MURANG'A UNIVERSITY OF TECHNOLOGY

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF APPLIED SCIENCES

UNIVERSITY ORDINARY EXAMINATION

2017/2018 ACADEMIC YEAR

EXAMINATION FOR MASTER OF SCIENCE IN CHEMISTRY

ACH 606: INSTRUMENTAL METHODS OF ANALYSIS

DURATION: 3 HOURS

DATE: 17TH AUGUST, 2018

TIME: 9.00 A.M. – 12.00 NOON

Instructions to Candidates:

1. Answer **Any Four** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

QUESTION ONE [25 marks]

a) Define the following terms: (2 marks)

i. Chromophore

ii. Auxochrome

b) Explain the observed UV absorption in the following molecules (3 marks)

c) Explain whether UV-VIS spectroscopy can be used to distinguish between the following molecules (4 marks)

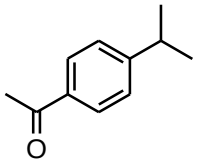
d) Calculate the UV maximum for the following molecules (5 marks)

e) Explain how IR spectroscopy might be used to distinguish between the following pairs of compound (8 marks)

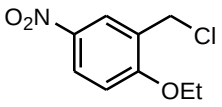
f) A dilute solution of 1, 3-pentanediol does not produce the characteristic IR signal for a dilute alcohol. Rather, it produces a signal that is characteristic of a concentrated alcohol. Explain. (3 marks)

QUESTION TWO [25 marks]

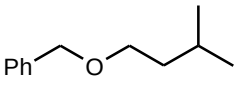
(a) Use the structures below to answer the questions that follow:



B



C



D

i. Cary out a retrosynthetic analysis of compound B, C and D. [9 marks]

ii. Suggest how the compounds B, C and D can be synthesized from available starting materials. [9 marks]

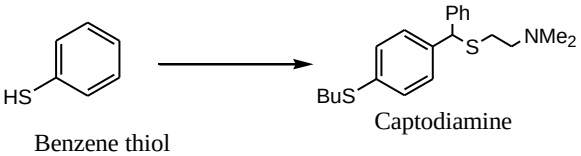
(b) i. Define green chemistry [1 mark]

ii. Describe the principles of green chemistry. [6 marks]

QUESTION THREE [25 marks]

(a) HS^- is rarely used in organic synthesis for nucleophilic displacement on RX to make thiols although NaSH is commercially available. Identify the problem with its use and suggest a reagent that can be used as its equivalent. [4 marks]

(b) Captodiamine, a sedative and tranquillizer drug has the structure given below:

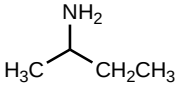


Benzene thiol Captodiamine

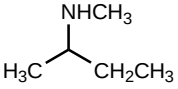
i. Carry out a retrosynthetic analysis of captodiamine with benzene thiol as a possible starting material. [4 Marks]

ii. Suggest how the compound might be synthesized in the laboratory. [4 Marks]

(c) Use the structures of the amines I-III below to answer the questions that follow:



I



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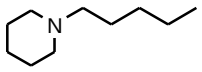


III

i. Do retrosynthetic analysis of amines I-III. [6 marks]

ii. Suggest synthetic pathway for the amines I-III. [7 marks]

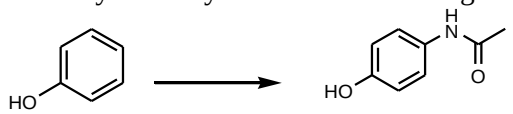
QUESTION FOUR [20 marks]

(a) Define the following terms: [2 mark]

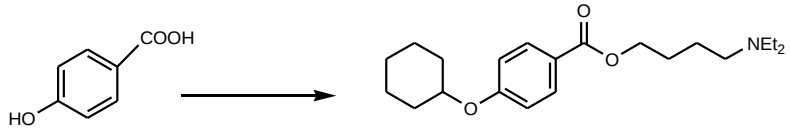
i. Stereospecific reaction

ii. Chemoselectivity

(b) Paracetamol and cyclomethycine are used as analgesic and anaesthetic drugs respectively.

I 

Phenol Paracetamol

II 

4-Hydroxybenzoic acid Cyclomethycine

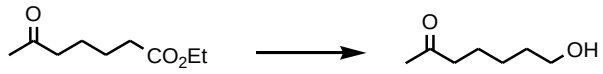
i. Do a retrosynthesis of paracetamol and cyclomethycine with the indicated compounds as possible starting materials. [7 marks]

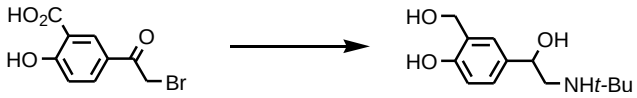
ii. Show how you would make paracetamol and cyclomethycine in the laboratory. Explain how chemoselectivity problem in the process is solved.
[7 marks]

(c) i. Identify the qualities of a good protecting group. [3 marks]

ii. Using suitable protecting groups show how the following transformations can be achieved:

[6 marks]

I 

II 

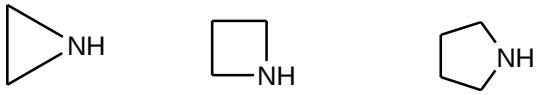
QUESTION FIVE [25 marks]

(a) Give an example each of two-group C-X disconnections involving: [6 marks]

i. 1,1 Difunctionalised compound
ii. 1,2- Difunctionalised compound
iii. 1,3- Difunctionalised compound

Cyclic amines can be synthesizes from intramolecular cyclization of haloamines and the ease of cyclization varies with ring size. Arrange the amine I-III in order of increasing ease of cyclization and explain your order. [5 marks]

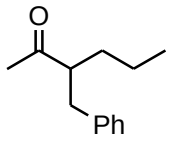
(b)

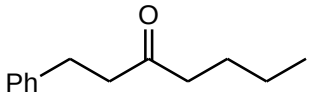


I II III

(c) i. What is regioselectivity? [1 mark]

ii. Suggest how the isomeric ketones I and II might be synthesized in the laboratory and explain how the problem of regioselectivity is solved.
[7 marks]

I 

II 

(d) Propose retrosynthetic and synthetic pathways for the aminoester below with the indicated conjugated ketone as a possible starting material.
[6 marks]