

THE PAPUA NEW GUINEA UNIVERSITY OF TECHNOLOGY

FIRST SEMESTER EXAMINATION

CH213 – APPLIED ORGANIC CHEMISTRY

MONDAY 30th MAY 2022 12:50 PM

TIME ALLOWED: 2 HOURS

INFORMATION FOR CANDIDATES:

1. You will have 10 minutes to read the question paper. You **MUST NOT** begin writing in the answer book during this time.
2. **ANSWER ALL QUESTIONS.**
3. All answers **MUST** be written on the answer book provided
4. Calculators are permitted in the examination room. Lecture notes, notebooks plain papers and textbooks are **NOT** allowed.
5. Mobile phones are not allowed. **SWITCH OFF THE MOBILE PHONES.**
6. Show all workings and calculations in the answer book.
7. **DRAW the STRUCTURES** clear and visible.
8. **DO NOT** overwrite.
9. Write your name and number clearly on the front page. **DO IT NOW.**

MARKING SCHEME: Total 50 marks

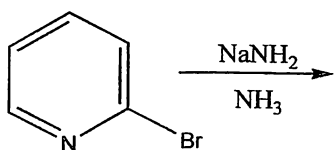
1. (a) (i) Carbon has how many principal energy levels? [1 mark]
(ii) Show the 4 valence orbitals of carbon. [2 marks]
(iii) How many valence electrons does carbon have? [1 mark]
- (b) Formaldehyde (CH_2O), has two single bonds and a double bond. [4 marks]
(i) There are how many possible electron densities?
(ii) What are the predicted bond angles?
(iii) Give the reason for the existence of predicted bond angles.
(iv) What is the geometrical shape of the bonds?
- (c) These questions relate to your laboratory exercise in the preparation of 2-chloro-2-methylpropane.
(i) What were the reasons for washing the product first with 10 ml of water followed by 10 ml of 5% NaHCO_3 ? [2 marks]
(ii) Why was anhydrous magnesium sulphate added to the final product? [1 mark]
(iii) The boiling point of 2-chloro-2-methylpropane is lower than the boiling point of 2-methylpropan-2-ol. Explain why? [2 marks]

(Total = 13 Marks)

2. (a) What THREE properties characterize a heterocyclic compound as an alkaloid? [3 marks]
- (b) Epoxyethane (epoxide) is an unstable compound that reacts readily with H_2O to produce ethylene glycol. Show the two-step reaction to the production of ethylene glycol starting with $\text{CH}_2=\text{CH}_2$. [4 marks]
- (c) Why are heterocyclic compounds such as pyrrole and furan classified as aromatic structures? [1 mark]

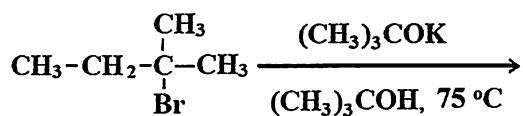
(Total = 8 Marks)

3. (a) Pyrrole and pyridine are both nitrogen based heterocyclic compounds. Explain why pyridine is more basic than pyrrole? [1 mark]
- (b) Explain why furan undergoes electrophilic substitution reaction more easily than benzene? [1 mark]
- (c) Complete the reaction equation below. [2 marks]



(Total = 4 Marks)

4. (a) Predict all possible products in the following reaction:



[5 marks]

- (b) Describe the mechanism of unimolecular nucleophilic substitution reaction ($\text{S}_{\text{N}}1$) in tertiary alkyl halide.

[5 marks]

(Total = 10 Marks)

5. (a) Define the following:

- (i) nucleophilic elimination reaction.
- (ii) Saytzeff rule.
- (iii) β – Elimination.

(6 Marks)

6. (a) Write the mechanism of nitration of benzene.

[5 marks]

- (b) Classify the following compounds into electrophilic reagents and nucleophilic reagents:

BF_3 , H_2O , AlCl_3 , ROH , ZnCl_2 , RNH_2 , FeCl_3 , RSH

[4 marks]

(Total = 9 Marks)