



MACHAKOS UNIVERSITY

University Examinations 2020/2021 Academic Year

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

FIRST YEAR SECOND SESSION EXAMINATION FOR

MASTER OF SCIENCE (CHEMISTRY)

SCH 832: NATURAL PRODUCTS

DATE: 28/8/2021

TIME: 2.00-5.00 PM

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 15 marks).

SECTION A

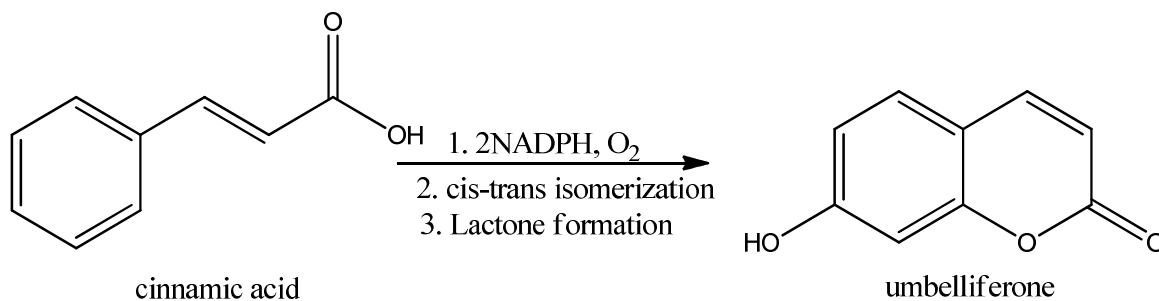
QUESTION ONE (30 MARKS)

- Define the term natural product and outline five techniques that are applied in characterization of natural products. (5 marks)
- Discuss the push and pull pest management strategy for the control of Stemborers and parasitic weed Striga. (6 marks)
- Natural products are said to have a narrow taxonomic distribution. Discuss what that means. (2 marks)
- Biomimetics is the science of borrowing from nature to produce systems that mimic the natural processes. Compare and contrast biosynthesis and chemical synthesis. (4 marks)
- Provide four sources of natural products. (4 marks)
- Provide four examples of primary metabolism pathways. (4 marks)
- Discuss the importance of secondary metabolites to plants and also to humans. (5 marks)

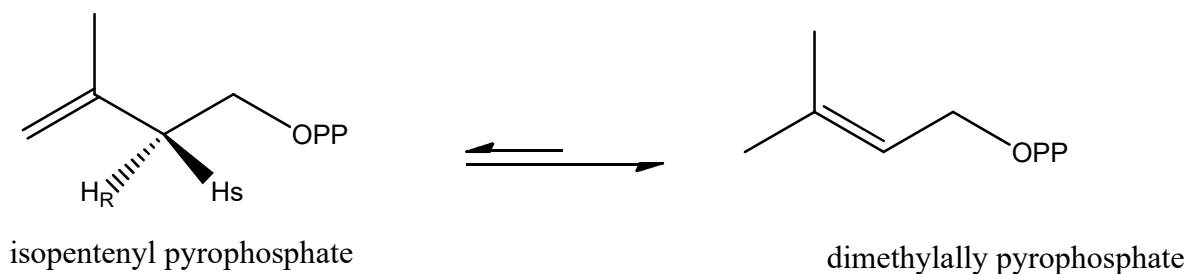
SECTION B

QUESTION TWO (15 MARKS)

- a) Discuss the contribution of natural products (NPs) to modern drug discovery (4 marks)
- b) Umbelliferone shown below is very important ingredient in sunscreen cream. Show how it is synthesized from cinnamic acid (6 marks)

