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(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. Essential oils can be extracted from plants by means of

(a) solvent extraction ( )

(b) steam distillation ( )

(c) fractional distillation ( )

(d) None of the above ( )

2. Which of the following tests could be employed for the detection of alkaloids from plant's extract?

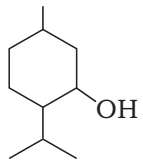
(a) Shino's test ( )

(b) Hager's test ( )

(c) Ninhydrin test ( )

(d) Molisch's test ( )

3. The IR data of the following compound shows a strong absorption band at 3000 cm^{-1} which indicates the presence of



(a) O—H stretching vibration ( )

(b) C—C stretching vibration ( )

(c) C—H stretching vibration ( )

(d) C—O stretching vibration ( )

4. How many signals does the saturated ketone $(CH_3)_2CHCH_2C(O)CH_2CH_3$ have in ^1H NMR spectra?

(a) Six ^1H signals ( )

(b) Three ^1H signals ( )

(c) Four ^1H signals ( )

(d) Five ^1H signals ( )

5. Which one of the following is correct?

(a) Neomenthol undergoes oxidation at a faster rate than menthol. ( )

(b) Neomenthol undergoes oxidation at a slower rate than menthol. ( )

(c) Neomenthol undergoes acetylation at a slower rate than menthol. ( )

(d) Neomenthol and menthol undergo oxidation at the same rate. ( )

6. An important indole alkaloid which has anticancer property is

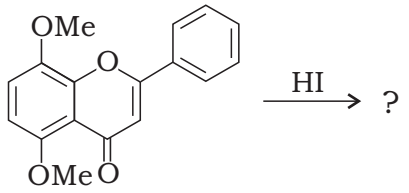
(a) morphine ( )

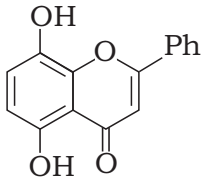
(b) romneine ( )

(c) pyrethrosine ( )

(d) vinblastine ( )

7. The product obtained from the following reaction is



(a) 

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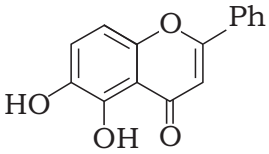
(b) 

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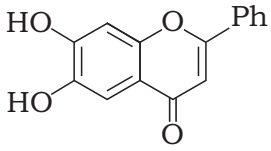
(c) 

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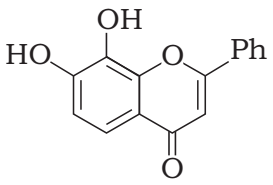
(d) 

( )

8. Nametkin rearrangement involves

(a) methyl group transfer ( )

(b) amino group transfer ( )

(c) nitro group transfer ( )

(d) cyano group transfer ( )

9. In the biosynthesis of (*S*)-reticuline to morphine, the first step involves

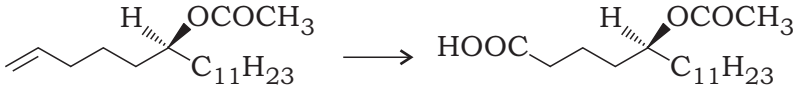
(a) carboxylation ( )

(b) hydrogenation ( )

(c) decarboxylation ( )

(d) dehydrogenation ( )

10. In the following transformation, the double bond gets oxidized and formed carboxylic acid as a final product. This transformation can be brought about by hydrogen peroxide in the presence of



(a) $RuCl_3$ ( )

(b) $FeCl_3$ ( )

(c) $RbCl_3$ ( )

(d) $AlCl_3$ ( )

(SECTION : B—SHORT ANSWER)

(*Marks* : 15)

Answer the following questions : 3×5=15

UNIT—I

1. What is isoprene rule? How will you classify terpenoids according to the number of isoprene units they contain?

OR

2. What are the most common steps employed for the isolation of alkaloids from plant's extract?

UNIT—II

3. Write short notes on :

(a) Chromophore

(b) Auxochrome

OR

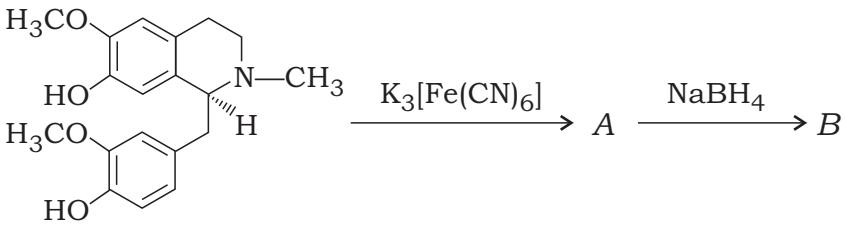
4. Write a brief note on the basic principle of mass spectrophotometer.

