energy vs displacement curve from mean position.
- (b) (i) How the presence of Hydrogen bonding can be predicted in IR spectra? Explain with an example.
- (ii) An intense band and the first overtone transition of HBr (bond length 0.142 nm) are centered at 2560 cm^{-1} and 5028 cm^{-1} .

Calculate the anharmonicity constant and force constant for H-Br bond. Mass of hydrogen: 1.0 g/mol and Mass of Br: 80.0 g/mol.

(c) (i) How will you distinguish between the overtones and hot bands of a spectrum?

(ii) Calculate the number of fundamental vibrational modes for NH_3 , H_2O and HCN .

(5,5,5)

4. (a) What are Rayleigh, Stokes and anti-Stokes lines?

How is the intensity of stokes lines different from that of anti-stokes lines in pure Raman spectrum?

Explain giving reasons.

(b) (i) Explain the factors that control intensity of spectral lines/band.

(ii) Triple bond has higher stretching frequency than corresponding double bond, which in turn has higher frequency than single bond. Explain.

(c) A molecule XY_2 has the following IR and vibrational Raman spectral data :

Wavenumber (cm^{-1})	IR	Raman
1243	Inactive	Active
2920	Active (PR)	Inactive
786	Active (PQR)	Inactive

Predict the geometry of XY_2 molecule. (5,5,5)

5. (a) Define Lambert-Beer's Law. What are its limitations? Give one application of this law.

(b) Explain the Phosphorescence phenomenon with the help of a suitable energy diagram. Why is it a delayed phenomenon?

(c) The first UV peak of 1,3-butadiene is observed at 210 nm, corresponding to a transition from HOMO (highest occupied molecular orbital) to LUMO (lowest unoccupied molecular orbital). Based on free electron model, calculate the length of the box to which this transition corresponds.

(5,5,5)

6. (a) Explain the term chemical shift. What is TMS? Why is it used as a reference standard in NMR?

(b) What is spin-spin coupling? Explain and sketch the NMR spectrum of methanol with and without spin-spin coupling.

- (c) Predict and draw the intensity distribution in hyper fine lines of ESR spectrum of methyl radical ($\cdot\text{CH}_3$). (5,5,5)

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[This question paper contains 4 printed pages]

Your Roll No. :

Sl. No. of Q. Paper : **5618** **I**

Unique Paper Code : 2173012016

Name of the Paper : DSE : Analytical
Methods in Chemistry

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

Semester : VI

Medium of the Question : English

Paper

Time : 3 Hours

Maximum Marks : 90

Instructions for Candidates :

- (a) Write your Roll No. on the top immediately on receipt of this question paper.
- (b) Attempt any **six** questions in all.

1. (a) Discuss the concept of blank analysis in analytical chemistry and discuss its role in minimizing systematic errors.
- (b) Analyze the statement "Good precision does not guarantee accuracy" with relevant examples.

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- (c) Discuss the standard addition method for quantifying the concentration of an unknown analyte, emphasizing its advantages over other calibration techniques.

5,5,5

2. (a) Compare atomic absorption spectroscopy (AAS) with atomic emission spectroscopy (AES) in terms of how they are used in analysis and their Limitations.

- (b) Describe the construction and working of an Electrodeless Discharge Lamp (EDL)

- (c) Define chemical interference and elaborate on its implication in Atomic Absorption Spectroscopy (AAS). Provide examples.

5,5,5

3. (a) Define thermal gravimetric analysis (TGA) and discuss its applications in materials characterization.

- (b) A mixture of MgO and MgCO_3 loses mass during heating. If the mass drops from 160 mg to 132 mg between $500-800^\circ\text{C}$, calculate the percentage composition of MgCO_3 .

- (c) Differentiate between Differential Scanning Calorimetry (DSC) and Differential Thermal Analysis (DTA) based on their principle, instrumentation and application.

