

Total No. of Printed Pages—12

6 SEM TDC CHM M 1 (N/O)

2017

(May)

CHEMISTRY

(Major)

Course : 601

(**Physical Chemistry**)

*The figures in the margin indicate full marks
for the questions*

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

1. Choose the correct answer : 1×5=5

(a) Which one of the following is not true for a photochemical reaction?

(i) Photochemical reaction involves absorption of light

(ii) The free energy change (ΔG) of a photochemical reaction must be negative

- (iii) Temperature has very little effect on the rate of photochemical reaction
- (iv) The intensity of light has a marked effect on the rate of a photochemical reaction
- (b) Which of the following polymers is formed by step reaction polymerization?
- (i) PVC
 - (ii) Polyethylene
 - (iii) Nylon-6,6
 - (iv) Polyaniline
- (c) Chemisorption plays an important role in
- (i) heterogeneous catalysis
 - (ii) homogeneous catalysis
 - (iii) both homogeneous and heterogeneous catalyses
 - (iv) None of the above
- (d) The maximum number of phases that can be in equilibrium for a two-component system at constant temperature and pressure is
- (i) 1
 - (ii) 2
 - (iii) 3
 - (iv) 4

- (e) A microcanonical ensemble consists of isolated systems each having
- (i) same value of volume (V), total number of molecules (N) and energy (E)
 - (ii) same value of volume (V), total number of molecules (N) and chemical potential (μ)
 - (iii) same value of volume (V), temperature (T) and chemical potential (μ)
 - (iv) same value of volume (V), temperature (T) and energy (E)

2. Answer the following questions : 2×5=10

- (a) What are the primary and secondary processes in a photochemical reaction? 2
- (b) Define degree of polymerization. The molecular weight of a sample of polyvinylchloride is 625000. Calculate the degree of polymerization. 1+1=2
- (c) What is autocatalysis? Give one example. 1+1=2
- (d) Explain why fusion curve in water system has a negative slope whereas the sublimation curve has a positive slope. 2

(e) Define thermodynamic probability.
What is the relation between thermodynamic probability and entropy? $1+1=2$

3. Answer any two questions from the following : $3\frac{1}{2}\times 2=7$

(a) State and explain Beer-Lambert law.
Define molar extinction coefficient. $3+\frac{1}{2}=3\frac{1}{2}$

(b) Discuss the kinetics of dimerization of anthracene. $3\frac{1}{2}$

(c) What do you mean by quenching of fluorescence? Describe chemiluminescence. $1\frac{1}{2}+2=3\frac{1}{2}$

4. Answer any one question from the following : 5

(a) State the differences between addition polymerization and step-reaction polymerization. Discuss various steps involved in the polymerization mechanism of styrene initiated by benzoyl peroxide at 60°C . $2+3=5$

(b) (i) What is copolymerization? Define reactivity ratio of monomers. Mention different types of copolymer formed in terms of reactivity ratio. $1+1+2=4$

(ii) What is Ziegler-Natta catalyst? 1

5. Answer any *one* question from the following : 5
- (a) (i) Write the important steps of surface reaction. 2
- (ii) What are enzyme catalyses? Discuss the effect of temperature on enzyme catalysis. 1+2=3
- (b) What is acid-base catalysis? Explain the theories of acid-base catalysis with suitable example. 1+4=5
6. Answer any *two* questions from the following : $4\frac{1}{2} \times 2 = 9$
- (a) (i) Find the number of phases and number of components for the following equilibria : $1 \times 2 = 2$
- (1) $\text{H}_2\text{O}(\text{s}) \rightleftharpoons \text{H}_2\text{O}(\text{l}) \rightleftharpoons \text{H}_2\text{O}(\text{g})$
- (2) $\text{NH}_4\text{Cl}(\text{g}) \rightleftharpoons \text{NH}_3(\text{g}) + \text{Cl}_2(\text{g});$

$$P_{\text{NH}_3} = P_{\text{Cl}_2}$$
- (ii) What is triple point? Explain why more than one triple points are observed in the phase diagram of sulphur. $1 + 1\frac{1}{2} = 2\frac{1}{2}$
- (b) What do you mean by congruent melting point? Draw and explain the phase diagram of a two-component system with the formation of a congruently melting compound. Comment on the stability of such compounds. $1 + 2\frac{1}{2} + 1 = 4\frac{1}{2}$

- (c) Define cryohydric point. Discuss the phase diagram of KI-H₂O system.

$$1+3\frac{1}{2}=4\frac{1}{2}$$

7. Answer any *two* questions from the following :

$$3\frac{1}{2}\times 2=7$$

- (a) Define partition function. Write the mathematical expression for translational partition function. Calculate the translational partition function for benzene in a volume of 1 m³ at 25 °C.

$$1+1+1\frac{1}{2}=3\frac{1}{2}$$

- (b) Derive the equation for the calculation of the molar entropy of an ideal monatomic gas.

