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(*University of Choice*)

MASINDE MULIRO UNIVERSITY OF SCIENCE AND TECHNOLOGY (MMUST)

MAIN CAMPUS
MAIN EXAMINATIONS

UNIVERSITY EXAMINATIONS
2021/2022 ACADEMIC YEAR

THIRD YEAR SECOND SEMESTER EXAMINATIONS

FOR THE DEGREE
OF
BACHELOR OF SCIENCE IN INDUSTRIAL BIOCHEMISTRY

COURSE CODE: **SCI 364**

COURSE TITLE: **INDUSTRIAL BIOTECHNOLOGY**

DATE: FRIDAY 22ND APRIL, 2022 **TIME: 12.00-2.00 PM**

INSTRUCTIONS TO CANDIDATES

Answer ALL questions

TIME: 2 Hours

1. Elucidate:
    a. Why industrial biotechnology is known as white biotechnology in reference to its impact on the environment (3Mks)
    b. The advantages of industrial biotechnology over chemical industries (3Mks)
    c. On the approaches of isolation of suitable microorganisms from the environment (5Mks)
    d. On the two broad cartegories in which fermentation products can be divided (5Mks)
    e. On the difference between septic and aseptic processes (4Mks)
    f. On key factors to consider when selecting a media for a fermentation process. (5Mks)

2. In an Industial Biotechnology context,
    a. Define the term fermentation as perceived by microbiologists. (3Mks)
    b. Elaborate on the objective of growing large quantities of cells (5Mks)
    c. Discuss the classification of fermentation on the basis of organization of biological systems. (5Mks)
    d. Discuss the different mode of fermentation (7Mks)

3. Briefly Highlight,
    a. On the method of enzyme production/Isolation (4Mks)
    b. On the advantages of enzymes over chemical catalysts (5Mks)
    c. The production of Kojic acid and its main use (6Mks)

4. Scientist have upscaled and commertialized products in industry using enzymes and microogranisms. Identify a product of interest in industrial Biotechnology and systematically explain how it has been developed and produced on a commertial scale in industry using micro-organisms or enzyme. (10 Mks)

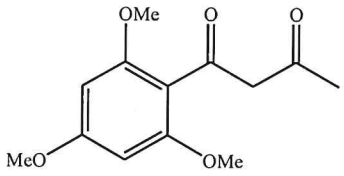
Question One (21 marks)

a. By use of examples, give the between primary and secondary metabolites 3 marks

b. Outline three reasons why plants biosynthesize secondary metabolites 3 marks

c. Natural products can be used in chemotaxonomy. Explain. 1 mark

d. State the class of each of the followng natural product labelled (J-N) 5 marks



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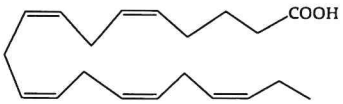

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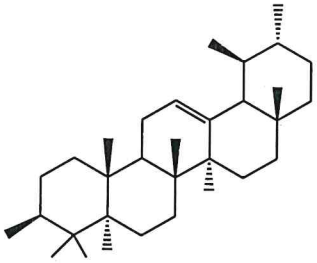

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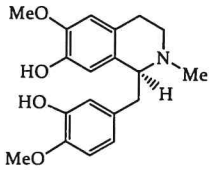

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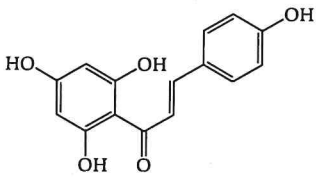
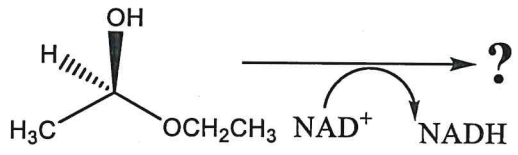


N

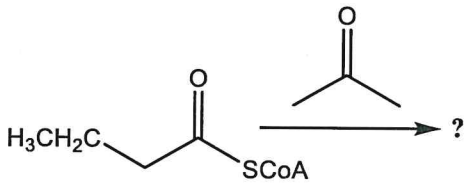
e. Explain two constraints in a living cell during biosynthesis of natural products. How are these constraints overcome? 3 marks

f. Complete the *in vivo* equations below; 2 marks

i.



