CHUKA UNIVERSITY

UNIVERSITY EXAMINATIONS

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

CHEM 446: CHEMISTRY OF NATURAL PRODUCTS

STREAMS: BSC. CHEMISTRY **TIME: 2 HOURS**

DAY/DATE: TUESDAY 21/09/2021 **11.30 A.M. – 1.30 P.M.**

INSTRUCTIONS:

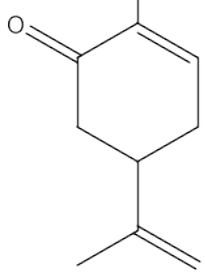
- ***Answer questions one (compulsory) and any other two questions***

QUESTION ONE [30 MARKS]

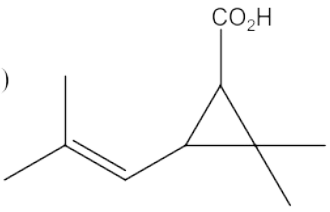
(a) Explain, with the aid of suitable examples, five commercial uses of alkaloids (**5 marks**)

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

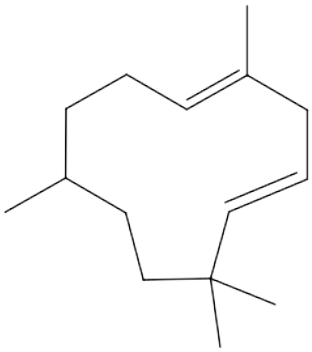
(i)



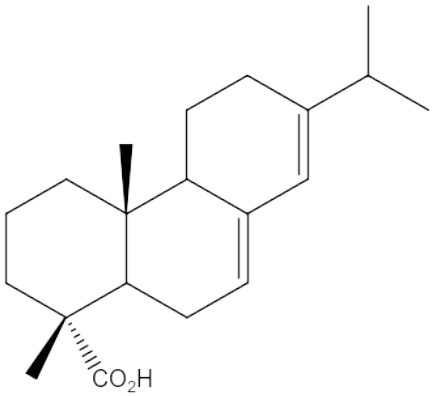
(ii)



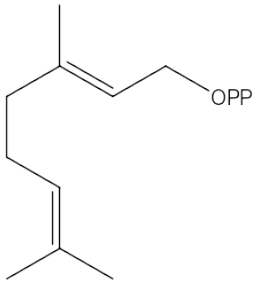
(iii)



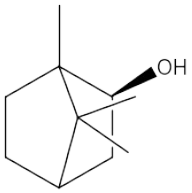
(iv)



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

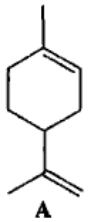
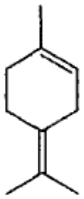


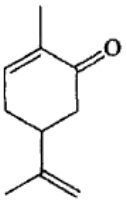
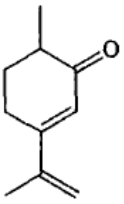
Geranyl pyrophosphate



Borneol

(d) Explain how each of the following pairs can be distinguished using a physical and a chemical method **(4 marks)**

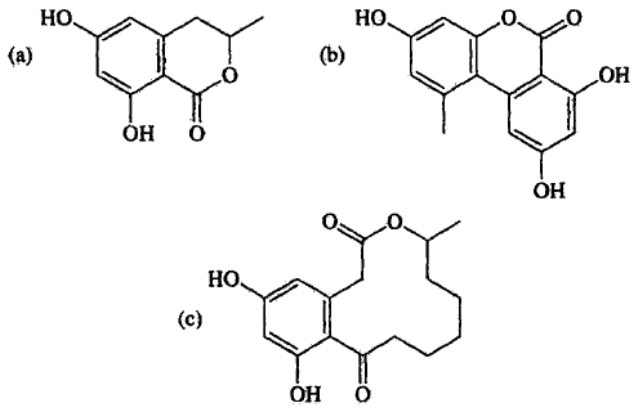
(a)  A and  B

(b)  C and  D

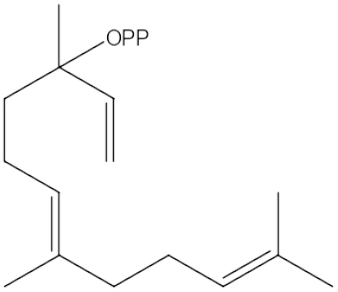
(e) Discuss the extraction, separation and purification of alkaloids from plant materials **(10 marks)**

QUESTION TWO [20 MARKS]

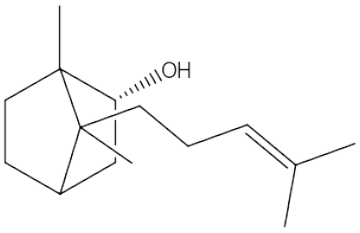
(a) Identify the acetate units in each of the following compounds **(3 marks)**



(b) Describe, with the aid of suitable equations, the biosynthesis of campherenol from nerolidyl pyrophosphate (**4 marks**)



Nerolidyl pyrophosphate



Campherenol

(c) Explain, with the aid of suitable examples, six commercial uses of terpenes and terpenoids (**3 marks**)

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

QUESTION THREE [20 MARKS]

(a) (c) A volatile plant product **M**, $C_8H_{14}O$, has strong IR absorption at 1717 cm^{-1}. It possess ^1H NMR signals at δ_H 1.65 (3H, s), 2.15 (3H, s), 2.4 (4H, m) and 5.20 (1H, t). On ozonolysis, compound **M** gives, among other products, propanone, and on treatment with iodine and alkali it gives triiodomethane (iodoform). What structural formula can be obtained from:

(i) Its molecular formula (**2 marks**) (ii) Its IR spectrum (**1 marks**)

(iii) Its ^1H NMR spectrum (**3 marks**) (iv) Its chemical reactions (**2 marks**)

(v) Deduce the structure of compound **M** (**2 marks**)

(b) Discuss the extraction and isolation of terpenes and terpenoids from plant materials (**10 marks**)

QUESTION FOUR [20 MARKS]

Alkaloid **G**, $C_8H_{13}NO$, is a tertiary base. It has IR absorption at 3500 cm^{-1} and ^1H NMR signals at δ 3.0 (5H, m), 3.8 (2H, s) and 5.4 (1H, t, J = 7 Hz). It can be oxidized under mild conditions with MnO_2 to give compound **H**, $C_8H_{11}NO$, which had an IR absorption at 1680 cm^{-1} and a UV absorption at 229 nm. Compound **H** formed a deep-red dinitrophenylhydrazone. On catalytic hydrogenation, **G** absorbed 1 mole of hydrogen to give **I**. This readily formed a monotoluene–*p*-sulfonate, which on reduction with $LiAlH_4$ gave **J**, $C_8H_{15}N$. When **J** was submitted to three successive Hofmann degradations with a hydrogenation after each stage, the C_8 hydrocarbon 3-methylheptane was obtained. Deduce the structure of **G** (**20 marks**)

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