5,5,5

4. (a) Explain the principles and applications of Thin Layer Chromatography (TLC), emphasizing its advantages over conventional column chromatography methods.
- (b) Differentiate between cationic and anionic exchangers, providing examples of each.
- (c) Discuss the significance of plate height and effective plate number in chromatographic separations. 5,5,5
5. (a) Describe the electronic transitions responsible for UV-Visible spectra and elucidate the concept of molar absorptivity.
- (b) Explain the concept of charge transfer transitions in UV-Visible spectroscopy.
- (c) What is the function of a monochromator in UV-Visible Spectrophotometry? Glass-cuvettes are not suitable for recording the UV region spectrum. Explain. 5,5,5
6. (a) Explain how Q-test is useful for rejecting or retaining of data?
- (b) Define accuracy and precision in the context of analytical measurements. Discuss strategies for improving both.
- (c) In a dataset of five measurements : 12.4, 12.6, 12.5, 12.7, 12.3 g compute the mean, standard deviation and relative standard deviation. 5,5,5

7. (a) Calculate the amount of metal extracted in a single extraction from 200 ml aqueous phase containing 800 mg of metal ion using 50 ml organic solvent with $D = 120$.
- (b) Define the terms distribution coefficient and distribution ratio and explain their significance in solvent extraction processes.
- (c) Describe the different mechanisms involved in the solvent extraction. 5,5,5
8. (a) Explain the process of sample delivery in flame spectroscopy and describe how atomization of the sample is achieved during the analysis.
- (b) Job's method (method of continuous variations) is used to determine the stoichiometry of a complex formed between two substances. Briefly explain how the method works and how the stoichiometric ratio is determined from the experimental data.
- (c) Define resolution in chromatography, Briefly describe its importance in separating mixture components and mention the main factors that influence it. 5,5,5

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[This question paper contains 2 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5971

J

Unique Paper Code : 2222511201

Name of the Paper : Electricity and Magnetism

Name of the Course : B.Sc. Prog. – Physical Sciences with Electronics/
Chemistry_NEP: UGCF-2022

Semester : II

Duration : 2 Hours

Maximum Marks : 60

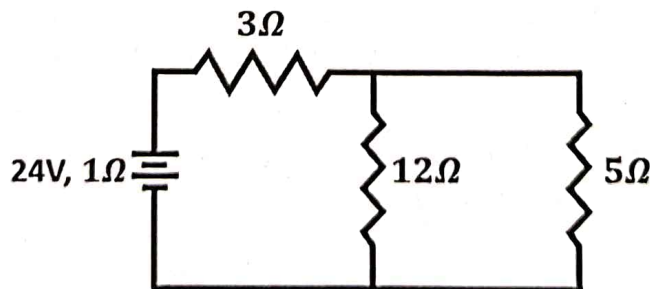
Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Use of non-programmable scientific calculator is allowed.
3. All questions carry equal marks.
4. Question No. 1 is compulsory.
5. Attempt any Four questions in total.

1. Answer any five of the following : (3×5=15)

- (a) An infinitely long wire has charge $2 \mu\text{C/m}$. Calculate the intensity of electric field at a point distant 10 cm normal to the length of the wire.
- (b) If the electric field is $\vec{E} = 6\hat{i} + 3\hat{j} + 4\hat{k}$, calculate the electric flux through a surface of area 20 units lying in the y-z plane.
- (c) State three properties of para magnetic materials.
- (d) Prove that $\nabla \cdot \vec{B} = 0$.
- (e) Explain the concept of displacement current.
- (f) State and explain the Superposition theorem.

2. (a) Derive an expression for electric potential and field at any point at a distance r from the centre of a dipole. (10)
- (b) Obtain the relation between polarization vector $\vec{P}$ and surface charge density of polarization charges. (5)
3. (a) Derive an expression for the magnetic field due to a current (I) carrying straight conductor of infinite length at a distance ' x '. (10)
- (b) A solenoid has a core of a material with relative permeability (μ_r) 400. The windings of the solenoid are insulated from the core and carry a current of 2 A. If it has 10 turns per cm, find the magnetic field (B) inside the solenoid. (5)
4. (a) Derive the four Maxwell's equations in differential form. (10)
- (b) Deduce the expression of self-inductance for an aircored solenoid of length ' l ' having N number of turns and area of cross-section A . (5)
5. (a) State Thevenin and Norton's theorem. Apply Thevenin's theorem to calculate the current flowing through 5Ω resistance (10)



- (b) Derive an expression for the capacitance of a parallel plate capacitor. (5)

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[This question paper contains 8 printed pages.]

Your Roll No.....