$$3\frac{1}{2}$$

- (c) From partition function of an ideal monatomic gas, show that molar heat capacity at constant volume, $C_V = \frac{3}{2}R$.

$$3\frac{1}{2}$$

(7)

(Old Course)

Full Marks : 48
Pass Marks : 19

Time : 3 hours

1. Select the correct answers : 1×5=5

(a) The true statement about photochemical reaction is

- (i) the presence of light is the primary requirement for reactions to take place
- (ii) temperature has a very little effect on the rate of photochemical reaction
- (iii) ΔG for photochemical spontaneous reactions may be positive or negative
- (iv) All of the above

(b) A sample of polystyrene has an average molecular weight of 208000. The degree of polymerization of this sample is

- (i) 2000
- (ii) > 2000
- (iii) < 2000
- (iv) None of the above

- (c) Shape-selective catalysis is a reaction catalyzed by
- (i) zeolites
 - (ii) enzymes
 - (iii) platinum
 - (iv) acids or bases
- (d) The point in the pressure-temperature curve of water system where the equilibrium $\text{ice} \rightleftharpoons \text{water} \rightleftharpoons \text{vapour}$ exists is called the
- (i) critical point
 - (ii) triple point
 - (iii) transition point
 - (iv) eutectic point
- (e) With the increase in temperature, partition function
- (i) increases
 - (ii) decreases
 - (iii) first decreases and then increases
 - (iv) neither increases nor decreases

2. Answer the following questions : 2×5=10

- (a) What do you mean by photo-sensitization? Explain with examples.
- (b) A protein sample consists of an equimolar mixture of
- haemoglobin ($M = 15.5 \text{ kg mol}^{-1}$)
 - ribonuclease ($M = 13.7 \text{ kg mol}^{-1}$)
 - myoglobin ($M = 17.2 \text{ kg mol}^{-1}$)

Calculate the number-average and mass-average molecular masses.

- (c) Explain the action of catalytic promoters and catalytic poisons.
- (d) A eutectic mixture has a definite composition and a sharp melting point, yet it is not a compound. Give reason.
- (e) Define canonical and grand canonical ensembles.

3. Answer any *two* of the following questions :

$3\frac{1}{2} \times 2 = 7$

- (a) Derive the rate expression for the reaction $\text{H}_2 + \text{Br}_2 \xrightarrow{h\nu} 2 \text{HBr}$, assuming steady-state approximation for H and Br atoms. How would you account for the low quantum yield for this reaction?

$2\frac{1}{2} + 1 = 3\frac{1}{2}$

- (b) State and explain Lambert-Beer law. Discuss its applications in analytical chemistry. $2\frac{1}{2}+1=3\frac{1}{2}$
- (c) Discuss about the primary and secondary processes in a photochemical reaction. $1\frac{1}{2}+2=3\frac{1}{2}$
4. Answer any *one* of the following questions : 5
- (a) (i) Explain the term 'intrinsic viscosity'. How is it related to the molecular weight of a polymer? Discuss how the molecular weight of a polymer can be determined by viscosity measurement. $1+1+2=4$
- (ii) Write briefly about living polymers. 1
- (b) (i) Describe the mechanism of polymerization of styrene initiated by benzoyl peroxide at 60 °C. 3
- (ii) Mention the technological importance of copolymers. 2
5. Answer any *one* of the following questions : 5
- (a) What is enzyme catalysis? Discuss the effects of concentration, temperature and pH on the rate of enzyme catalysis. Explain why enzyme catalysts are highly specific. $1+3+1=5$

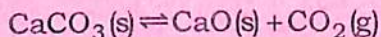
- (b) (i) Differentiate between homogeneous catalysis and heterogeneous catalysis. Discuss the mechanism of heterogeneous catalysis on the basis of adsorption theory. $1+2=3$
- (ii) Explain the term 'autocatalysis' with one example. 2

6. Answer any *two* of the following questions :

$$4\frac{1}{2} \times 2 = 9$$

- (a) What is peritectic change? Draw and explain the labelled phase diagram of $\text{Na}_2\text{SO}_4\text{-H}_2\text{O}$ system. $1+3\frac{1}{2}=4\frac{1}{2}$

- (b) (i) Determine the number of components, number of phases and degrees of freedom in the following equilibria : $1\frac{1}{2} \times 2 = 3$



when $P_{\text{NH}_3} \neq P_{\text{HCl}}$

- (ii) Distinguish between the triple point and freezing point of a pure substance. $1\frac{1}{2}$
- (c) (i) Derive Clausius-Clapeyron equation. 3
- (ii) The possibility of a four-phase equilibria in the sulphur system is ruled out. Explain why. $1\frac{1}{2}$

7. Answer any *two* of the following questions :

$3\frac{1}{2} \times 2 = 7$

(a) What do you mean by partition function? Discuss the physical significance of partition function. Define molar partition function. $1 + 1\frac{1}{2} + 1 = 3\frac{1}{2}$