UNIT—III

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

OR

6. Complete the given reaction (mechanism not required) :

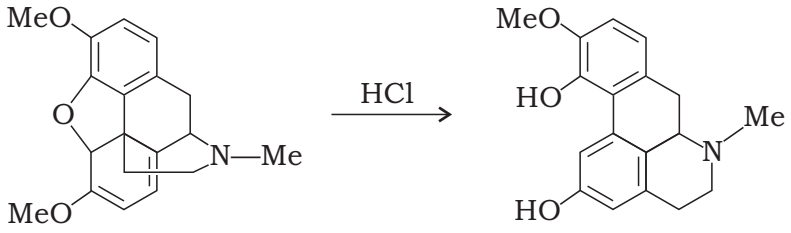


UNIT—IV

7. Explain in brief how the shape of molecules could play pivotal role in the pheromonal activity of insects. Give example.

OR

8. In the following transformation, thebaine is converted into a more stable skeletal structure *A* in the presence of acid catalyst. Write down all the suitable reaction mechanisms and structures involved in its transformation :



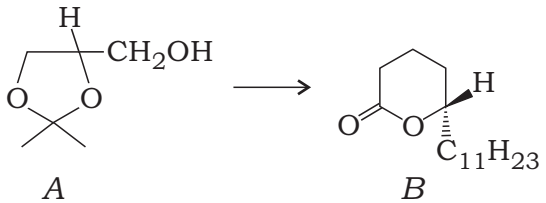
Thebaine *A*

UNIT—V

9. What is semiochemical? Give example.

OR

10. In the following reaction, (*R*)-2,3-*o*-isopropylideneglycerol (*A*) is converted into (*S*)-5-hexadecanolide (*B*). Write down all the reactions involved in the transformation (mechanism not required) :



A *B*

(SECTION : C—DESCRIPTIVE)

(*Marks* : 50)

Answer the following questions : 10×5=50

UNIT—I

1. *(a)* What are tetraterpenes? Give example. 2

(b) Discuss with examples the method of detection of alkaloids from plant's extract using Dragendorff's and Mayer's tests. 3

(c) Describe in detail the biosynthetic pathway of different types of terpenoids in plants starting from photosynthesis. 5

OR

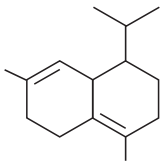
2. *(a)* How many carbon atoms are present in sesquiterpenoids? Give one example of any triterpenoid. 1

(b) Write any two biologically important diterpenes found in nature and draw their structures. 4

(c) What is Hofmann degradation? Explain with example. Mention the limitations of Hofmann degradation in the structural studies of alkaloids. 5

UNIT—II

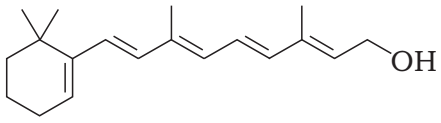
3. *(a)* What is coupling constant? How many NMR signals do you expect from the following compound? 2



δ-Cadinene

(b) Write a descriptive note on the use of IR spectroscopy for structural determination of naturally occurring organic compounds. 4

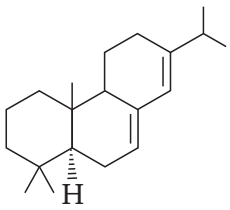
(c) Using Woodward-Fieser rule, calculate the wavelength of maximum adsorption (λ_{max}) for retinol (*B*) : 4



B

OR

4. *(a)* Using Woodward-Fieser rule, calculate λ_{max} for abietadiene : 2



(b) A compound having molecular formula $C_6H_{14}O$ was shown to have the following spectral data :

(i) IR : 3351, 2993, 2885, 1121 cm^{-1}

(ii) ^1H NMR : Singlet at 4·80 ppm (singlet, 1H), 4·03 ppm (multiplet, 1H), 1·23–1·40 ppm (multiplet, 9H) and 0·88 ppm (triplet, 3H)

