# KIBABII UNIVERSITY

## UNIVERSITY EXAMINATIONS
## 2020/2021 ACADEMIC YEAR

### FOURTH YEAR SECOND SEMESTER
### MAIN EXAMINATIONS

**FOR THE DEGREE OF BACHELOR OF SCIENCE**

**COURSE CODE:** SCH 431

**COURSE TITLE:** CHEMISTRY OF NATURAL PRODUCTS

**DATE:** 12/10/2021 **TIME:** 2:00-4:00PM

---

**INSTRUCTIONS TO CANDIDATES**

TIME: 2 Hours

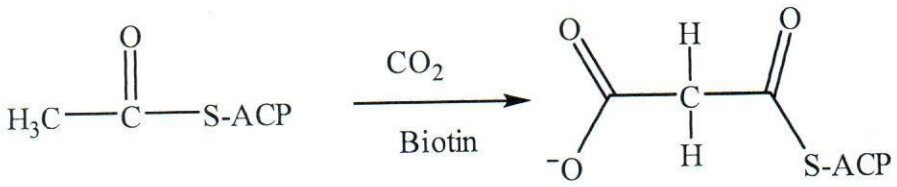
**Answer question ONE and any TWO of the remaining**

**Question 1 (30 marks)**

a) Define the following terminologies [7 marks]

i). Phytoallexin
ii). Allelopathy
iii). Myctoxin
iv). Fatty acid
v). Patenting
vi). Bioprospecting
vii). Aposematism

b) The conversion of Acetyl-S-CoA to Malonyl-S-CoA is shown in the reaction given below




i). Give the structure of biotin [2 marks]

ii). Biotin acts as a coenzyme. What is a coenzyme? [1 mark]

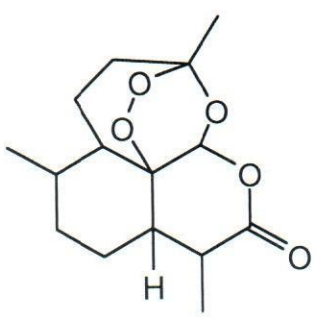
iii). Give the mechanism for the transformation of acetyl –S-CoA to malonyl–S-CoA using biotin as a coenzyme. [4 marks]

iv). Starting form Acetyl-S-CoA, show how Butyl-S-ACP is formed. Use equations to illustrate this transformation. [7 marks]

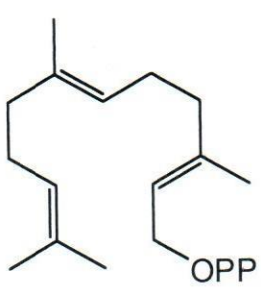
c) Mention four physiological activities of prostaglandins [4 marks]

**Question 2 (20 marks)**

a) Artemisinin is a drug used to treat multi-drug resistant strains of *Plasmodium falciparum* malaria. The compound is a sequiterpene lactone isolated from the plant *Artemisia annua*, long use in traditional Chinese medicine. Outline the biosynthesis of artemisinin starting from farnesyl diphosphate. [20 marks]



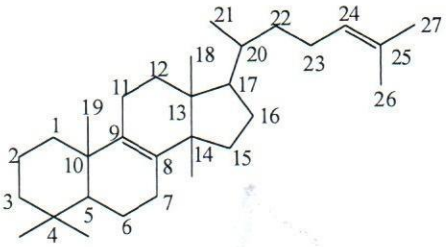

Artemisinin



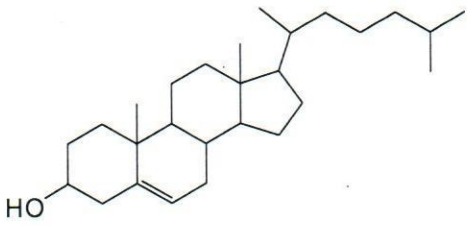

Farnesyl diphosphate

**Question 3 (20 marks)**

a) Conversion of lanosterol to cholesterol involves loss of three methyl groups, saturation of the side chain and double bond migration of the $\Delta^{8,9}$ double bond to the $\Delta^{5,6}$ position. Using equations, show how the methyl groups in position 4 in lanosterol are lost, and how the side chain double bond is saturated. [8 marks]

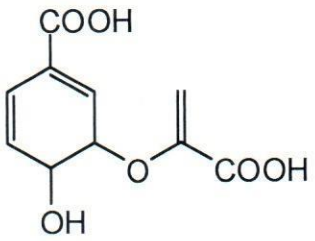



Lanosterol



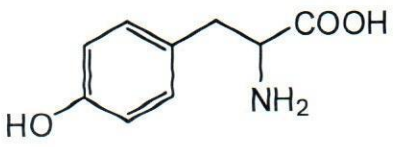

Cholesterol

b) Amino acids are divided into families depending on a common biosynthetic precursor. The aromatic amino acids, tryptophan, tyrosine and phenylalanine are derived from chorismic acid (structure shown below).

