



MAASAI MARA UNIVERSITY

REGULAR UNIVERSITY EXAMINATIONS 2021/2022 ACADEMIC YEAR FOURTH YEAR FIRST SEMESTER

SCHOOL OF PURE, APPLIED AND HEALTH SCIENCES BACHELOR OF SCIENCE (BSc.) & BACHELOR OF EDUCATION (SCIENCE)

COURSE CODE: CHE 4135

COURSE TITLE: NATURAL PRODUCTS CHEMISTRY

DATE: 5TH APRIL 2022

TIME: 1430 – 1630 HOURS

INSTRUCTIONS TO CANDIDATES

1. Answer the compulsory question ONE and any other TWO in section B.
2. All University Examinations rules and regulations apply.

This paper consists of 5 printed pages. Please turn over:

SECTION A

QUESTION ONE (30 MARKS)

a) Distinguish between the following terms citing relevant examples in each case: **(6 marks)**

- (i) *in vivo* and *in vitro* reactions
- (ii) oxidative coupling and oxidative cleavage reactions
- (iii) Primary and secondary metabolites

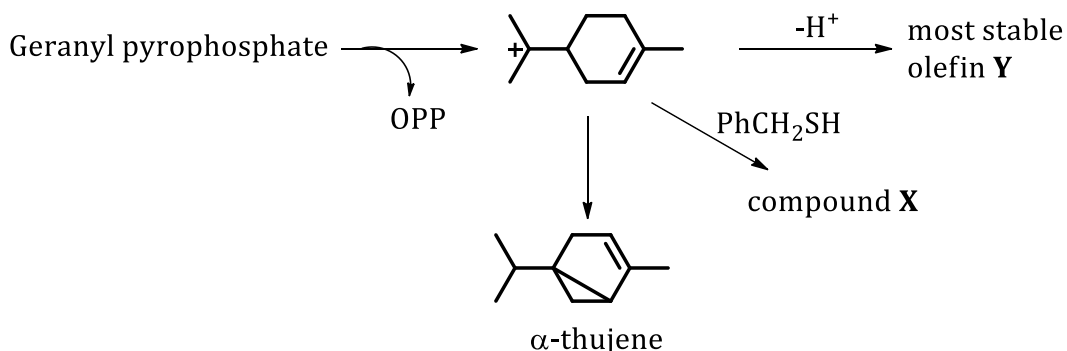
b) Suggest reasons for the following observations **(8 marks)**

- (i) High levels of blood cholesterol is a health hazard
- (ii) Morphine is an important pharmacological drug whereas its diacetyl derivative – heroine is outlawed
- (iii) Ecdysone is a key hormone in insect metamorphosis but is also regarded as a useful insect control hormone
- (iv) Animals grazing in dry lands for a longer period tend to have infertility problems

c) Complete the following table by providing examples of natural drug or pharmacological effect/class: **(4 marks)**

Natural drug	Pharmacological effect
	Analgesic
Quinine	
Penicillin	
	Antioxidant

d) Given the following scheme:



- (i) Provide the structure of Geranyl pyrophosphate(GPP). Hint: GPP is an acyclic diene **(2 marks)**
- (ii) Draw the structures of **X** and **Y** **(2 marks)**

(iii) What is the structure of minor product Y? Why one product is preferentially formed over the other? **(3 marks)**

(iv) Devise arrow pushing mechanism for the synthesis of α -thujene from the intermediate given **(3 marks)**

e) What is isoprene rule? **(2 marks)**

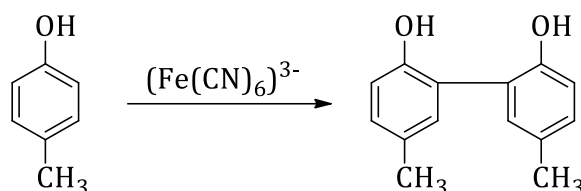
SECTION B

QUESTION TWO (20 MARKS)

a) What structural clue do the following analytical techniques used to analyze natural products provide? **(3 marks)**

