



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: CHM414

COURSE TITLE: PHOTOCHEMISTRY & PERICYCLIC REACTIONS

COURSE UNIT: 2

INSTRUCTION: Answer question 1 and any other two questions

Time: 2 hours

1. (a) Give reasons for the following observations

 - (i) Interconversion of cyclobutene to butadiene is a forbidden process thermally but an allowed process photochemically. **(11 marks)**
 - (ii) Conrotatory ring opening of cyclobutene to butadiene is an allowed process thermally but a forbidden process photochemically **(11 marks)**

(b) Derive the Stern-Volmer equation for the reaction of a fluorophore ($S1^*$) with a quencher (Q); after which the fluorophore was deactivated and the quencher excited **(8 marks)**
2. (a) State the Grotthus –Draper law and Stark-Einstein law of electrochemical equivalence **(8 marks)**

(b) Calculate the number of moles of $HCl(g)$ produced by the absorption of one joule of radiant energy of wave length 480 nm in the reaction $H_2(g) + Cl_2(g) \longrightarrow 2HCl(g)$ if the quantum yield of the photochemical radiation is 1.0×10^6 **(12 marks)**
3. (a) What is the technical meaning of Stoke's shift in flourometry? **(4 marks)**

(b) Mention any **three (3)** factors that can influence the magnitude of the Stokes' shift **(6 marks)**

(c) Highlight any **five (5)** differences between thermal and photochemical reactions (**10 marks**)

4. (a) State the Franck-Condon Principle (**4 marks**)

(b) Give the any eight (8) reaction pathways of the possible reactions that an electronically excited species can undergo (**16 marks**).

5. (a) What is the major difference between fluorescence and phosphorescence (**4 marks**)

(b) State the four ways that a molecule can relax prior to fluorescence emission (**8marks**)

(c) Mention any three (3) types of lifetime that exist in photochemistry (**3 marks**)

The conversion of **1** into **2** may be achieved in a two step process. The use of photochemical irradiation results in formation of a reactive intermediate **3**, which subsequently rearranges to **2** under non-photochemical conditions.

Identify the structure of intermediate (**3**). (**5 marks**)