



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

**COURSE CODE: CHM 409**

**COURSE TITLE: PHOTOCHEMISTRY & PERICYCLIC REACTIONS**

**COURSE UNIT: 2**

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

**Time : 2 hours**

**QUESTION 1**

1) (a) Briefly explain the following terms / concepts

(i) Antarafacial and suprafacial cycloaddition reactions **(6 marks)**

(ii) symmetry allowed and symmetry forbidden pericyclic reactions **(6 marks)**

(iii) Photosensitization **(3 marks)**

(iv) Optical pumping in Laser Technology. **(3 marks)**

(b) Write a general equation that represent photodissociation of  $X_2$  molecule. **(2 marks)**

(c) Use Einstein law to show that the energy of radiation can be written as

$E = \frac{1.1925 \times 10^5}{\lambda} \text{ kJ/mole}$ . Hence calculate the energy that can be generated by a radiation

whose wavelength is 10 nm **(10 marks)**

**QUESTION 2**

2) (a) State the Woodward-Hoffmann's rule for pericyclic reactions **(5 marks)**

(b) Predict the stereochemistry of 5, 6 – dimethylcyclohexa-1,3-diene when formed (i) thermally, and (ii) photochemically, from trans, cis trans-octa-2,4,6-triene. **(15 marks)**

**QUESTION 3**

3. Briefly explain using an example in each case the following terms

(a) Ring-closure electrocyclic reaction **(6 marks)**

(b) Diatropic rearrangements **(6 marks)**

(c) sigmatropic rearrangement reactions **(8 marks)**

**QUESTION 4**

4. (a) Highlight the mechanism involve in the photochemical reaction of toluene with Chlorine **(6 marks)**
- (b) When irradiated with light of 5000 Å wavelength,  $1 \times 10^{-4}$  mole of a substance is decomposed. How many photons are absorbed during the reaction if its quantum efficiency is 100. (Avogadro number =  $6.02 \times 10^{23}$ ). **(11 marks)**
- (c) What are cyclo addition reactions **(3 marks)**

#### QUESTION 5

5. (a) List the three (3) major components of laser **(6 marks)**
- (b) (i) Photolysis of HBr is known to be characterised with two sets of reaction. Name the reaction and write suitable equations for each. Hence write the overall reaction. **(8 marks)**
- (ii) Write an equation that can be used to calculate the quantum yield of a photochemical reaction. Hence calculate the quantum yield for photolysis of HBr. **(6 marks)**