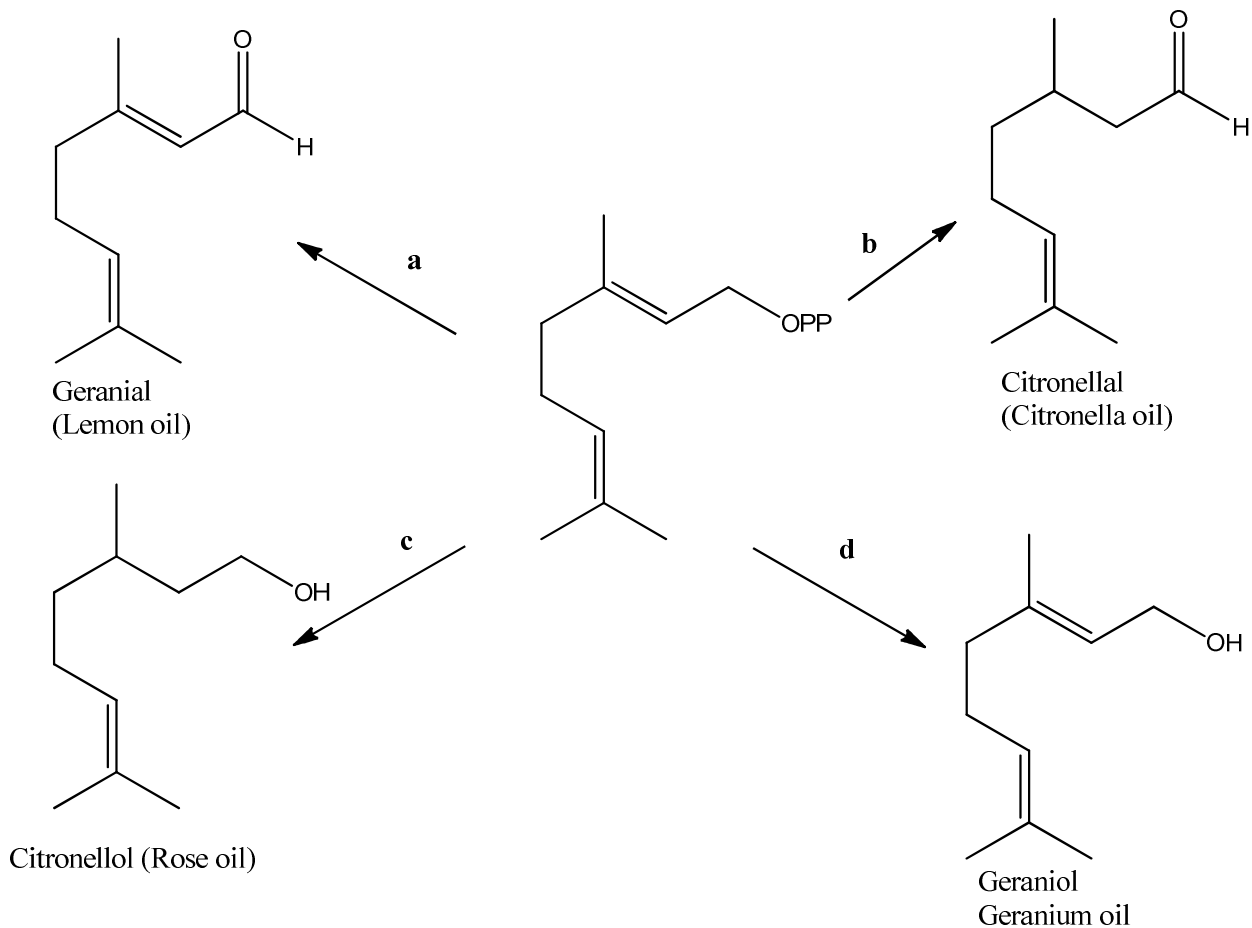


- c) Mevalonic acid pathway produces isopentenyl pyrophosphate (IPP), which isomerizes to dimethyl allyl pyrophosphate (DMAPP) as shown below. Show the mechanism for the isomerization and discuss why the equilibrium favors DMAPP. (5 marks)



QUESTION THREE (15 MARKS)

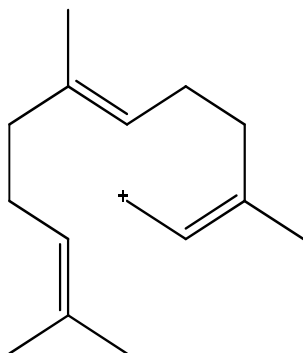
- a) Since January 2020, most global activities have been paralyzed by Corona Virus Disease 2019 (so called COVID-19). As a chemist, discuss what role Natural products chemistry could play in addressing the impacts of COVID-19. (5 marks)
- b) Provide the reagents for the transformations shown below. (8 marks)



