2021

Full Marks - 60

Time - 3 hours
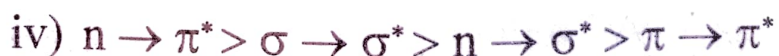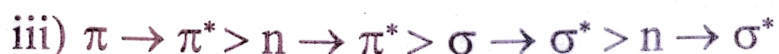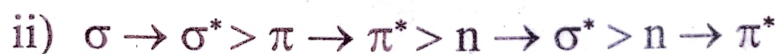
The figures in the right-hand margin indicate marks

Answer *all* questions

Part-I

1. Answer the following :   1 × 8

   a) The energy required for various transitions follow the order :

      i) $\sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \pi^*$

      ii) $\sigma \rightarrow \sigma^* > \pi \rightarrow \pi^* > n \rightarrow \sigma^* > n \rightarrow \pi^*$

      iii) $\pi \rightarrow \pi^* > n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^*$

      iv) $n \rightarrow \pi^* > \sigma \rightarrow \sigma^* > n \rightarrow \sigma^* > \pi \rightarrow \pi^*$

   b) The radiation in the wavelength range 400-800nm corresponds to ___.

      i) UV

      ii) IR

      iii) Visible

      iv) Far IR

[Turn Over

c) How wave number and wavelength are related to each other ?

d) How δ is related to τ scale chemical shift.

e) How many signals are would you expect in the NMR spectrum of ethyl Chloride.

f) Separation of ions in mass Spectrometer takes place on the basis of

   i) mass

   ii) Charge

   iii) Molecular weight

   iv) Mass to Charge ratio

g) Write down the Haworth projection formula of α-D-Glucose

h) Which of the following does not exhibit NMR :

   i) $_7N^{15}$

   ii) $_{15}P^{31}$

   iii) $_9F^{19}$

   iv) $_6C^{12}$

Part-II

2. Answer any *eight* of the following : $1\frac{1}{2} \times 8$

    a) What is Hooke's law ?

    b) Predict the various electronic transitions possible in H-CHO.

    c) Why methanol is a good solvent in UV Spectroscopy ?

    d) What do you mean by Hyperchromic shift ?

    e) Why water can not be used as a solvent for IR Spectroscopy ?

    f) Calculate the energy associated with a radiation having wavelength $4000°A$.

    g) What are Polysaccharides ? Give any two examples.

    h) What do you mean by epimers ?

   i) Define coupling constant.

    j) What do you mean by base peak ?

[Turn Over

Part-III

3. Answer any *eight* of the following : 2×8

   a) The reduced mass of a diatomic molecule is 2.5×10^{-26} Kg and its vibrational frequency is 2900 cm^{-1}. Calculate the value of force constant.

   b) What is the effect of Hydrogen bonding in UV absorption ?

   c) What do you mean by the no of fundamental vibrations ?

   d) Why is TMS used as a standard reference in NMR Spectroscopy.

   e) Explain-Hydrogen bonding causes deshielding.

   f) How can be Arabinose is converted to Glucose.

g) Calculate the λ_{max} value for the UV Spectrum of
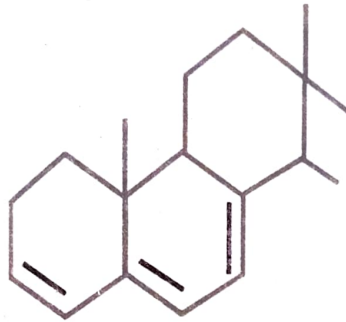
h) What happens when D-Glucose reacts with Phenyl hydrazine. Give equation.

i) How will you convert Glucose to Fructose.

j) Write notes on-Metastable Peaks.

k) What is Mc-Lafferty rearrangement ?

Part-IV

4. a) Discuss the various types of electronic transitions which occur in the UV region.   6

OR

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Part-I

1. Answer the following : 1×8

   a) Which of the following is known as the Schrodinger equation ?

      i) $E = mc^2$

      ii) $E = h\gamma$

      iii) $\lambda = \dfrac{h}{p}$

      iv) $\hat{H}\psi = E\psi$

   b) Number of vibrational degree of freedom in CO_2 is ____ ?

   c) The bond order in H_2 molecule is ____ ?

[Turn Over

d) The expression for Hamiltonian Operator is :

i) $\dfrac{h^2}{8\pi^2 m} \nabla^2 + V$

ii) $-\dfrac{h^2}{8\pi^2 m} \nabla^2 + V$

iii) $\dfrac{h^2}{8\pi^2 m} \nabla^2 - V$

iv) $-\dfrac{h^2}{8\pi^2 m} \nabla^2 - V$

e) The total number modes of vibration of a linear molecule consisting of N atoms is given by :

i) $3N - 5$

ii) $3N - 6$

iii) $3N - 2$

iv) $3N - 7$

f) The rotational spectum of a rigid diatomic rotator consists of equally spaced lines with spacing equal to :

i) $\dfrac{3B}{2}$

   ii) B

   iii) $\dfrac{B}{2}$

   iv) 2B

g) Which of the following show vibrational spectrum ?

   i) H_2

   ii) HCl

   iii) CO

   iv) N_2

h) In triplet state, the number of unpaired electron present is :

   i) 0

   ii) 1

   iii) 2

   iv) 3

Part-II

2. Answer any *eight* of the following :   1½ × 8

   a) What is an operator ?

   b) Why He_2 molecule does not exist ?

                                                  [Turn Over

[4]

c) What are photochemical reactions. Give an example.

d) State Grotthus-Draper law.

e) What is Hamiltonian Operator ?

f) Why H_2 molecule does not show rotational spectrocopy ?

g) What do you mean by the term triplet state ?

h) Draw potential energy curve for bonding molecular orbital of H_2 molecule.

i) At room temperature most of the molecules are in the zero vibrational level. Comment.

j) Define the term quenching.