(b) Deduce the relationship between partition function and Gibbs' free energy. $3\frac{1}{2}$

(c) Derive an expression for translational partition function for an ideal monatomic gas using particle in a box model. $3\frac{1}{2}$

Total No. of Printed Pages—10

6 SEM TDC CHM M 3 (N/O)

2 0 1 7

(May)

CHEMISTRY

(Major)

Course : 603

(Inorganic Chemistry—III)

*The figures in the margin indicate full marks
for the questions*

(New Course)

Full Marks : 48
Pass Marks : 14

Time : 2 hours

1. Select the correct answer : 1×5=5

(a) Hemocyanin contains

(i) magnesium

(ii) iron

(iii) copper

(iv) zinc

- (b) The DNA and RNA helices are stabilized by
- (i) Mg^{2+}
 - (ii) Fe^{2+}
 - (iii) Ca^{2+}
 - (iv) Cu^{2+}
- (c) Which of the following materials is not used as binders in TLC?
- (i) Plaster of Paris
 - (ii) Starch
 - (iii) Silica gel
 - (iv) All of the above
- (d) Which of the following is used to decolourise and deodorize vegetable and mineral oils?
- (i) Kaolinite
 - (ii) Montmorillonite
 - (iii) Laponite
 - (iv) None of the above
- (e) Which of the following belongs to ceramics?
- (i) Earthen ware
 - (ii) Porcelain
 - (iii) Tera cotta
 - (iv) All of the above

UNIT—I

2. (a) Answer any *three* questions :

- (i) What is carbonic anhydrase? Discuss its activity in living organism. 4
- (ii) Discuss the role of sodium and potassium in biological process. 4
- (iii) What is hemoglobin? Discuss its main functions. 4
- (iv) Explain how metal poisoning can be treated by chelation therapy. 4

(b) Write a note on any *one* of the following : 2

- (i) *cis*-platin
- (ii) Plastocyanin

UNIT—II

3. Answer any *three* questions : 3×3=9

- (a) What do you mean by non-covalent interaction? Mention the name of any two types with examples. 1+2=3
- (b) What are the advantages of nano-materials in modern science? Mention two applications of nano-materials. 3

- (c) What do you mean by **step-up and step-down syntheses** of nano-materials? Name one method which follows step-down procedure. 2+1=3
- (d) What do you mean by composite materials? Write a note on the application of nano-composite material. 1+2=3

UNIT—III

4. Answer any *three* questions : 3×3=9
- (a) Describe the principle and application of thin-layer chromatography. 3
- (b) Apply paper chromatography to separate a mixture of amino acids. How is R_f value calculated and what information is obtained from this value? 3
- (c) What is FTIR? What kind of information do you get from it? 3
- (d) Write the principle behind atomic absorption spectroscopy. Give its two applications. 1+2=3
- (e) Write short notes on the following : 1½+1½=3
- (i) Choice of solvent system in chromatography
- (ii) Principles of column chromatography

UNIT—IV

5. Answer the following questions :

(a) What is Portland cement? How is it manufactured industrially? 1+3=4

(b) Discuss the health hazards which may be caused by mercury and its compounds. 4

Or

What are the hazards associated with nuclear accident? 4

(c) Write short notes on any *two* of the following : 1½×2=3

(i) Role of binder and solvent in paint industry

(ii) Ceramics

(iii) Classification of paints

(6)

(Old Course)

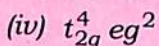
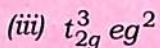
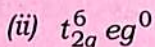
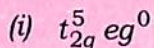
Full Marks : 48

Pass Marks : 19

Time : 3 hours

1. Select the correct answer : 1×5=5

(a) The electron configuration of Fe in oxyhemoglobin is



(b) Which of the following contains molybdenum?

(i) Aldehyde oxidase

(ii) Ceruloplasmin

(iii) Amine oxidase

(iv) None of the above

(c) Which of the following is not a clay mineral?

(i) Benitoite

(ii) Laponite

(iii) Bentonite

(iv) Kaolinite

- (d) In fluorescence spectroscopy, the emitted radiation has
- (i) a shorter wavelength
 - (ii) a longer wavelength
 - (iii) high energy per photon
 - (iv) None of the above
- (e) Demineralized water is obtained by
- (i) Clark's process
 - (ii) permutit process
 - (iii) ion-exchange process
 - (iv) ozonisation

UNIT—I

2. (a) Answer any *three* questions :

- (i) Describe the role of zinc in human body. 4
- (ii) What are the functions of hemoglobin and myoglobin? What are the principal similarities in their structures? 3+1=4
- (iii) Explain the role of alkali and alkaline earth metals in biological system. 4

(iv) Write short notes on any *two* of the following : 2×2=4

(1) Chelation therapy

(2) Nitrogenase

(3) Cyanocobalamin

(b) Give the name of any two copper enzymes and mention one function of each. 2

UNIT—II

3. Answer any *three* questions : 3×3=9

(a) What do you mean by supramolecular interaction? How is it different from covalent interaction? Give one example. 1+1+1=3