(iii) m/z = 45, 59, 73, 84, 87, 102

What is the structure of the compound? 4

(c) What are the factors that affect the chemical shift value in ^1H NMR? Describe in detail why NMR spectroscopy is so useful in the structural elucidation of naturally occurring organic compounds. 4

UNIT—III

5. *(a)* Draw and discuss the stereochemistry of (–)-abietic acid. 1+4=5

(b) What are rotenones? Assign the configuration of C-6a and C-5′ in isorotenone taking suitable reactions. 1+4=5

OR

6. *(a)* Draw all the eight stereoisomers of menthol and name them. 4

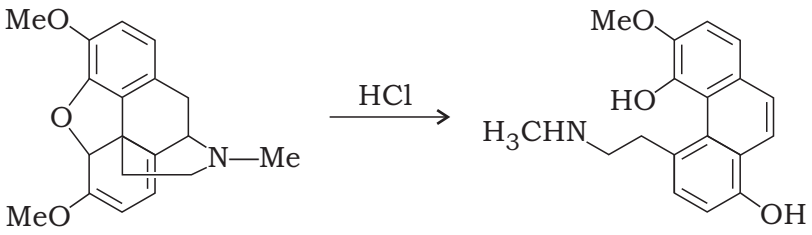
(b) Draw the structures of (+)-laudanosine and (–)-norlaudanosine and assign the configurations of the chiral centres. 3+3=6

UNIT—IV

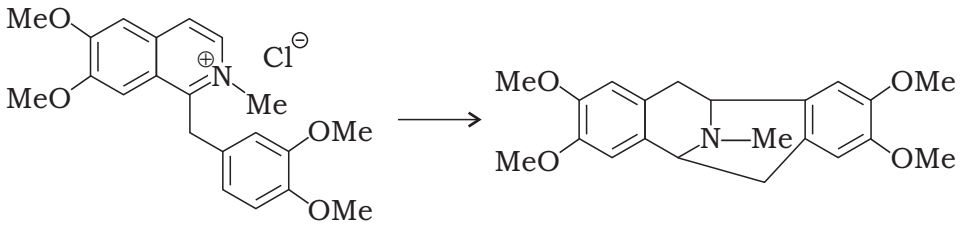
7. *(a)* Write a descriptive note on plant-insect interaction by giving suitable example. 4

(b) Write suitable mechanisms for the following conversions : 3×2=6

(i)

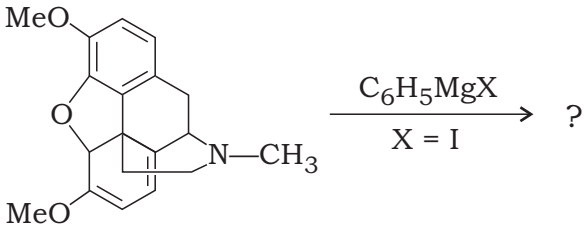


(ii)



OR

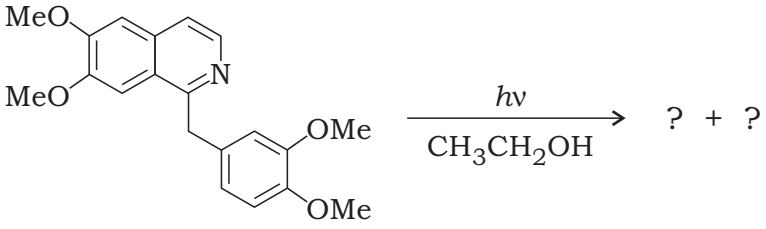
8. *(a)* Draw the structure of the compound obtained in the following reaction : 1



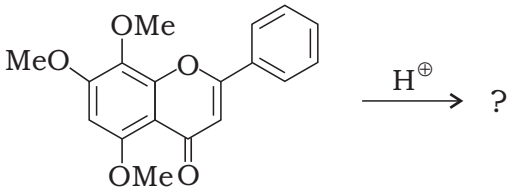
(b) What kind of defense mechanisms have been employed by the insects to protect themselves against their predators? Explain by giving examples. 3

(c) Complete the following reactions with suitable mechanisms : 3×2=6

(i)

