



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

COURSE CODE: CHM 414

COURSE TITLE: PHOTOCHEMISTRY AND PERICYCLIC REACTIONS

COURSE UNIT: 2

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

Time: 2 hours

1. (a). i. What is electromagnetic spectrum, hence state the two wavelengths that defines the spectrum **2 Marks**.
(ii). Arrange the radiations in the electromagnetic spectrum in order of increasing wavelength – **3 Marks**
(b). (i). Outline **THREE (3)** postulates of the Quantum theory – **3 Marks**.
(ii). What is photochemistry, hence state one photochemical reaction that happens in nature. – **2 Marks**.
(c). (i). In a tabular form, present **THREE (3)** differences between thermal and photochemical reactions – **3 Marks**.
(ii). State the 1st Law of photochemistry – **2 Marks**.
(d). (i). Differentiate between spontaneous and simulated emission – **2 Marks**.
(ii). Write the full meaning of the acronym, Laser, hence state **TWO (2)** properties of laser light. – **3 Marks**.
(e). State the Spin selection rule. – **4 Marks**.
(f). (i). What are pericyclic reactions? – **2 Marks**.
(ii). Describe in a sentence for each, the terms: Suprafacial and antarafacial in pericyclic reactions – **4 Marks**.
2. (a). (i). Explain in not more than two sentences, why hydrogen peroxide must be stored in a light-proof bottle – **2 Marks**.
(ii). What are the two steps involved in a photochemical reaction, hence write an equation to show the process – **3 Marks**.
(b). (i). Highlight any **TWO (2)** important photophysical processes in photochemistry – **2 Marks**.
(ii) Outline **THREE (3)** applications of photochemical reactions – **3 Marks**.
(c). (i). Explain the term ‘Fluorescence quenching’ – **2 Marks**.
(ii). State any **THREE (3)** examples of organic photochemical reactions – **3 Marks**.
(d). (i). What is a selection rule? – **2 Marks**.
(ii). Differentiate between singlet and triplet state. Which of them is relevant to phosphorescence – **3 Marks**.
- 3 (a). Write equations to show the following photochemical reactions (i) production of carbohydrates (ii) dissociation of ozone. – **4 Marks**.
(b). (i). Outline any **THREE (3)** factors that affect the stokes’ shift – **3 Marks**.
(ii). Describe any **TWO (2)** essential criteria for all photochemical reactions – **2 Marks**.
(c). (i). Give appropriate equations for the quantum yield of any **THREE (3)** photochemical process – **3 Marks**.
(ii). A 150 W lamp emits green light with a wavelength of 490 nm. Determine the number of photons emitted in 2.0 s assuming the lamp operates at 100 % efficiency. Take speed of light, $c = 3.0 \times 10^8 \text{ ms}^{-1}$. – **6 Marks**.
(d). State any **TWO (2)** elements of a laser. – **2 Marks**.
- 4 (a). (i). Differentiate between primary and secondary photochemical process. Hence, if the quantum yield is greater than 1, what does it mean? – **3 Marks**.
(ii). Use a suitable structural equation only show the photochemical cycloaddition of thymine – **3 marks**. (b). State **TWO (2)** differences between forbidden and allowed pericyclic reactions – **4 Marks**.
(c). Describe the following acronyms (i) HOMO (ii) LUMO – **4 Marks**.
(d). Using suitable example, describe Cheletropic reactions – **6 Marks**.

- 5 (a). In a tabular form, differentiate between sigmatropic and electrocyclic reactions. – **4 Marks.**
- (b). Using a ruthenium (II) complex describe the formation of an excited state due to the absorption of light – **5 Marks.**
- (c). (i). Describe population inversion and its importance in lasers – **2 Marks.**
- (ii). State how the atmospheric ozone is formed, hence write **THREE (3)** equations to show the mechanism – **5 marks.**
- (d). State the LaPorte Selection Rule and hence allowed transition in terms of ($g \leftrightarrow u$). – **4 Marks.**