(b) What is isomorphous replacement in clay minerals? Give the general formula of kaolinite clay. Mention its one application. 1+1+1=3

(c) Write a note on polymer nanocomposite material. 3

(d) Name two basic approaches for synthesis of nanomaterials. Mention the name of any two characterization techniques for them. 2+1=3

(e) Discuss about the advantage and application of solid-state reaction. 3

UNIT—III

4. Answer any *three* questions : 3×3=9
- (a) Describe the principle and application of thin-layer chromatography. 3
- (b) What is FTIR? What kind of information do you get from it? 3
- (c) Apply paper chromatography to separate a mixture of amino acids. How is R_f value calculated and what information is obtained from it? 3
- (d) Write short notes on any *two* of the following : 1½×2=3
- (i) Choice of solvent system in chromatography
- (ii) Principles of column chromatography
- (iii) Atomic absorption spectroscopy

UNIT—IV

5. Answer the following questions :
- (a) Mention two sources through which lead can enter human body. Discuss the poisoning effect of lead. 1+3=4

Or

What are the hazards associated with nuclear accident? 4

(10)

- (b) What is Portland cement? How is it manufactured industrially? $1+3=4$
- (c) Write short notes on any *two* of the following : $1\frac{1}{2}\times 2=3$
- (i) Role of binder and solvent in paint industry
 - (ii) Ceramics
 - (iii) Classification of paints

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2017

(May)

CHEMISTRY

(Major)

Course : 605

(Organic Chemistry)

(New Course)

Full Marks : 48

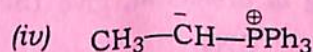
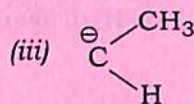
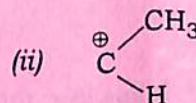
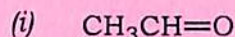
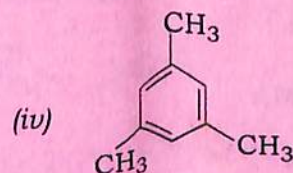
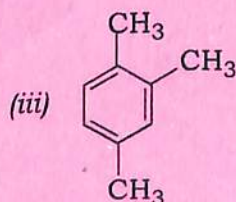
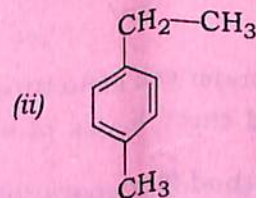
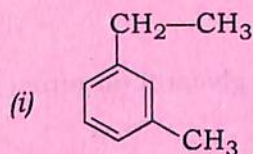
Pass Marks : 14

Time : 2 hours

The figures in the margin indicate full marks for the questions

1. Choose the correct answer from the following :

1×5=5

(a) Which one of the following is the correct synthon of the synthetic equivalent $\text{Ph}_3\text{P} = \text{CH} - \text{CH}_3$?(b) The NMR spectrum of the compound C_9H_{12} , exhibits τ 3.22 (s, 3H) and 7.75 (s, 9H). Which of the following structures is in conformity with the data?

(c) Which of the following is a xanthate dye?

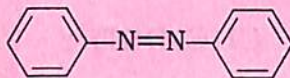
(i) Phenolphthalein

(ii) Fluorescein

(iii) Congo red

(iv) Orange II

(d) The compound



(azobenzene) having a chromophore $-N=N-$, is known as

(i) auxochrome

(ii) vat dye

(iii) mordant dye

(iv) chromogen

(e) In which region, NMR spectra are observed?

(i) Microwave

(ii) UV/visible

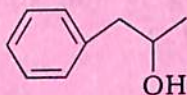
(iii) Radiofrequency

(iv) X-ray

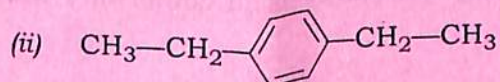
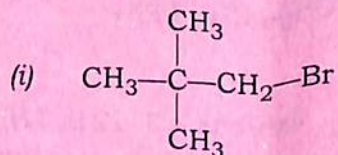
2. Answer any five from the following :

2×5=10

(a) Simply show that where to disconnect and mention the synthons and synthetic equivalents of the following :



(b) In which of the following molecules does spin-spin coupling occur? If splitting is observed, give the multiplicity of each kind of hydrogen :



(c) Draw the condensed structural formula of a triacyl glycerol obtained from glycerol and three moles of stearic acid.

(d) Give the method of preparation of the monomers of the following polymers (any one) :

(i) PMMA

(ii) PAN

(e) What are leucocompounds? How is Fuchsine prepared?