ii.



g. By use of a reaction mechanism, show the formation of product in f(ii) above 4 marks

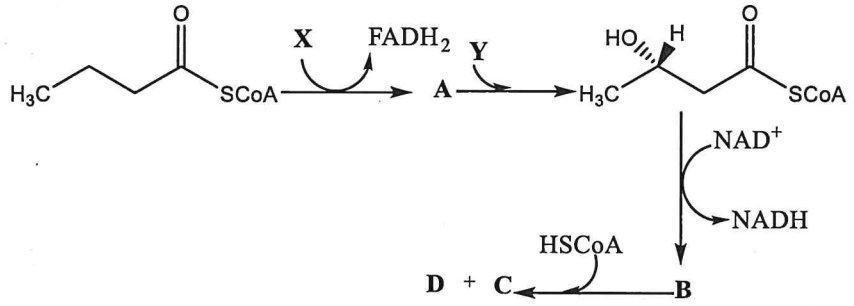
Question Two 19 marks

a) Draw the structural formulae of the 'fatty acids' whose names are given below 2 marks

i. Dodecanoic acid

ii. (9Z)-octadecenoic acid

b) Fatty acids undergo β-oxidation to provide energy in biological systems.

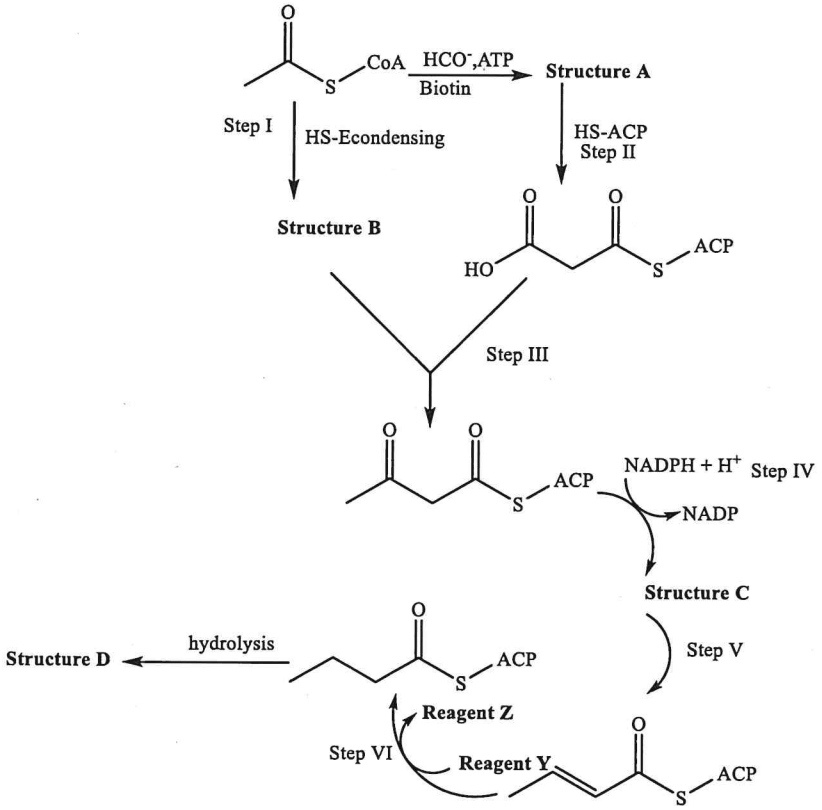


i. What are the missing reagents X and Y? 2 marks

ii. Give the structures of B, C and D 3 marks

iii. Explain the process involved in formation of intermediate B 1 mark

c) Fatty acids are biosynthesized following the scheme given below. Study it carefully and use it to answer the following questions.