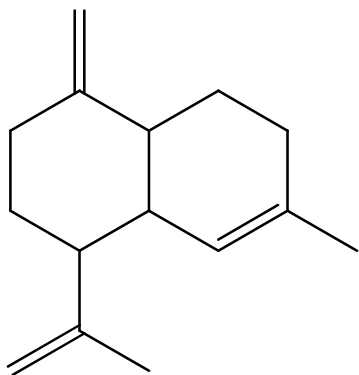
- c) Provide three different ways in which isoprene C5 units (IPP and DMAPP) can combine to give different terpenes. (3 marks)

QUESTION FOUR (15 MARKS)

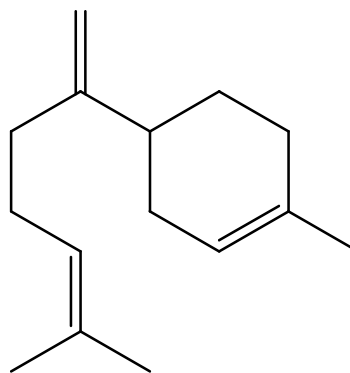
- a) Show how the sesquiterpenes A and B are biosynthesized from E, Z-FPP cation. Include all intermediates and utilize curly arrows to indicate the flow of electrons. (6 marks)



E,Z-Farnesyl cation

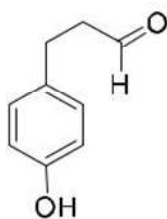


A

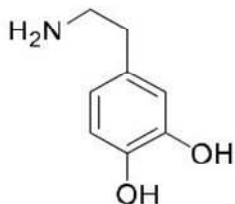


B

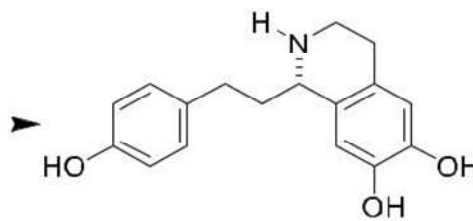
- b) Flavonoids are said to be secondary metabolites derived from mixed synthetic pathway. Identify the two pathways. (2 marks)
- c) Draw a mechanism for the condensation of aldehyde (1) with dopamine (2) to give tetrahydroisoquinoline (3), which is an alkaloid. (5 marks)



(1)

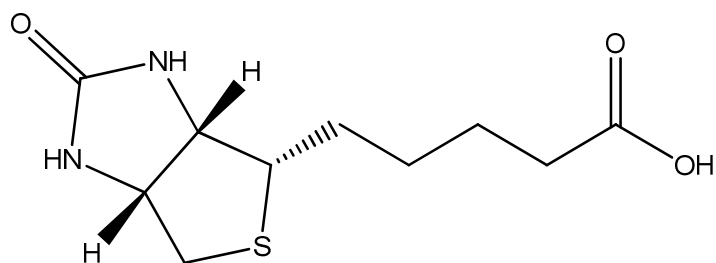


(2)



(3)

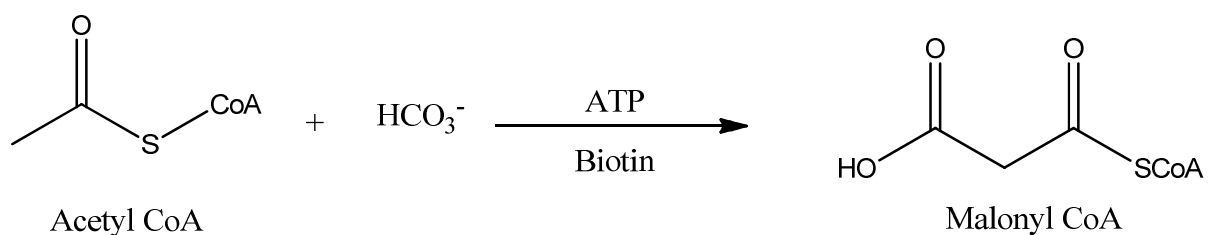
- b) Biotin acts as a cofactor in synthesis of fatty acids. From its structure, describe the properties that make it achieve this function. (2 marks)



biotin

QUESTION FIVE (15 MARKS)

- a) Acetyl CoA is an important precursor in fatty acid biosynthesis. However, acetyl-CoA needs to be further activated by a biotin-dependent enzyme before it can be used to form the extender unit malonyl-CoA. Provide the mechanism of the reaction shown below (6 marks)



- b) Using relevant examples, illustrate clearly how biosynthesis of fatty acids differs from that of polyketides (4 marks)
- c) Suggest a mechanism for the following *in vivo* conversion. (5 marks)

