

**CHUKA UNIVERSITY EXAMINATIONS (2021)**

**CHEM 446: CHEMISTRY OF NATURAL PRODUCTS**

**STREAMS: BSc (CHEM)**

**TIME: 2 HRS**

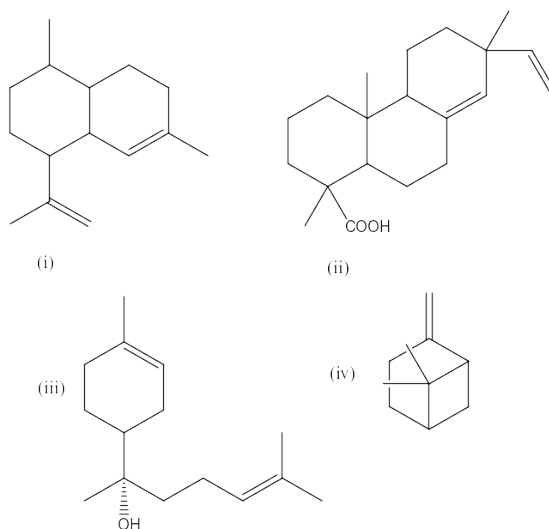
**INSTRUCTIONS**

Answer question **One** (Compulsory) and any other **Two** questions

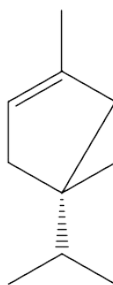
**QUESTION ONE [30 MARKS]**

(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**)

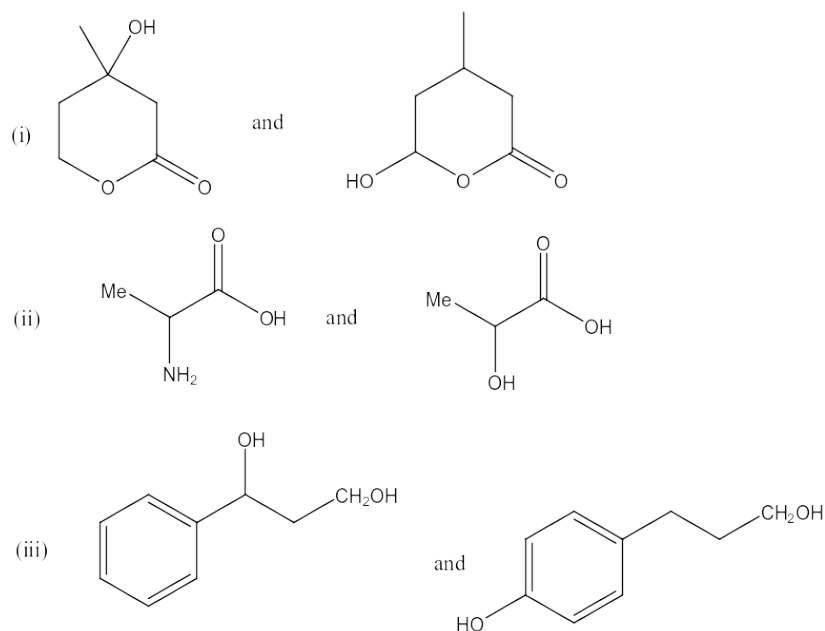


(c) Describe, with the aid of suitable equations, the biosynthesis of thujene from geranyl pyrophosphate (**5 marks**)



Thujene

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



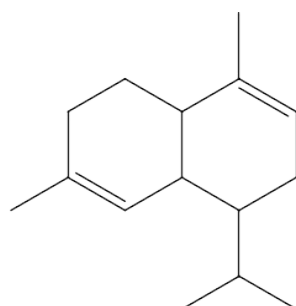
(e) Describe how alkaloids are isolated from plant materials (**6 marks**)

(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**)

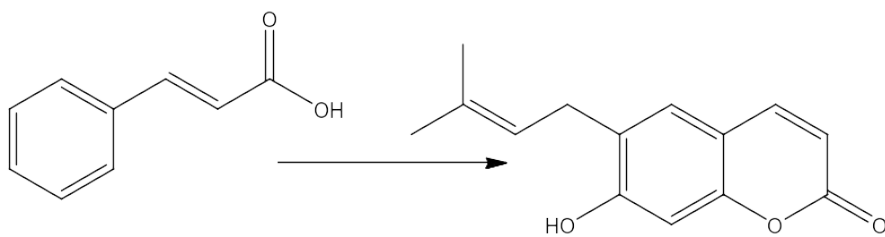


(c) Explain four roles of secondary metabolites in plants and animals (**4 marks**)

### **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**)

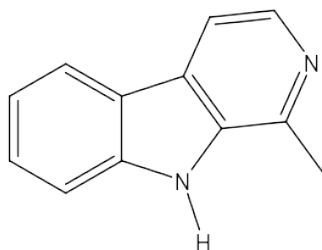


Cinnamic acid

(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  $\delta_H$  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  $\delta_H$  5.40 converted the signal at  $\delta_H$  2.78 to a singlet and the signal at  $\delta_H$  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  $\delta_H$  1.17 (3H, t,  $J = 7.3$  Hz), 2.74 (2H, q,  $J = 7.3$  Hz), 6.78 (1H, dd,  $J = 7.1$  and 16.6 Hz), 6.89 (1H, d,  $J = 16.6$  Hz) and 9.85 (1H, d,  $J = 7.1$  Hz). Deduce the structure to compound **T** (10 marks)