(f) The IR spectrum of methyl salicylate shows the peaks 3300 cm^{-1} , 1700 cm^{-1} , 3050 cm^{-1} , 1540 cm^{-1} , 1590 cm^{-1} and 2950 cm^{-1} . Attribute these peaks to the following :

(i) $-\text{CH}_3$

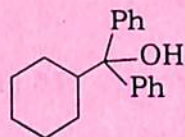
(ii) $>\text{C}=\text{O}$

(iii) $-\text{OH}$ group of the ring

(iv) Aromatic ring

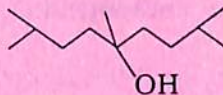
UNIT—I

3. Synthesize the following compound with proper retrosynthetic analysis : 3



Or

Synthesize the following tertiary alcohol with retrosynthetic analysis : 3

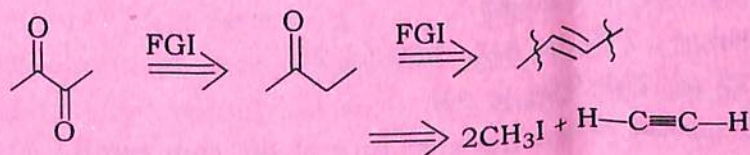


4. How would you synthesize the following TM, working reverse with Wittig reaction? 2

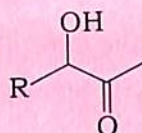


Or

From the disconnection pattern shown below, synthesize the following TM : 2



5. Mention where to disconnect the following α -hydroxyketone and suggest its synthesis : 3



UNIT—II

Answer *any one* question

6. (a) Calculate λ_{\max} in UV spectrum for the following compound : 2



- (b) Distinguish between the isomers of compound having molecular formula C_3H_6O using IR technique. 2

- (c) A compound with molecular mass 116 gives the following information on analysis :

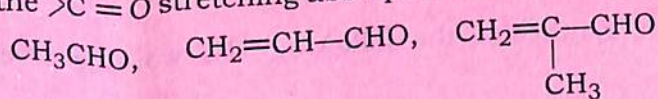
UV : 283 $m\mu$ ϵ_{\max} 22

IR ν (cm^{-1}) : 3000–2500 (b), 1715 (s); 1342 (w)

NMR δ value : 2.12 (s, 3H), 2.60 (t, 2H), 2.25 (t, 2H), 11.1 (s, 1H)

Assign the structure of the compound. 3

7. (a) Compare the $>C=O$ stretching absorptions in the following compounds : 3



(i)

(ii)

(iii)

- (b) A compound with molecular formula $C_{10}H_{20}O$ shows a strong absorption at 1705 cm^{-1} in its IR spectrum and NMR spectrum of the compound shows the following peaks :

δ value : 7.22 (s, 5H), 3.59 (s, 2H)

2.77 (q, 2H), 0.95 (t, 3H)

Giving reasons, assign the structure of the compound. 4

UNIT—III

8. Answer any two questions :

2×2=4

- (a) What is rancidity? How can you prevent rancidity?
- (b) What are phosphoglycerides? Mention their biological importances.
- (c) What is saponification value of a fat? What is its significance in determining the quality of lipid?

UNIT—IV

Answer any one question

9. (a) What are the chromophores and auxochromes present in the following dyes? 1+1=2

(i) Methyl orange

(ii) Indigotin

(b) What are the requisites for a compound to be acted as a dye? 1

(c) Synthesize alizarin from phthalic anhydride. 2

10. (a) How will you synthesize fluorescein? 2

(b) How would you prepare Congo red from naphthionic acid? Discuss its use as acid-base indicator. 2+1=3

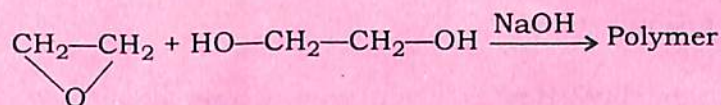
UNIT—V

Answer any one question

11. (a) How are Nylon-6 and Nylon-6,6 manufactured? Show the process through which molecular chains are held together in them. 1+1+1=3

(b) Rubber and gutta-percha both are polyisoprene derivatives. Upon ozonolysis both form laevulic aldehyde ($\text{CH}_3\text{COCH}_2\text{—CH}_2\text{—CHO}$). On the basis of this information, how would you assign their structural segments and relationships? 2

- (c) Give the possible structure of the polymer obtained in the following reaction : 1



12. (a) Define isotactic, syndiotactic and atactic polymers with suitable illustrations. 1+1+1=3
- (b) Discuss how you would prepare the following (any one) :
- (i) Phenol-formaldehyde resin
- (ii) A polyester 2
- (c) What change occurs in the chain structure when rubber is vulcanized? 1

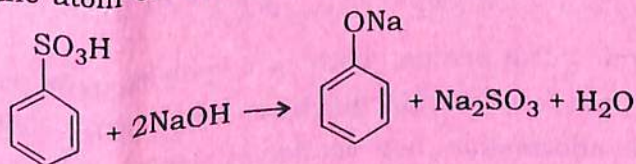
UNIT—VI

Answer any **one** question

13. (a) "Synthetic methods should be designed to maximize the incorporation of all the starting materials in the process into the final product." Explain the statement with suitable example. 2
- (b) Give one Green reaction which can be carried out in aqueous medium. 1
14. (a) Give any three basic principles to plan a Green synthesis. 1½
- (b) Explain that catalytic reagents (as selective as possible) are superior to stoichiometric reagents. 1½

