

CHUKA



UNIVERSITY

UNIVERSITY EXAMINATIONS

EXAMINATION FOR THE AWARD OF DEGREE OF BACHELOR OF SCIENCE
IN CHEMISTRY

CHEM 446: CHEMISTRY OF NATURAL PRODUCTS

STREAMS:

TIME: 2 HOURS

DAY/DATE: TUESDAY 23/03/2021

11.30 A.M – 1.30 P.M

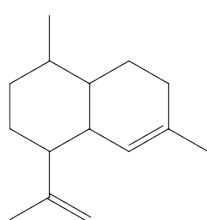
INSTRUCTIONS:

Answer question One (Compulsory) and any other Two questions

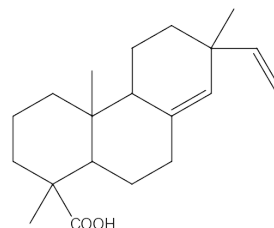
QUESTION ONE [30 MARKS]

(a) Explain, with the aid of suitable examples, five commercial uses of isoprenoids (5 marks)

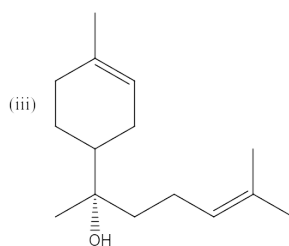
(b) Identify the isoprene unit(s) in the following compounds (6 marks)



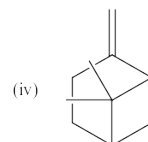
(i)



(ii)

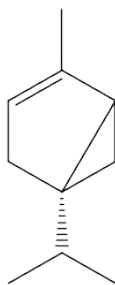


(iii)



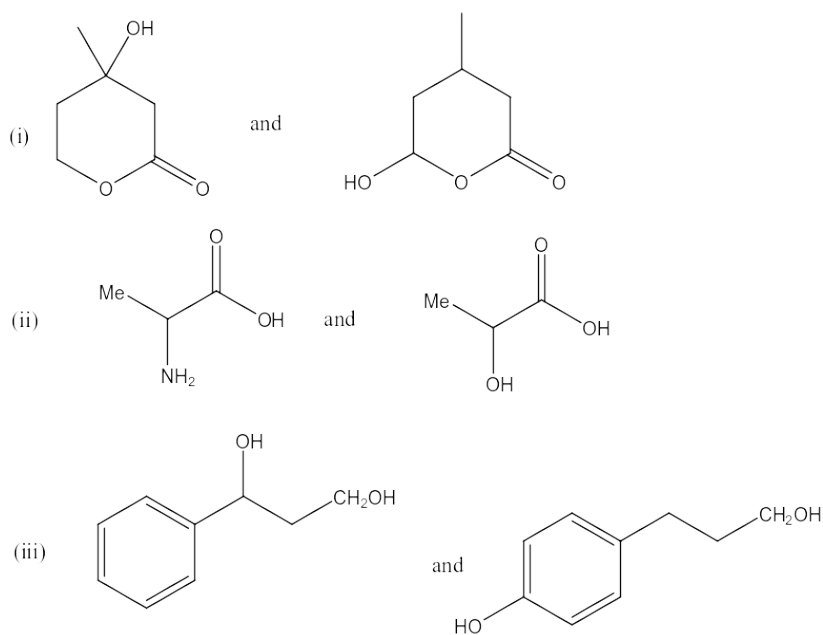
(iv)

(c) Describe, with the aid of suitable equations, the biosynthesis of thujene from geranyl pyrophosphate (5 marks)



Thujene

(d) Explain how each of the following pairs can be distinguished using a physical and a chemical method (6 marks)



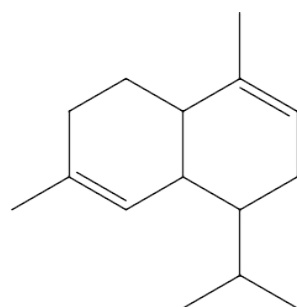
(e) Describe how alkaloids are isolated from plant materials (6 marks)

(f) State the functions of Vitamin A (2 marks)

QUESTION TWO [20 MARKS]

(a) Describe the formation of isopentenyl diphosphate through the mevalonate pathway (10 marks)

(b) Show how the following sesquiterpene is biosynthesized (6 marks)

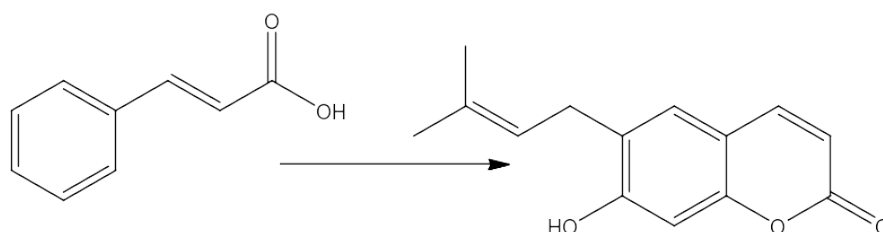


(c) Explain four roles of secondary metabolites in plants and animals (4 marks)

QUESTION THREE [20 MARKS]

(a) Describe how mono- and sesqui-terpenoids are extracted from plant materials (6 marks)

(b) Show how the following coumarin is biosynthesized from cinnamic acid (4 marks)

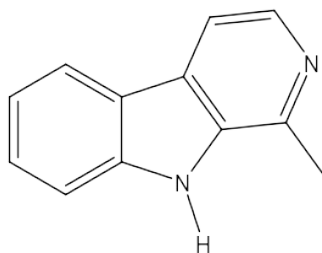


Cinnamic acid

(c) A monocarboxylic acid **O**, $C_6H_6O_4$, has been obtained from a *Xestosporzgia* species. It possesses IR absorption at 3300 (broad), 1730 and 1700 cm^{-1} , and intense UV absorption at 217 nm. It possesses 1H -NMR signals at δ_H 2.78 (2H, d, $J = 7$ Hz), 5.40 (1H, m), 6.10 (1H, d, $J = 5$ Hz), 7.75 (1H, dd, $J = 2$ and 5 Hz) and 10.15 (1H, exchangeable with 2H_2O). In a spin decoupling experiment, irradiation of the signal at δ_H 5.40 converted the signal at δ_H 2.78 to a singlet and the signal at δ_H 7.75 to a doublet, $J = 5$ Hz. When compound **O** was heated with sodium hydroxide and the solution carefully acidified, a dicarboxylic acid **P**, $C_6H_8O_5$, was obtained. Deduce the structure for **O** (10 marks)

QUESTION FOUR [20 MARKS]

(a) Show how the following alkaloid is biosynthesized (6 marks)



(b) Discuss the commercial importance of alkaloids (4 Marks)

(c) Compound **T**, $C_6H_8O_2$, obtained from the insect *Sigara falieni*, had IR absorption at 2840, 2740, 1690, 1621 and 980 cm^{-1} . It gave a silver mirror on treatment with moist silver oxide, and it formed a bis(2,4-dinitrophenylhydrazone) derivative. The ^1H NMR spectrum showed signals at δH 1.17 (3H, t, $J = 7.3\text{Hz}$), 2.74 (2H, q, $J = 7.3\text{Hz}$), 6.78 (1H, dd, $J = 7.1$ and 16.6 Hz), 6.89 (1H, d, $J = 16.6\text{ Hz}$) and 9.85 (1H, d, $J = 7.1\text{ Hz}$). Deduce the structure to compound

T (10 marks)
