

2025

(CBCS)

(6th Semester)

CHEMISTRY

TWELFTH (B) PAPER

(Natural Products)

Full Marks : 75

Time : 3 hours

The figures in the margin indicate full marks for the questions

(SECTION : A—OBJECTIVE)

(Marks : 10)

Tick (✓) the correct answer in the brackets provided :

1×10=10

1. During the biosynthesis of terpenoids, condensation of dimethylallyl diphosphate with isopentenyl diphosphate results in the formation of

- (a) farnesyl pyrophosphate ()
- (b) geranyl pyrophosphate ()
- (c) 3R-Mevalonic acid ()
- (d) MVA-5-diphosphate ()

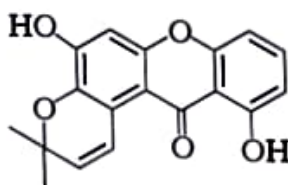
2. Diterpenes contains

- (a) five isoprene units ()
- (b) three isoprene units ()
- (c) four isoprene units ()
- (d) two isoprene units ()

3. In classical methods for the determination of structure, the primary step is detection of

- (a) pressure ()
- (b) functional group ()
- (c) temperature ()
- (d) acid or base ()

4. The following naturally occurring compound, tovoxanthone shows IR absorption band at 3012 cm^{-1} , which could be attributed to the presence of



- (a) ether group ()
- (b) ketone group ()
- (c) aromatic (Ar-H) group ()
- (d) hydroxy group ()

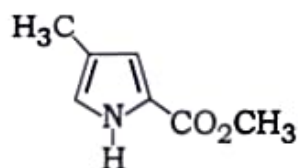
5. Naturally occurring germacranolides arise from all-*trans*

- (a) farnesyl pyrophosphate ()
- (b) farnesyl flavones ()
- (c) complex anthocyanidins ()
- (d) isoquinolines ()

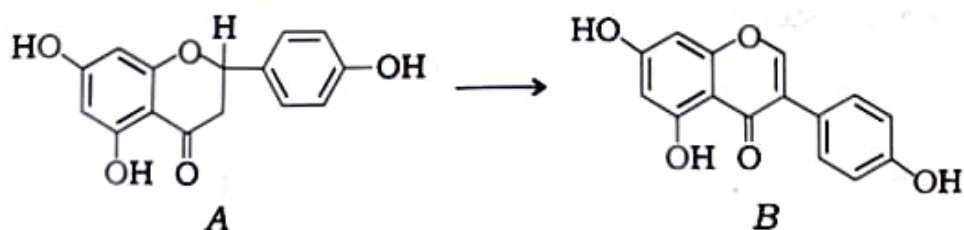
6. Which of the following statements is true with respect to (-) abietic acid?

- (a) It is a triterpene. ()
- (b) It is a tricyclic, di-unsaturated acid. ()
- (c) It has three chiral centres. ()
- (d) On oxidative degradation it yields ergosterol. ()

7. The following compound, methyl 4-methylpyrrole-2-carboxylate, isolated from ant species, *Atta texana* and *Atta cephalotes* is a/an



- (a) aggregating pheromone ()
 (b) sex pheromone ()
 (c) alarm pheromone ()
 (d) trail-marking pheromone ()
8. Nametkin rearrangement involves
 (a) amino-group transfer ()
 (b) methyl-group transfer ()
 (c) nitro-group transfer ()
 (d) cyano-group transfer ()
9. The first step in the synthesis of reserpine is
 (a) Hoffmann degradation ()
 (b) carboxylation ()
 (c) retro-Diels-Alder reaction ()
 (d) Diels-Alder reaction ()
10. The transformation of flavanone, (2S)-naringenin (A) to an isoflavone, genistein (B) is brought about by



- (a) NADPH-7-oxidoreductase ()
 (b) cytochrome P 450 hydroxylases ()
 (c) cytochrome P 450 monooxygenase ()
 (d) isoflavone o-methyl transferase ()

(SECTION : B—SHORT ANSWERS)

(Marks : 15)

Answer the following questions :

3×5=15

UNIT—I

1. What are terpenes? Explain isoprene rule.

OR

2. Write a note on isolation of alkaloids.

UNIT—II

3. What are the advantages of spectroscopic method over classical method for the determination of structure of the chemical compound?

OR

4. What is coupling constant? Why is it useful in the structural elucidation of organic compounds?

UNIT—III

5. Write a note on stereochemistry of abietic acid.

OR

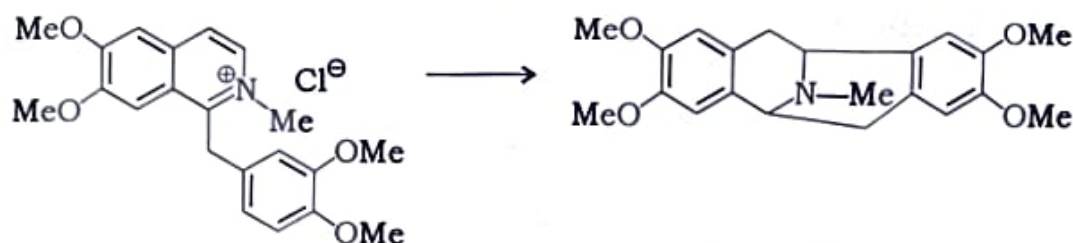
6. What are germacranolides? Give two examples and draw their structures.