Or

Calculate the atom efficiency of the following reaction : 1½



(Old Course)

Full Marks : 48

Pass Marks : 19

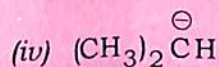
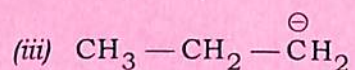
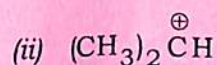
Time : 3 hours

The figures in the margin indicate full marks for the questions

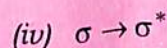
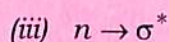
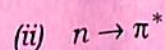
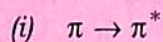
1. Choose the correct answer from the following :

1×5=5

(a) The correct synthon of the synthetic equivalent of $[(\text{CH}_3)_2\text{CH}]_2\text{CuLi}$ is



(b) In a carbonyl compound, the increase in polarity of a solvent, which one of the following transitions shifts to shorter wavelength?



(c) Which of the following is a xanthene dye?

(i) Phenolphthalein

(ii) Orange II

(iii) Fluorescein

(iv) Congo red

(d) The multiplicity of the signals of $\text{CH}_3 - \text{CH}_2 - \text{OH}$ in NMR spectroscopy is

(i) two triplet and a quintet

(ii) singlet, triplet and quartet

(iii) three singlet

(iv) None of the above

(e) Which one of the following is a thermosetting polymer?

(i) Nylon-6

(ii) Nylon-6,6

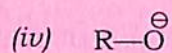
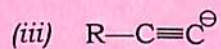
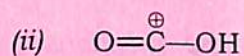
(iii) Bakelite

(iv) SBR

2. Answer any *five* from the following :

2×5=10

(a) Write down the synthetic equivalents for the following synthons : $\frac{1}{2} \times 4 = 2$



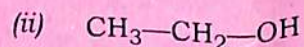
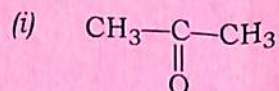
(b) Write short notes on :

1+1=2

(i) Bathochromic or red shift

(ii) Hypsochromic or blue shift

(c) Give the approximate IR absorption bands of the following compounds : 1+1=2



(d) Give the names and structures of the monomer units that are used to prepare the following polymers :

1+1=2

(i) Orlon

(ii) Neoprene

(e) What are acidic azo dyes? How is methyl orange prepared?

1+1=2

(f) What is the range of infrared radiations? What are the units used in IR spectroscopy?

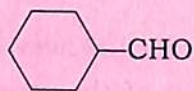
1+1=2

(g) Write the advantages of using water as Green solvent.

2

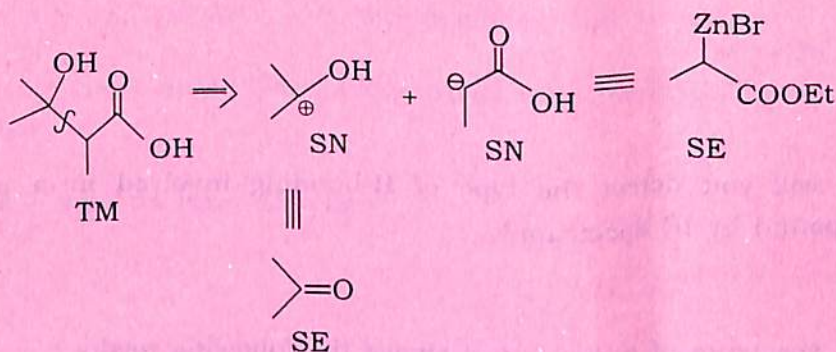
UNIT-I

3. Synthesize the following compound with proper retrosynthetic analysis : 3

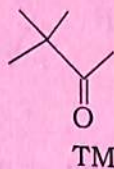


Or

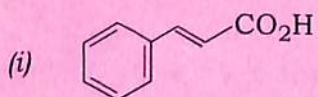
From the disconnection pattern shown below, propose the synthesis for the TM : 3



4. What do you mean by FGI? How would you synthesize the following TM working reverse with pinacol-pinacolone transform? 1+2=3



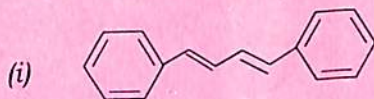
5. Simply show where to disconnect the following and mention their synthons and synthetic equivalents : 1+1=2



UNIT—II

Answer any **one** question

6. (a) Indicate the increasing order of wavelength λ_{\max} of the following compounds in the UV region of the spectrum : 2

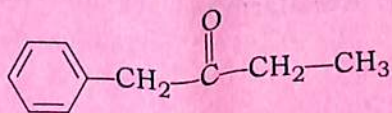


- (b) How will you detect the type of H-bonding involved in a particular compound by IR spectrum? 2