Sr. No. of Question Paper : 5861

J

Unique Paper Code : 2172512401

Name of the Paper : DSC- Chemistry of Carboxylic
Acids & their Derivatives,
Amines and Heterocycles

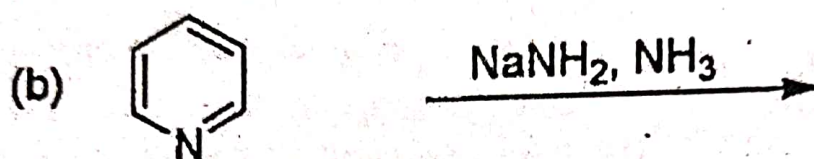
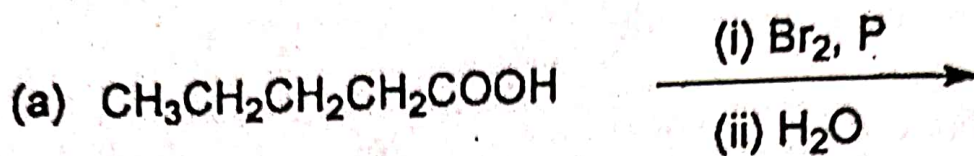
Name of the Course : B.Sc. (Prog.)

Semester : IV

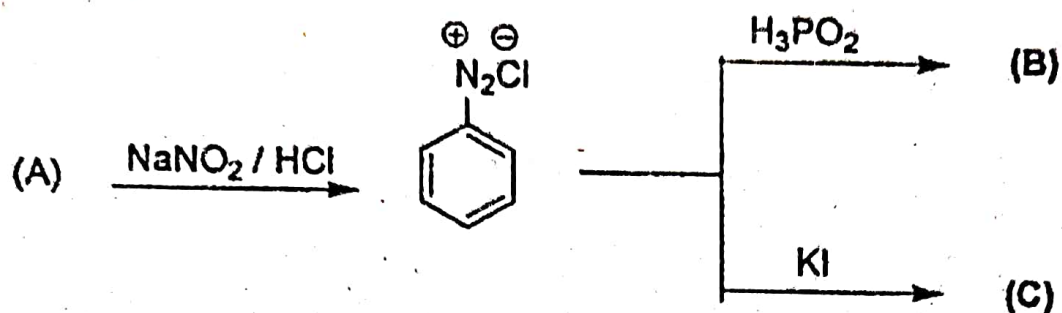
Duration : 2 Hours Maximum Marks : 60

Instructions for Candidates

1. Write your Roll. No. on the top immediately on receipt of this question paper.
2. Attempt any four questions, all questions carry equal marks:
 1. (i) Identify the name of the reaction and write the product:



- (ii) How will you distinguish between primary, secondary and tertiary amines by Hinsberg test. Explain with reactions.
- (iii) Give a comparison between Hofmann elimination and Saytzeff elimination, with suitable example.
- (iv) Write the structure of A, B and C.



(4,4,4,3)

2. (i) Give reason for the following:

(a) Trichloroacetic acid is stronger acid than acetic acid.

(b) Alkaline hydrolysis of esters is preferred over acidic hydrolysis for preparation of carboxylic acids.

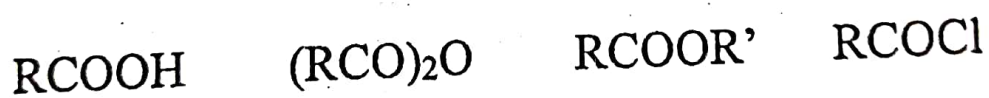
(ii) Differentiate between the keto and enol form of ethylacetoacetate. How are they isolated.

(iii) What is Claisen condensation. Give its mechanism.

(iv) Pyrrole undergoes electrophilic substitution reactions at C-2. Explain why. (4,4,4,3)

3. (i) What is Perkin condensation. Write its mechanism.

(ii) Arrange the following in increasing order of reactivity towards nucleophilic reaction give reason for the same.