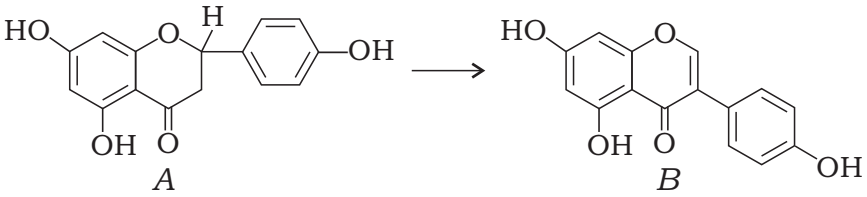


(ii)

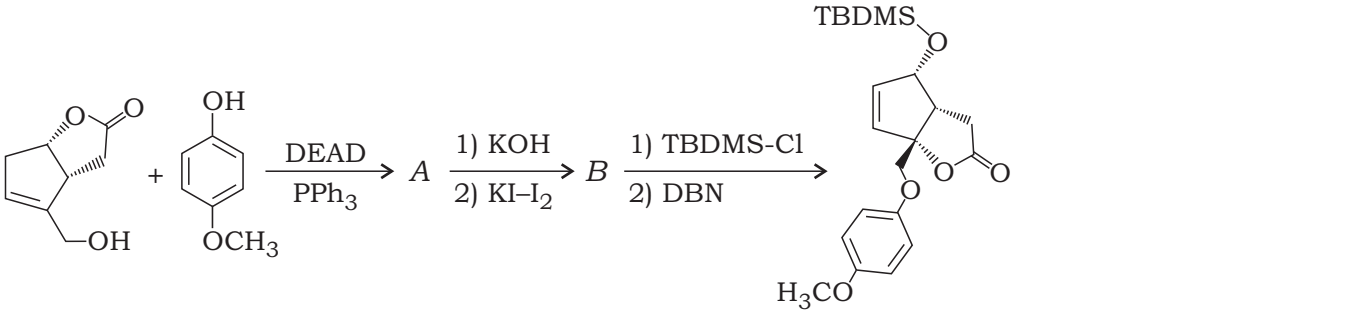


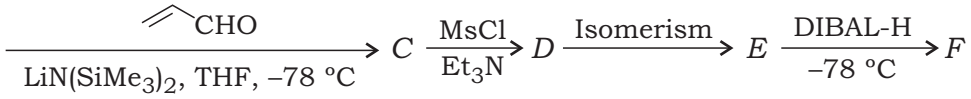
UNIT—V

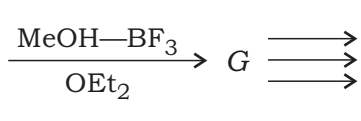
9. *(a)* What is the name of the enzyme responsible for the transformation of flavone to isoflavone? Describe in brief the biosynthetic conversion of (2*S*)-naringenin (*A*) to genistein (*B*) : 3

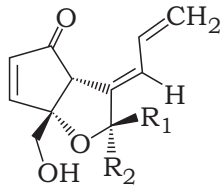


(b) Deduce the structures of *A*–*G* and complete the reactions with suitable mechanisms : 7







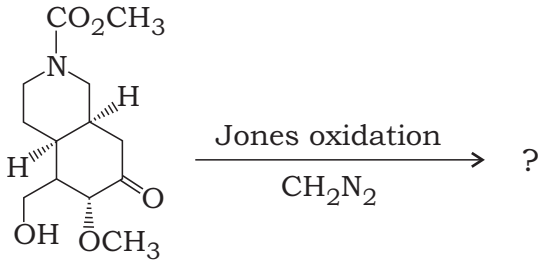


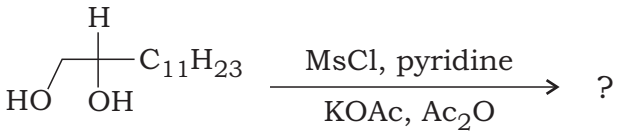
1) R_1 = H; R_2 = OH
2) R_1 = OH; R_2 = H

OR

10. *(a)* Predict the products for the following reactions (mechanism not required) : 1+2+2=5

(i) 

(ii) 

(iii) 

(b) Describe in detail the (*R*)-reticuline to morphine biosynthetic pathway and write down all the reaction mechanisms involved. 5

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