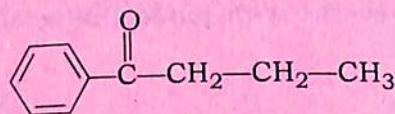
- (c) PMR spectrum of a compound shows the following peaks :

NMR δ value : 7.22 (s, 5H), 3.59 (s, 2H), 2.77 (q, 2H), 0.97 (t, 3H)

In the IR spectrum, there is a strong absorption band at 1705 cm^{-1} . Giving reasons, find out which of the following structures is in keeping with the above data : 3

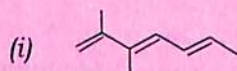


A



B

7. (a) Calculate λ_{\max} for the following structures (any one) : 2



- (b) Explain the term 'spin-spin coupling'. Why does a peak for a particular set of protons split into a triplet? Give example. 3

(c) A compound having molecular formula $C_{10}H_{14}$ gives the following NMR data :

(i) Singlet (δ 0.88) 9H

(ii) Singlet (δ 7.28) 5H

Assign the structure to the compound on the basis of the above data. 2

UNIT—III

8. Answer any two questions :

2×2=4

(a) What are triglycerides? Give two examples with structures.

(b) What is iodine value? What is its significance in determining the quality of a lipid?

(c) Write a note on rancidification.

UNIT—IV

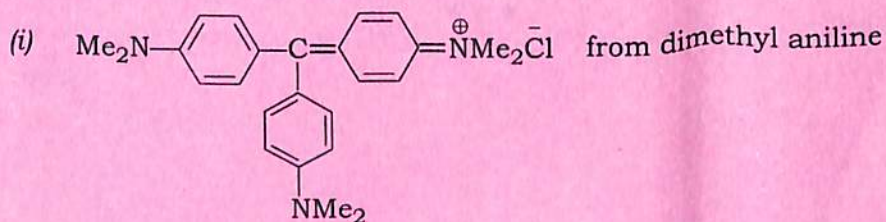
Answer any one question

9. (a) Explain the terms 'chromophores' and 'auxochromes' giving suitable examples.

1+1=2

(b) Suggest synthesis of the following :

1½×2=3



(ii) Indigotin from anthranilic acid

10. (a) Why do we use methyl orange as acid-base indicator?

2

(b) What is the difference between phthalein and xanthene? How would you prepare phenolphthalein?

1+2=3

UNIT—V

Answer any **one** question

11. (a) Discuss the mechanism of anionic polymerization of methyl methacrylate. 2
(b) How would you prepare the following (any two)? 2×2=4
(i) Nylon-6
(ii) Urea-formaldehyde resin
(iii) Neoprene
12. (a) Illustrate the process of condensation polymerization with particular emphasis in the formation of polyester. 2
(b) Write a short note on Ziegler-Natta polymerization. 2
(c) What is the significance of the process of vulcanization in the rubber industry? 2

UNIT—VI

13. Why are the uses of most of the organic solvents not preferred in Green chemistry? Give two examples of ultrasound and microwave assisted reactions. 2+1=3

Or

Why biocatalyst has many advantages in the context of Green chemistry? Name two Green catalysts and their uses. 2+1=3

6 SEM TDC CHM M 7 (N/O)

2 0 1 7

(May)

CHEMISTRY

(Major)

Course : 607

(Spectroscopy)

*The figures in the margin indicate full marks
for the questions*

(New Course)

Full Marks : 48

Pass Marks : 14

Time : 2 hours

1. Choose the correct option : 1×5=5

(a) The radiation in the wavelength range
400–800 nm corresponds to

- (i) ultraviolet
- (ii) infrared
- (iii) visible
- (iv) far IR

(b) The value of extinction coefficient increases with

- (i) increase in conjugation
- (ii) addition of chromophore
- (iii) both of (i) and (ii)
- (iv) None of (i) and (ii)

(c) The molecule which is microwave active is

- (i) HCl
- (ii) CO₂
- (iii) H₂
- (iv) N₂

(d) The number of NMR signals formed by 2-chloropropene is

- (i) 2
- (ii) 3
- (iii) 1
- (iv) None

- (e) In case same lines are obtained both in infrared and Raman spectra, then the molecule
- (i) should be centrosymmetric
 - (ii) has no centre of symmetry
 - (iii) has high value of dipole moment
 - (iv) has low value of dipole moment

2. Answer any *five* of the following : $2 \times 5 = 10$

- (a) Water is a good solvent for UV- and visible-spectroscopy but not for IR-spectroscopy. Explain.
- (b) Explain Fermi resonance.
- (c) Discuss about the interaction of electromagnetic radiation with a rotating molecule.
- (d) Explain mutual exclusion principle with examples.

- (e) Describe Larmor frequency.
- (f) Cu^+ ion does not show ESR spectra but Cu^{2+} ion shows ESR spectra. Explain.