Part-III

3. Answer any *eight* of the following : 2×8

a) Find the expression for the following operator :

$$\left(\frac{d}{dx} + X\right)\left(\frac{d}{dx} - X\right)$$

b) What are the draw backs of valence bond theory ?

c) What is Born Oppenheimer approximation ?

d) Distinguish between thermal reactions and Photochemical reactions.

e) What do you mean by Fluorescence ?

f) What is the moment of inertial of a diatomic molecule whose reduced mass is 2.5×10^{-20} kg and bond order distance is $2.5 A°$?

g) Give selection rule for rotational spectra.

h) What is Zero point energy of anharmonic oscillator ?

i) What is P, Q and R brances of vibrational - rotational spectrum ?

j) What are Stoke's and anti-stoke's lines ?

Part-IV

4. a) Derive an expression for the wave function of a particle in one dimensional box and how can this function be normalized ?   6

OR

b) Discuss Schrodinger wave equation for hydrogen atom in terms of polar coordinates. Separate the resultant equation in three equations using the technique of separation of variables.

5. a) Write the salient features of molecular orbital theory (MOT) and construct the MO's by LCAO of H_2^+ ion.   6

OR

b) Discuss the formation and stability of hydrogen molecule on the basis of VBT ?

6. a) How vibrational frequency is related to the vibrational energy of a harmonic oscillator ? From this relation, derive expression for zero point energy.   6

OR

b) Derive an expression for rotational energy of diatomic molecule taking as rigid rotator.

7. a) What is Raman effect ? Discuss pure rotational Raman spectra.   6

OR

b) Write notes any *two* of the following :

   i) Franck-Condon principle

   ii) Quantum yield

   iii) Chemiluminiscence.

2020

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Answer *all* questions

1. a) Define and explain the degree of polymerisation ? Give their relationship with molecular weight ?   6

   b) What is tacticity of a polymer ? How polymers are classified depending on tacticity ? Give one example from each ?   9

   OR

   c) Describe the various types of polymerisation techniques ?   10

   d) What do you mean by functionality ? Write the functionality of phenol.   3

   e) What is oxidative coupling polymerization ?   2

2. a) Derive the machanism and kinetics of free radical polymerization ? 10

   b) Compare condensation polymerization with addition polymerization ? 5

OR

   c) What is the crystalline melting point Tm of a polymer ? What are the factors that influence the Tm ? 10

   d) Discuss the measurement of crystalline melting point by DSC ? 5

3. a) What do you mean by number average molecular weight, weight average molecular weight and viscosity average molecular weight of polymer ? 6

   b) How molecular weight of polymer is determined by lights scattering method ? 6

   c) Find $\bar{M}_w$ for polypropylene, given its degree of polymerization as 10,000 ? 3

OR

[3]

d) State and explain W-L-F equation ? 10

e) Write the relationship between Tg and Tm for symmetrical and unsymmetrical polymers. 5

4. a) Explain solubility parameter ? 5

b) What is Flory-Huggins theory of polymer solutions ? 5

c) Determine the Osmotic pressure of polymer solution by using Flory Huggins equation ? 5

OR

d) Write short notes on the following : 3 × 5

i) Polyamides

ii) Polysiloxane

iii) Polystynene and stynene copolymer.

L-75-1300

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Answer *all* questions

Part-I

1. Answer any *eight* of the following : 1×8

   a) Name one Ozone depleting Substance.

   b) What is CFC ?

   c) Who is the father of green Chemistry ?

   d) Give any two examples of non-renewable resources.

   e) TEL is an ___ agent. (Anti Knocking, Reducing, Oxidising).

   f) What is SCORR ?

   g) Which gas was responsible for Bhopal gas tragedy ?

   h) Name a green nitrating agent.

[Turn Over

Part-II

2. Answer any *eight* of the following : 1½ × 8

a) What is a Solvent less reaction ?

b) What are neat reactions ?

c) What is the composition of Bio gas ?

d) What is Sevin ?

e) What do you mean by Bio-Catalyst ? Give an example.

f) Define atom economy ?

g) What is green solvent ?

h) What is acid rain ?

i) What is green Chemistry ?

j) What are Bio gases ?

Part-III

3. Answer any *eight* of the following : 2 × 8

a) What are the goals of green Chemistry ?

b) What was the cause of Bhopal gas tragedy ?

c) What are the merits of using Bio Catalysts ?

d) What are renewable and non-renewable sources ?

e) Write the green synthesis of adipic acid.

f) Describe the green synthesis of Catechol.

g) What is ultra sound assisted Simmons-Smith reaction ?

h) Calculate % of atom economy in the reaction :

Buta-1, 3-diene + Ethene → Cychohexene

i) Give green synthesis of Furfural.

j) What is super critical water ?

Part-IV

4. a) Discuss the "twelve principles of Green Chemistry".   6

OR

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

i) Super critical CO_2 as a green Solvent

ii) Crown ether

iii) Phase transfer catalyst.

5. a) Discuss-Blocking and de-blocking procedure in organic synthesis.   6

OR

b) How to design a green synthesis ? Explain.

6. a) Describe the green synthesis of any *two* of the following compounds : 6

   i) Paracetamol

   ii) disodium imino di-acetate (DSIDA)

   iii) methyl methacrylate.

OR

   b) Describe the green synthesis of micro wave assisted reactions :

   i) Diels-Alder reaction in Organic Solvent medium

   ii) Hofmann elimination reaction in water solvent medium.

7. a) Explan why right fit Azo Pigments replace the conventional ones like Inorganic and Organic Pigments. 6

OR

   b) What is Sustainable dovelopment ? How can it be realised through green Chemistry ?