



NATIONAL OPEN UNIVERSITY OF NIGERIA PLOT 91, CADASTRAL ZONE,  
NNAMDI AZIKIWE EXPRESSWAY, JABI – ABUJA  
FACULTY OF SCIENCES  
DEPARTMENT OF CHEMISTRY  
2025\_2 EXAMINATIONS

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**COURSE CODE:** CHM421

**COURSE TITLE:** HETEROCYCLIC CHEMISTRY

**COURSE UNIT:** 2 UNITS

**TIME:** 2 HOURS

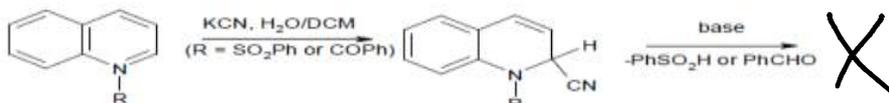
**INSTRUCTION:** ANSWER QUESTION 1 AND ANY OTHER 2 QUESTIONS

**QUESTION 1 (30 MARKS)**

- (a). Describe the steps involved in the Skraup Synthesis of quinoline, including the role of each reagent in the reaction. **(10 marks)**.
- (b). Explain how the nature of the cation and solvent influences the site of electrophilic attack in the formation of the indolyl anion, distinguishing between N-1 and C-3 substitution. **(5 marks)**
- (c). Describe the general properties of benzopyrilium salts, particularly anthocyanins, and explain how their color changes with pH. **(5 marks)**
- (d). Discuss the properties, uses, and limitations of Warfarin as both a rodenticide and an anticoagulant. Include in your discussion how it functions in the body, its historical development, and the challenges associated with its use. **(10 marks)**

**QUESTION 2 (20 MARKS)**

- (a). Describe the Döbner-von Miller Synthesis, including the role of  $\alpha$ ,  $\beta$ -unsaturated carbonyl compounds, and outline the key steps in the reaction mechanism. **(5 marks)**
- (b). Complete the below equation for reaction of Quinoline with Potassium cyanide. **(3 marks)**



- (bii). What is warfarin used for, and how does it help in preventing complications related to blood clots? **(2 marks)**
- (c). Describe the electrophilic substitution reactions of quinoline, focusing on the factors that determine whether quinoline or the quinolinium ion is the substrate for electrophilic attack. Provide examples of different nitration and sulphonation reactions. **(5 marks)**
- (d). Explain the mechanism and outcome of nucleophilic addition/substitution reactions in quinoline, with emphasis on the formation of Reissert adducts and the Chichibabin reaction. **(5 marks)**

**QUESTION 3 (20 marks)**

(a). Describe the Friedlaender Synthesis, highlighting the main problem associated with it and the method used to overcome this issue. **(5 Marks)**

(b). Compare the Friedlaender Synthesis and the Pfitzinger Synthesis based on their starting materials. **(3 Marks)**

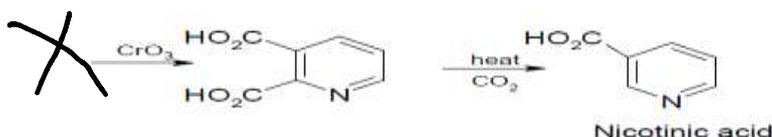
(c). Give the equation for Friedlaender Synthesis and the Variation of Pfitzinger Synthesis **(12 marks)**

#### QUESTION 4 (20 marks)

(a). Discuss the structure, natural source, historical significance, and modern applications of quinine. **(10 Marks)**

(b). Explain the optical activity and sensitivity to ultraviolet light of quinine. **(5 marks)**

(c). Complete the reaction below for the Synthesis of Nicotinic Acid from Quinoline. **(3 marks)**.



(cii). Why are oxonium salts derived from the pyran nucleus comparatively stable, and how is the pyrilium ion formed? **(2 marks)**

#### QUESTION 5 (20 marks)

(a). Describe the reduction and nucleophilic addition reactions of isoquinolinium salts, including the products formed. **(10 marks)**

(b). Describe the Bischler-Napieralski Synthesis, including the steps involved in the preparation of 1-substituted 3,4-dihydroisoquinolines. **(8 Marks)**

(c). Explain the Pictet-Gams modification. **(2 marks)**