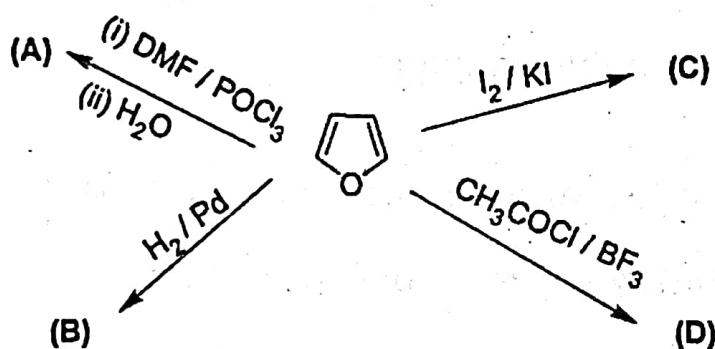
(iii) Convert

(a) Acetyl chloride to t-butyl alcohol

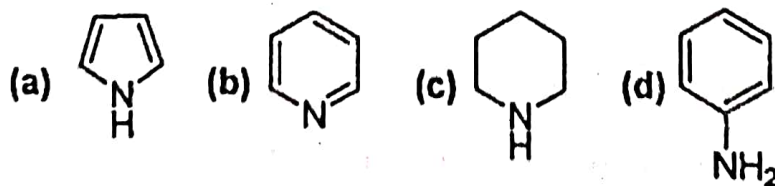
(b) Ethylacetoacetate to 2-methylbutanoic acid

(iv) Write the synthesis of 3-chloropyridine from pyrrole using dichlorocarbene. (4,4,4,3)

4. (i) Write the structure of A, B, C and D in the following reactions of furan:



- (ii) What is the order of aromaticity of furan, thiophene and pyrrole. Give reason for this.
- (iii) Arrange in increasing order of basicity. Give reason for it.

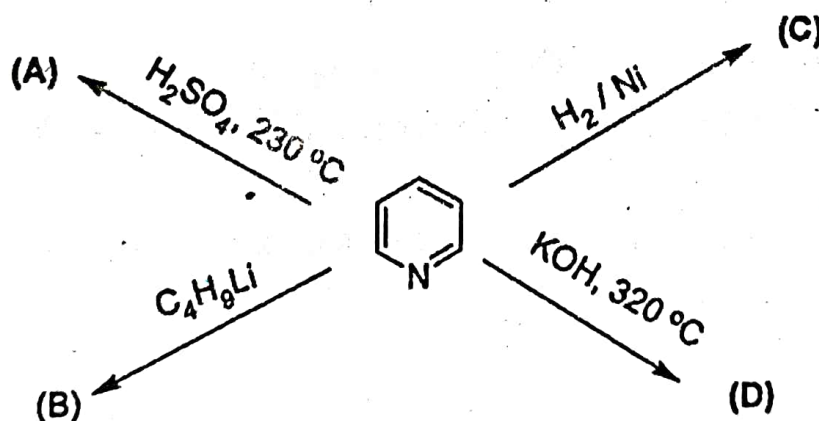


(iv) Pyrrole undergoes coupling reaction with benzene diazonium salt whereas pyridine does not. Explain.

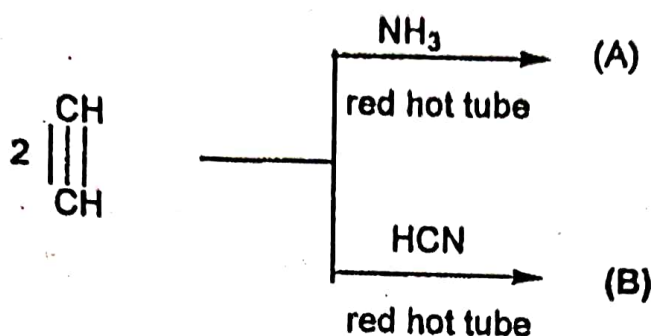
(4,4,4,3)

5. (i) Furan undergoes Diels Alder reaction. Explain why with suitable example.

(ii) Write the structure of products A, B, C and D in the following reactions of pyridine:



(iii) (a) Write the product A and B obtained when two moles of acetylene treated with either ammonia or HCN.



(b) What is sulfanilic acid. Give its method of preparation.

(iv) What is carbylamine reaction. Write the chemical reaction and give its use. (4,4,4,3)

6. (i) What is Hoffmann degradation reaction. Give its mechanism.