UNIT—I

3. (a) Discuss the effect of isotopic substitution on the rotational spectra of a diatomic molecule. 2½
- (b) The rotational spectrum of HF has lines 41.9 cm^{-1} apart. Calculate the bond length of H—F bond in HF. 2½

UNIT—II

4. (a) State and explain fundamental and overtone frequencies with mathematical expressions. 3

Or

Show that the frequency of the absorbed radiation in pure vibrational spectra is equal to the fundamental frequency of vibration ν_0 of the molecule. 3

- (b) Roughly sketch the fundamental vibrations of water molecule. 2
- (c) In the near IR spectrum of CO, there is an intense band at 2144 cm^{-1} . Calculate (i) the fundamental vibrational frequency of CO, (ii) the force constant and (iii) zero-point energy. 3

UNIT—III

5. (a) What are Stokes and anti-Stokes lines? Explain with anti-Stokes lines are weaker than that of Stokes lines. 2+2=4
- (b) Write the differences between Raman spectra and infrared spectra. 3

UNIT—IV

6. (a) Discuss various types of electronic transition with one example each. 4
- (b) Explain bathochromic shift with two examples. 2

Or

Write a short note on auxochrome. 2

UNIT—V

7. (a) Draw the high resolution NMR spectra of 1-chloropropane and 2-chloropropane. $1\frac{1}{2}+1\frac{1}{2}=3$

(b) What is chemical shift in NMR-spectroscopy? Mention two factors that affect chemical shift. $2+2=4$

Or

Discuss relaxation processes in NMR-spectroscopy. 4

(7)

(Old Course)

Full Marks : 48

Pass Marks : 19

Time : 3 hours

1. Choose the correct option : 1×5=5

(a) The radiation in the wavelength range 400–800 nm corresponds to

- (i) ultraviolet
- (ii) infrared
- (iii) visible
- (iv) far IR

(b) The value of extinction coefficient increases with

- (i) increase in conjugation
- (ii) addition of chromophore
- (iii) both of (i) and (ii)
- (iv) None of (i) and (ii)

- (c) The molecule which is microwave active is
- (i) HCl
 - (ii) CO₂
 - (iii) H₂
 - (iv) N₂
- (d) The number of NMR signals formed by 2-chloropropene is
- (i) 2
 - (ii) 3
 - (iii) 1
 - (iv) None
- (e) In case same lines are obtained both in infrared and Raman spectra, then the molecule
- (i) should be centrosymmetric
 - (ii) has no centre of symmetry
 - (iii) has high value of dipole moment
 - (iv) has low value of dipole moment

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

- (a) The nuclei like ¹²C and ¹⁶C do not exhibit NMR spectra. Explain.

- (b) Water is a good solvent for UV- and visible-spectroscopy but not for IR-spectroscopy. Explain.
- (c) Explain Fermi resonance with one example.
- (d) Discuss about the interaction of electromagnetic radiation with a rotating molecule.
- (e) Explain the principle of mutual exclusion.
- (f) Cu^+ ion does not show ESR spectra but Cu^{2+} ion shows ESR spectra. Explain.
- (g) Describe Larmor frequency.

UNIT—I

3. (a) Discuss the effect of isotopic substitution on the rotational spectra of a diatomic molecule. 2
- (b) The rotational spectrum of HF has lines 41.9 cm^{-1} apart. Calculate the bond length of H—F bond in HF. 2
- (c) State the reason why the microwave studies are done in gaseous state only. 1

UNIT—II

4. (a) Show that the frequency of the absorbed radiation in pure vibrational spectra is equal to the fundamental frequency of vibration ν_0 of the molecule. 3
- (b) In the near IR spectrum of CO, there is an intense band at 2144 cm^{-1} . Calculate (i) the fundamental vibrational frequency of CO, (ii) the force constant and (iii) zero-point energy. 3
- (c) Roughly sketch the fundamental vibrations of water molecule. Show how many of them are infrared active and Raman active. 2

UNIT—III

5. (a) What are Stokes and anti-Stokes lines in Raman spectroscopy? Why anti-Stokes lines are less intense than Stokes lines? 3
- (b) Discuss about the rotational Raman spectrum in linear molecule. 3
- (c) Write any one difference between Raman spectra and infrared spectra. 1

UNIT—IV

6. (a) Discuss various types of electronic transition with one example each. 3
- (b) Write short notes on the following : $1\frac{1}{2}+1\frac{1}{2}=3$
- (i) Bathochromic shift
- (ii) Auxochrome

UNIT—V

7. (a) Discuss briefly the principle of ESR-spectroscopy. 3
- Or
- Discuss the relaxation processes in NMR-spectroscopy. 3
- (b) Draw the high resolution NMR spectra of 1-chloropropane and 2-chloropropane. $1+1=2$
- (c) What is chemical shift in NMR-spectroscopy? Mention one factor that affects chemical shift. 2