- (i) Nuclear Magnetic Resonance
- (ii) Infra-red spectroscopy
- (iii) UV-Vis spectroscopy

b) *p*-methylphenol undergoes oxidative coupling reaction when refluxed in presence of trace amounts ferric hexacyano complex. The C-C coupling process involves free radicals. Fe^{3+} is reduced to Fe^{2+} . Propose a detailed half-arrow pushing mechanism for this reaction. **(4 marks)**



c) List the aromatic amino acids that are derived from Shikimate pathway **(3 marks)**

d) Outline the biological significance of the following hormones **(4 marks)**

- (i) Juvenile Hormone (JH)
- (ii) Inkosterone
- (iii) Testosterone
- (iv) Progesterone

e) How are these sex hormones derived from cholesterol (C27)? **(2 marks)**

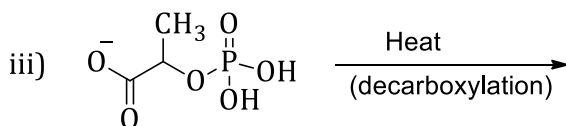
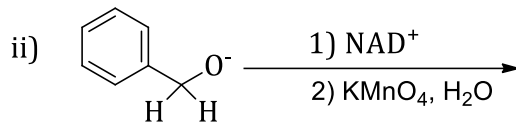
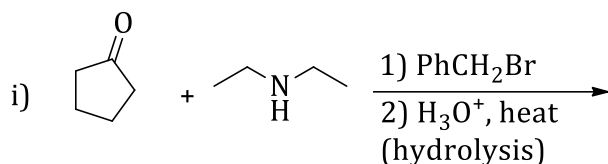
f) Give four classes of terpenes indicating the number of carbon atoms present in each class. **(4 marks)**

QUESTION THREE (20 MARKS)

a) Define the following terms and provide examples: **(3 marks)**

- (i) Biosynthesis
- (ii) Pharmacognosy
- (iii) Camphor

b) Provide the intermediates and final products for the following reactions which mimic biological reactions: **(6 marks)**



c) Explain the importance of the following biological molecules: **(3 marks)**

- (i) Co-enzymes
- (ii) Cholesterol
- (iii) Riboflavins/Quinones

d) Briefly discuss three important *in vivo* reactions. Compare reactions you have chosen with the related *in vitro* reactions. **(6 marks)**

e) State any two general properties of alkaloids. **(2 marks)**

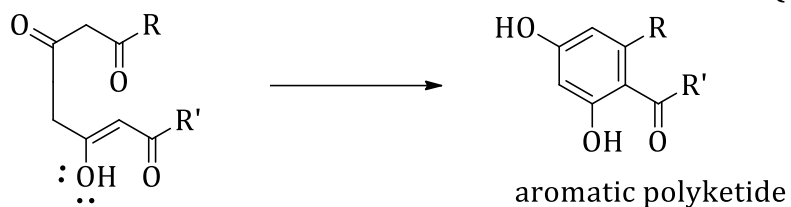
QUESTION FOUR (20 MARKS)

a) Name three different classes of terpenoids and indicate the carbon units' count in each case. **(3 marks)**

b) Explain the importance of pheromones in insects **(3 marks)**

c) Write a sequence of reactions that describe the formation of Geranyl pyrophosphate (GPP) from isopentenyl pyrophosphate (IPP). **(8 marks)**

d) Polyketides play a central role in mammalian metabolic processes. They are formed by condensation of acetate units without reduction of the β -carbonyl moieties. Provide a reasonable arrow pushing mechanism for the following ring folding reaction. **(3 marks)**



e) State the pharmacological activities associated with the following alkaloids: **(3 marks)**

- (i) codeine
- (ii) colchicine
- (iii) Cocaine

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