(ii) What is the order of basicity of CH_3NH_2 , $(\text{CH}_3)_2\text{NH}$, $(\text{CH}_3)_3\text{N}$ in aqueous medium. Explain on the basis of inductive and solvation effects.

(iii) Write the product formed when primary, secondary and tertiary aliphatic amine react with nitrous acid.

(iv) How is ethylamine prepared by Gabriel phthalimide synthesis. (4,4,4,3)

This question paper contains 4 printed pages]

Roll No.

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S. No. of Question Paper : 5930

Unique Paper Code : 2173522009

Name of the Paper : DSE : Biomolecules II

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

Semester : IV

Duration : 2 Hours

Maximum Marks : 60

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

Attempt all parts of the question together.

Attempt any *four* questions.

Each question carries 15 marks.

1. (a) (i) Write the structures of glycine in acidic and alkaline media.
(ii) Write the name, colour and structure of the complex formed by the reaction of α -amino acid with Ninhydrin. What is the importance of this reaction ?
- (b) Give at least *one* example of the following :
 - (i) Essential amino acid
 - (ii) Non-essential amino acid
 - (iii) A protein molecule having quaternary structure

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(iv) An amino acid having a secondary amino group

(v) N-terminal Protecting Group.

(c) What is a peptide bond ? Explain the secondary structures of protein by making the necessary diagram. 5,5,5

2. (a) What do you mean by the protection of $-NH_2$ and $-COOH$ groups during peptide synthesis from α -amino acids ? Explain *one* suitable method used for N-terminal protection.

(b) Give the 'Edman Method' of determination of an N-terminal amino acid in a polypeptide.

(c) (i) All α -amino acids are crystalline, high melting and water soluble. Account for this fact.

(ii) How the electrophoresis method is used for the separation of amino acids ? 5,5,5

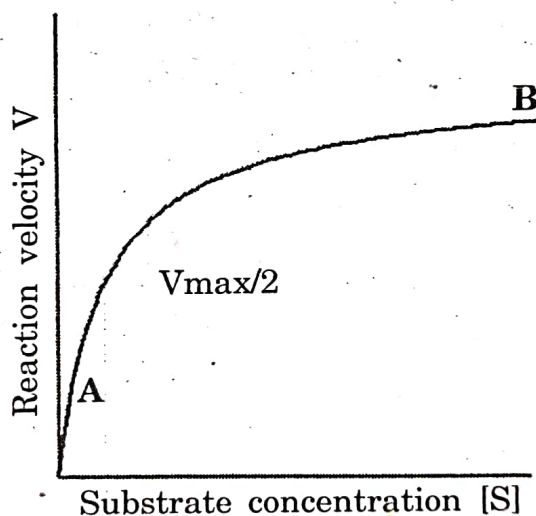
3. (a) (i) Define active sites. Give the chief characteristics of the active sites of the enzymes.

(ii) How is an enzyme different from an inorganic catalyst ?

(b) Define SAR. Explain the binding role of the hydroxyl group and aromatic ring in drug designing.

(c) What is the mechanism of enzyme-catalysed reactions and illustrate how catalysis occurs at the active site of the enzyme by taking a suitable example. 5,5,5

4. (a) Differentiate between the following :
- (i) Reversible and Irreversible inhibition
 - (ii) Absolute specificity and Reaction specificity.
- (b) Define holoenzyme and explain its components. Can these components be separated and what will be the consequence of this ?
- (c) The following graph is obtained on studying the effect of substrate concentration on reaction velocity in an enzyme-catalysed reaction. Write the Michaelis-Menten equation and explain the effect on reaction velocity corresponding to substrate concentration at points A and B.



5,5,5

5. (a) What is metabolism and how do anabolism and catabolism contribute to it ?
- (b) What is glycolysis and where does it occur in the cell ? What happens to pyruvate under hypoxic conditions ?

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- (c) Define calorific value of food. Out of fat, protein and carbohydrate, which has a high calorific value and why ? 5,5,5
6. (a) How do the products of glycolysis enter in to Kreb's cycle ? Give reaction and how many ATP molecules are generated from one molecule of glucose in the Kreb's cycle.
- (b) Draw the structure of NADH and explain how it acts as an electron carrier in various biological reactions.
- (c) How are carbohydrates converted into energy ? In which form is this energy conserved in the cell, and why ? 5,5,5