UNIT—IV

7. Discuss in brief, the roles of secondary metabolites in the defensive mechanism of insects.

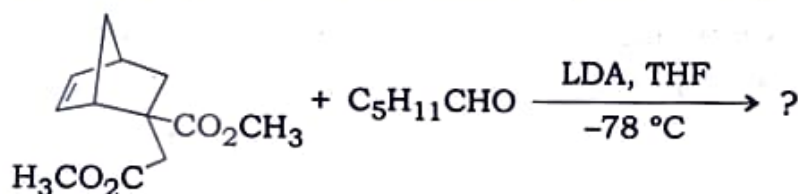
OR

8. Write suitable reaction mechanisms for the following conversion :



UNIT—V

9. Complete the following reaction with suitable mechanism :



OR

10. Write a short note on reticuline to morphine.

(SECTION : C—DESCRIPTIVE)

(Marks : 50)

Answer the following questions :

10×5=50

UNIT—I

1. (a) What are alkaloids? Give two examples. Write a short note on the methods used for the detection of alkaloids in plant extracts. 4
- (b) Discuss in detail, the biosynthesis of all kinds of terpenoids via photosynthesis. 6

OR

2. (a) Explain with an example the Hoffmann degradation of alkaloids and its limitations. 5

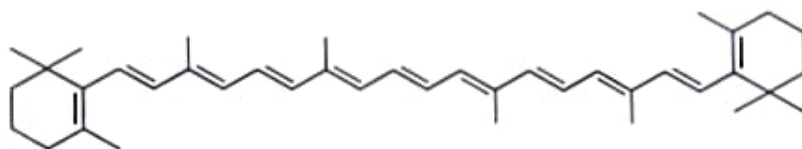
- (b) Explain the isolation of alkaloids. 3
- (c) Write the structure of fernesol and also write how many isoprene units are present in it. 2

UNIT—II

3. (a) What is the basic principle of mass spectrometry? 3
- (b) How many NMR signals are observed in the spectrum of $\text{CH}_3\text{—CH}_2\text{—OH}$? 3
- (c) 2-Hydroxy-3-nitroacetophenone shows two carbonyl stretching frequencies at 1692 cm^{-1} and 1658 cm^{-1} . Explain. 4

OR

4. (a) Using Fieser-Kuhn rule, calculate the adsorption maximum (λ_{max}) for the following compound, β -carotene : 3



- (b) Write a note on the application of IR spectroscopy for structural determination of naturally occurring organic compounds. 3
- (c) A naturally occurring compound, found in many kinds of fruits with a molecular formula $\text{C}_4\text{H}_8\text{O}_2$, was shown to have the following spectral data :
- (i) IR : 2985 cm^{-1} , 2877 cm^{-1} , 1742 cm^{-1}
- (ii) Mass (m/z) : 88, 73, 61, 45, 43 (100), 15, etc.
- (iii) ^1H NMR : δ 1.30 ppm (3H, triplet), 2.01 ppm (3H, singlet), 4.12 ppm (2H, quartet)

What is the structure of the compound?

4

UNIT—III

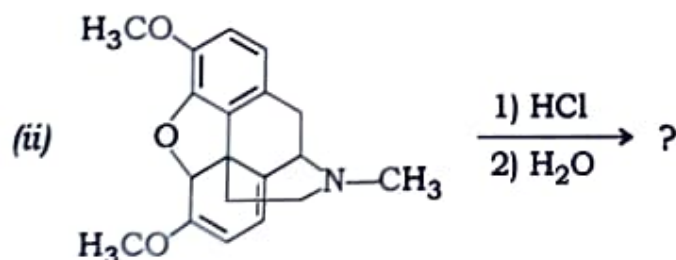
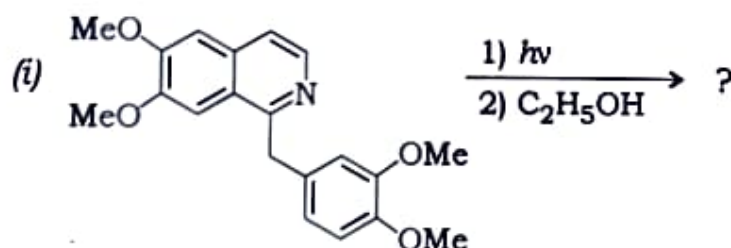
5. (a) Write a note on the stereochemistry of retenoids. 3
 (b) Write the names and structures of all the stereoisomers of menthol. 3
 (c) Describe the absolute stereochemistry of morphine. 4

OR

6. (a) Discuss in detail the absolute configuration of benzyl isoquinoline alkaloids. 5
 (b) Draw the structures of vinblastine and (+)-laudanosine. Indicate the number of chiral centres present in the structures of each compound. 5

UNIT—IV

7. (a) Elucidate, with examples, the amicable and antagonistic interactions between plants and insects in the natural environment. 4
 (b) Complete the following reactions with suitable mechanism : 6



OR

8. (a) Write a note on biological function of pheromones. 3
 (b) What are semiochemicals? Discuss the roles for the survival of species possessing them. 3
 (c) Explain Wesley-Moser rearrangement. 4

UNIT—V

9. (a) Discuss the stereoselective synthesis of reserpine. 5
 (b) Discuss the synthesis of a chiral marine natural product. 5

OR

10. (a) Deduce the reticuline to morphine biosynthetic pathway clearly mentioning the different types of reactions and enzymes involved in it. 6
 (b) Complete the following reactions (mechanism not required) : 4