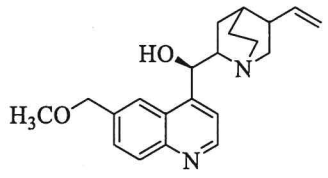
i. Draw the chemical structures of A and B in step I 2 marks

ii. Draw the structure C and explain process involved in its formation 2 marks

iii. State the reagents involved in step VI 2 marks

iv. Draw the structure of the end product D 1 mark

d) Quinine, whose structure is given below, is an example of an alkaloid obtained from *Cinchona officinalis*



i. Why are alkaloids basic? 1 mark

ii. Based on chemical structure, which class of alkaloids does compound G belongs to? Explain 2 marks

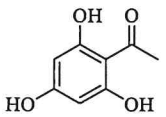
iii. Name one human use of the compound G above 1 mark

Question Three 13 marks

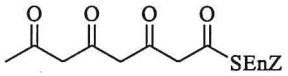
a) Polyketide can cyclize to obtain various classes of natural products through condensation reactions of the Knoevenagel and Claisen types

i. Define the term 'polyketides' 1 mark

ii. Phloracetophenone is a secondary metabolite derived from cyclisation of polyketide thioester below. By use of chemical equations, show how the product is formed. 5 marks

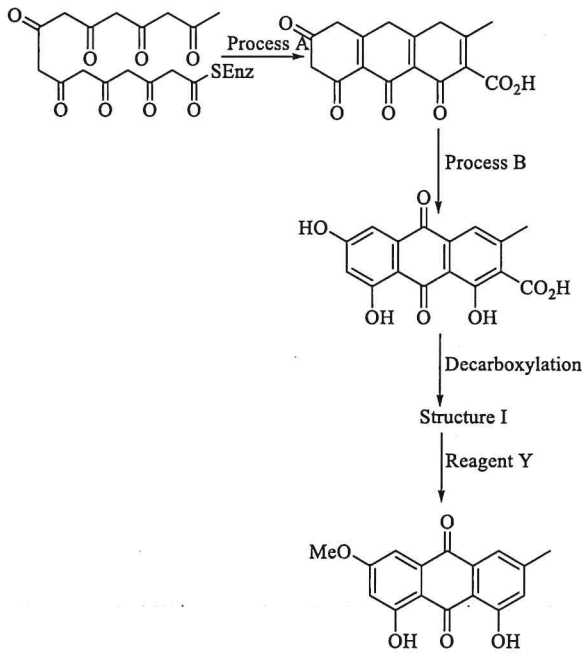


Phloracetophenone



polyketidethioester

b) Structural variety of polyketide-derived natural products is increased enormously by secondary structural modifications. Use the scheme below to answer the questions that follow

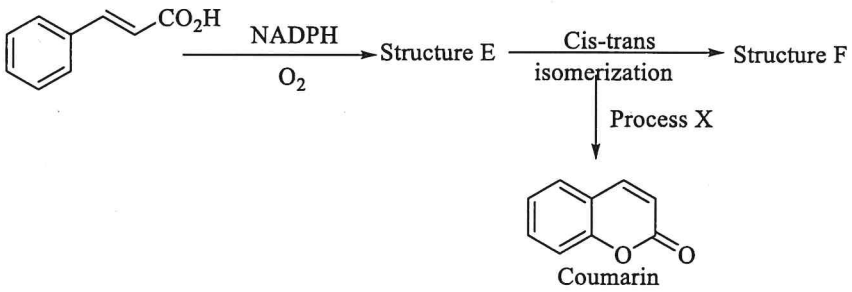


i. State the processes A and B 2 marks

ii. Draw the chemical structure of I 1 mark

iii. State the reagent Y 1 mark

c) Below is a scheme showing biosynthesis of coumarins.



i. Identify and draw the structures E and F 2 marks

ii. Name the process X 1 mark

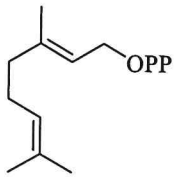
Question Four 17 marks

a) Terpenes are biosynthesized by joining isopentyl pyrophosphate (IPP) and 3,3-dimethyl allyl pyrophosphate (DMAPP)

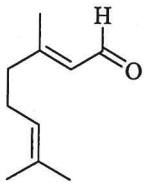
IPP DMAPP

i. By use of equations, show how IPP is biosynthesized 3 marks

ii. Geranial is a monoterpene obtained from GPP. Use chemical equations to show how GPP is obtained from IPP and DMAPP. 4 marks



GPP



Geranial

iii. What class of terpenoids does Geranial belong? Explain 2 marks

iv. Explain the modifications that GPP undergo to form geranial 2 marks

v. Describe how geranial can be isolated and identified from its source 4 marks

vi. State two physical properties of geranial 2 marks