



NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE, NNAMDI  
AZIKIWE EXPRESSWAY, JABI – ABUJA  
FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY  
2023\_1 EXAMINATIONS

COURSE CODE: CHM 416

COURSE TITLE: ORGANIC SYNTHESIS

COURSE UNIT: 2

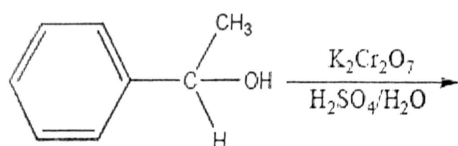
INSTRUCTION: Answer question one (1) and any other two questions

Time: 2 hours

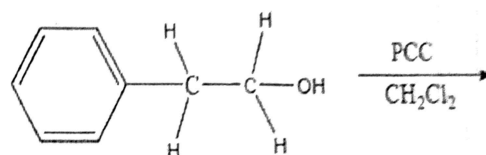
QUESTION 1

1. (a) Draw the structures of the products formed from the following reactions:

(i)



(ii)



(6 marks)

(b) Pyridinium chlorochromate (PCC) can be used in the oxidation of primary alcohols.

Write the formula of PCC and explain why it is used for this process. (4 marks)

(c) Using equations, describe the process for the formation of PCC with the aid of equation. (2 marks)

(d) With the aid of suitable equations, explain the mechanism of the Aldol condensation showing the formation of a nucleophile, alkoxide, base and enolate. (8 marks)

(e) Explain the following reactions: (i) Reformatsky reaction (ii) Perkin reaction (8 marks)

(f) Give the names of the two (2) intermediate species formed in the mechanism of Wittig reaction (2 marks)

QUESTION 2

2. (a) Define oxidation with reference to organic molecules and give two (2) examples to illustrate your definition. (8 marks)

(b) Some organic molecules undergo successive dehydrogenation. Arrange the following from the most oxidized to the least: ethane, ethyne and ethene. Explain your answers using bond multiplicity. (4 marks)

(c) With the aid of equation, describe the formation of chromic acid (an oxidizing reagents) from dichromate ion using displayed formula. (8 marks)

### QUESTION 3

3. (a) Describe the process of preparing potassium permanagate ( $\text{KMnO}_4$ ) as an oxidizing agents for alkenes. (10 marks)

(b) Define Reduction in Organic Chemistry (4 marks)

(c) Explain the following types of reduction reactions of organic compounds:

(i) Catalytic hydrogenation (ii) Chemical methods of reduction (6 marks)

### QUESTION 4

4. (a) Give three (3) examples of catalyst used for hydrogenation in the laboratory. (3 marks)

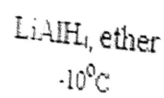
(b) Lithium aluminium hydride ( $\text{LiAlH}_4$ ) and sodium borohydride ( $\text{NaBH}_4$ ) are commercially available and useful reducing agents in organic chemistry. Explain why and how the anions from these hydrides can attack multiple bonds such as  $\text{C}=\text{O}$ . (5 marks)

(c) Give three (3) differences in the behavior of lithium aluminium hydride ( $\text{LiAlH}_4$ ) and sodium borohydride ( $\text{NaBH}_4$ ) when used as reducing agent in organic synthesis. (6 marks)

(d) Using equations, explain two (2) methods of preparing ethyne. (6 marks)

### QUESTION 5

5. (a) The organic compound X with the formula,  $\text{C}_6\text{H}_5\text{CH}=\text{C}(\text{C}_2\text{H}_5)\text{CHO}$ , reacts under the conditions below to give organic products A and B. Give the structural formula of A and B.



B

(4 marks)

(b) Give the structures and the names of the product obtained when  $CH_3CH_2COCH_2COOC_2H_5$  is reacted separately with (i)  $NaBH_4$  in ethanol and (ii)  $LiAlH_4$  in ether.

(6 marks)

(c) Define aldol addition reaction.

(3 marks)

(d) Describe the Diels-Alder reaction and show the mechanism involved between 1,3-butadiene and but-1-ene

(7 marks)