



**NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE, NNAMDI  
AZIKIWE EXPRESSWAY, JABI – ABUJA  
FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY  
2022\_2 EXAMINATION QUESTIONS**

**COURSE CODE: CHM416**

**COURSE TITLE: ORGANIC SYNTHESIS**

**COURSE UNIT: 2**

**INSTRUCTION: Answer question 1 and any other two questions**

**Time: 2 hours**

**QUESTION 1**

1. (a) Describe the process of syn hydroxylation of alkenes. Give two common oxidizing reagents that can be involved in this process. **(6 marks)**
- (b) Cyclic osmate ester and cyclic permanganate ester are common intermediates formed from syn addition of OH groups to alkenes. Give the structures of these two compounds. **(6 marks)**
- (c) Give one major reason for the production of lower yields of diols when cold dilute potassium permanganate is used for oxidation of alkene. **(2 marks)**
- (d) Define ozonolysis. **(4 marks)**
- (e) Describe the three (3) processes involved in the Horner-Wadsworth-Emmons (HWE) reaction. **(3 marks)**
- (f) State three (3) advantages of Wittig reactions over other olefination methods. **(6 marks)**
- (g) State the advantage of Wolff-Kishner method of reduction of carbonyl groups over reduction with Lithium Aluminium Hydride ( $\text{LiAlH}_4$ ). **(3 marks)**

**QUESTION 2**

- 2 (a) Ozonide is an intermediate formed from ozonolysis, show its displayed formula. **(3 marks)**
- (b) Per acids are commonly used for oxidations of organic compounds. Give the systematic names of the following compounds: i)  $\text{m-ClC}_6\text{H}_4\text{CO}_3\text{H}$  ii)  $\text{CF}_3\text{CO}_3\text{H}$  **(4 marks)**
- (c) Give four (4) reasons for the wide use of *m*-chloroperbenzoic acids over peracetic acid in the formation of epoxides from alkenes. **(8 marks)**
- (d) What does MCPBA stands for? Show the structure of the product formed from the reaction between *m*-CPBA and 3,4- dimethyl-3-hexene and give the specific name of the reaction. **(5 marks)**

**(5 marks)**

### QUESTION 3

3. (a) A diol can be formed from the reaction of cyclohexene with cold dilute potassium permanganate ( $\text{KMnO}_4$ ). Show the structure and give the name of the product formed from this reaction. **(4 marks)**
- (b) What product is formed when cyclopentene is reacted with osmium tetroxide followed by treatment with basic hydrogen peroxide? Explain why this reaction is preferred to the use of hydrogen sulphide with cyclopentene. **(4 marks)**
- (c) Show a general mechanism for the reaction between a named alkene and peroxyacid to form epoxide and acid. **(12 marks)**

### QUESTION 4

4. (a) State two types of chemical methods for reduction. **(4 marks)**
- (b) Platinum and palladium are very active metals used for reduction of organic compounds. Explain why both metals are the most preferred and most frequently used catalysts in the reduction of alkenes. **(6 marks)**
- (c) Lindlar's catalyst are used in the reduction of alkynes to alkenes. Explain why they are used and give the composition of Lindlar's catalyst. **(6 marks)**
- (d) What are the functional group that results from a 2-stage reaction of phenol with (i)  $\text{H}_2$ , Raney Nickel? (ii) Chromic acid? Give the structure of the final product formed from (ii) **(4 marks)**

### QUESTION 5

5. (a) Show the acceptable mechanism of Wittig reaction. **(12 marks)**
- (b) Give your reasons for choosing the mechanism in (a). **(4 marks)**
- (c) State and explain one limitation of the Wittig reaction. **(4 marks)**