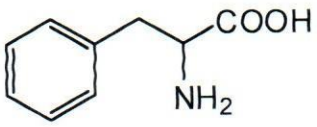



**Chorismic acid**

i). Show how the amino acid tyrosine and phenylalanine are formed from chorismic acid [6 marks]

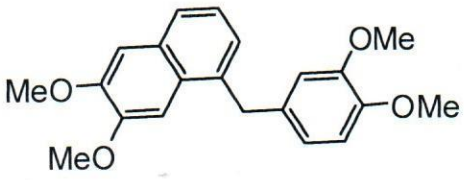



Tyrosine




Phenylalanine

ii). Papaverine (structure shown below) found in opium poppy is an opium alkaloid antipasmodic drug, used primarily in the treatment of visceral spasm and vasospasm.



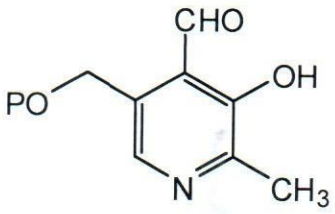

Starting from tyrosine, show how this alkaloid can be biosynthesized. [6 marks]

**Question 4 (20 marks)**

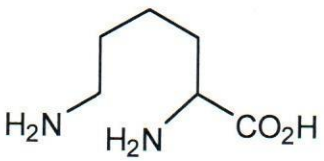
a) Pyridoxal phosphate is a cofactor important in amino acid metabolism.

i). Show how the phosphate transforms the amino acid lysine to 4-aminobutanal

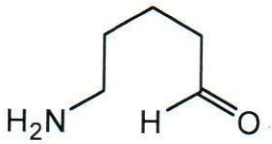
[8 marks]




Pyridoxal phosphate



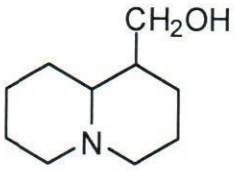

Lysine



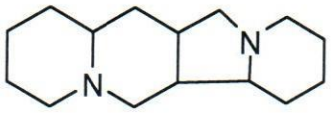

4-Aminobutanal

ii). Show how aminobutanal can be transformed to lupinine and spartein (structures shown below)

[6 marks]



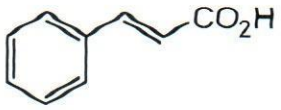

Lupinine



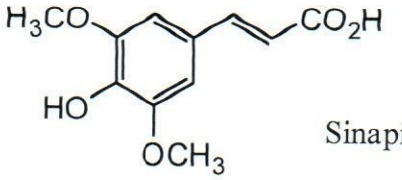

Spartein

b) E-Cinnamic acid is transformed to sinapic acid. Show how this can be achieved

[6 marks]




E-cinnamic acid

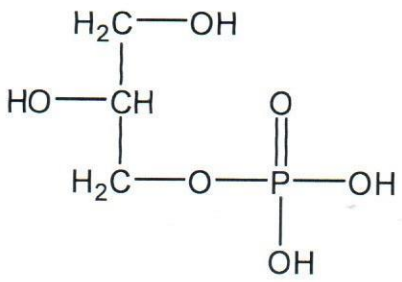



Sinapic acid

**Question 5 (20 marks)**

a) Most phospholipids contain a diglyceride, a phosphate group and a simple organic molecule. Starting from glycerol-3-phosphate, give a general scheme for the formation of phosphatidic acid.

[4 marks]




Glycerol-3-phosphate

b) Phosphatidic acid undergoes hydrolysis to give 1,2-diacylglycerol to which is then transformed to triglyceride. Using equations, show how this transformation is accomplished [5 marks]

c) The phosphate group in phosphatidic acid is esterified with an alcohol to give phospholipids, such as phosphatidylcholine, phosphatidylethanolamine, phosphatidylserine and phosphatidylmyoinositiol. Give structures of these phospholipids. [4 marks]

d) Give one source and one use of phosphatidylcholine. [2 marks]

e) Platelet Activating Factor (PAF) activates blood platelets and contributes to diverse biological effects

i). Give the structure of PAF [2 marks]

ii). Identify the different biological effects PAF contributes to. [3 marks]