# 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 624: ADVANCED ORGANIC SYNTHESIS

DURATION: 3 HOURS

DATE: 17TH AUGUST, 2018

TIME: 9.00 – 12.00 NOON

**Instructions to Candidates:**

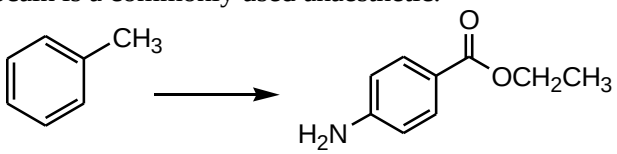
1. Answer **Any Four** questions.
2. Mobile phones are not allowed in the examination room.
3. You are not allowed to write on this examination question paper.

**QUESTION ONE [25 marks]**

(a) Define the following terms as used in organic synthesis and give an example in each case: [6 marks]

i. Synthon
ii. Disconnection
iii. Functional group interconversion

(b) Benzocain is a commonly used anaesthetic.

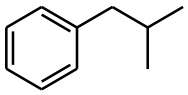



Toluene Benzocain

i. Do a retrosynthetic analysis of benzocain with toluene as a possible starting material for the synthesis. [4 marks]

ii. Show how benzocain might be synthesized in the laboratory and explain the order of events. [4 marks]

(c) The alkylbenzene **A** can be prepared from benzene via Friedel-Crafts reaction. Discuss why this cannot easily be accomplished through alkylation. Design synthesis of **A** from benzene using an appropriate Friedel-Crafts reagent. [4 marks]



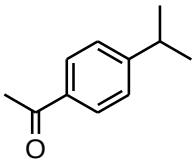
Alkyl benzene **A**

(d) Using examples, explain how aromatic nucleophilic substitution can be effected during synthesis. [5 marks]

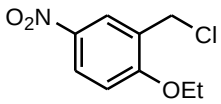
(e) Account for the fact that carbenes react with alkenes to form a three member ring. [2 marks]

**QUESTION TWO [25 marks]**

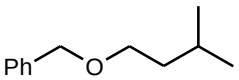
(a) Use the structures below to answer the questions that follow:




**B**




**C**




**D**

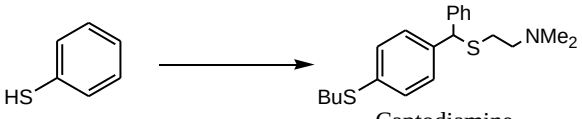
i. Cary out a retrosynthetic analysis of compound B, C and D. [9 marks]
ii. Suggest how the compounds B, C and D can be synthesized from available starting materials. [9 marks]

(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:

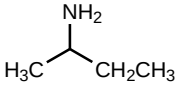



Benzene thiol Captodiamine

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:

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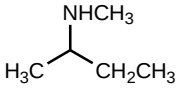
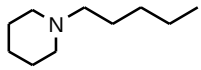



II




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.

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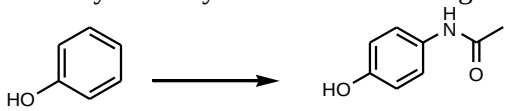
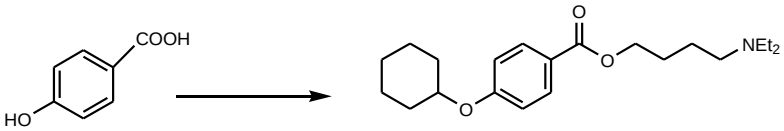



Phenol Paracetamol

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]

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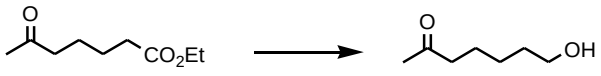


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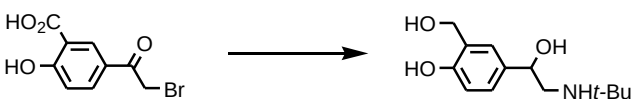


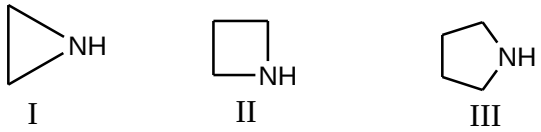
**QUESTION FIVE [25 marks]**

(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]

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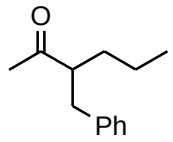


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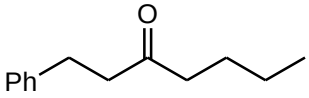


(d) Propose retrosynthetic and synthetic pathways for the aminoester below with the indicated conjugated ketone as a possible starting material. [6 marks]