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# **KIBABII UNIVERSITY**

**UNIVERSITY EXAMINATIONS  
2020/2021 ACADEMIC YEAR**

**FOURTH YEAR SECOND SEMESTER  
MAIN EXAMINATIONS**

**FOR THE DEGREE OF BACHELOR OF SCIENCE**

**COURSE CODE: SCH 441 E**

**COURSE TITLE: PHOTOCHEMISTRY**

**DURATION: 2 HOURS**

**DATE: 13/10/2021**

**TIME: 2:00-4:00PM**

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**INSTRUCTIONS TO CANDIDATES**

- Answer **QUESTION ONE** (Compulsory) and any other two (2) Questions.
- Indicate **answered questions** on the front cover.
- Start every question on a new page and make sure question's number is written on each page.

This paper consists of 4 printed pages. Please Turn Over



KIBU observes ZERO tolerance to examination cheating

### Question 1

- a) State the TWO basic laws of photochemistry. [2mks]
- b) State four differences between photochemical and thermal reactions. [4mks]
- c) Caffeine molecules absorb radiation at wavelength of  $6.039 \times 10^{-6} \text{ m}$ . Calculate the following:
- frequency of this radiation; [2mks]
  - energy change associated with this absorption ( $h = 6.626 \times 10^{-34} \text{ Js}$ ) [2mks]
- d) 0.25 mg of compound A with molecular weight  $140 \text{ g mol}^{-1}$  was dissolved in 50 mL of the solvent. If the absorbance of this solution at wavelength 310 nm is 0.35, calculate the molecular extinction coefficient at 310 nm. [3mks]
- e) Explain the difference between singlet and triplet excited states. [4mks]
- f) State four differences between fluorescence and phosphorescence [4mks]
- g) State three types of photochemical reactions [3mks]
- h) Using mechanisms, discuss the photochemistry of hydrogen-chlorine reaction [3 mks]
- i) Using an example and mechanism, explain Paterno-Buchi reaction [3 mks]

### Question 2

- a) State Beer Lamberts law. [1mk]
- b) The percentage radiation transmitted by a solution containing 2-aminonicotinic acid at pH 3.6 and 298 K at 320 nm is 72.4% for a solution  $2 \times 10^{-5} \text{ mol L}^{-1}$  in a one cm cell. Calculate:
- the absorbance at 320 nm, [2mks]
  - the molecular extinction coefficient, [2mks]
  - radiation transmitted if the cell length is 5 cm [2mks]
- c) Derive the relation depicting the concentration of each species in a solution containing compounds A and B with their absorbance measured at wavelength  $\lambda_1$  and  $\lambda_2$  respectively. [4mks]
- d) Absorbance of a solution containing compounds A and B at wavelengths 310 and 370 nm are 0.45 and 0.25 respectively. Calculate the concentrations of A and B from the following data. [6mks]
- e) State three limitations of **Beer Lamberts law**. [3mks]

### Question 3

- a) Define clearly *quantum efficiency* for a photochemical reaction. [1mk]
- b) State four primary effects of absorption of radiation by atomic and molecular systems [4 mks]
- c) Describe how the Absorbed Intensity of radiation is measured. [6mks]
- d) In photochemical decomposition of acetone using 313 nm light,  $7.57 \times 10^{-6} \text{ mol}$  of carbon monoxide is formed in 20 minutes. If the light absorbed corresponds to  $2.41 \times 10^{-3} \text{ J s}^{-1}$ , calculate the quantum efficiency for the formation of carbon monoxide. [5mks]
- e) Give four reasons for low quantum yield [4mks]

### Question 4



a. Explain the physical pathways of a photochemically excited molecule using Jablonski diagram [12mks]

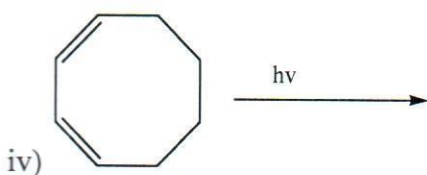
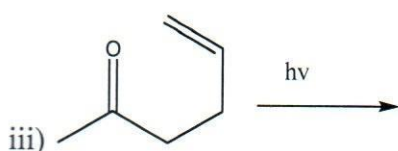
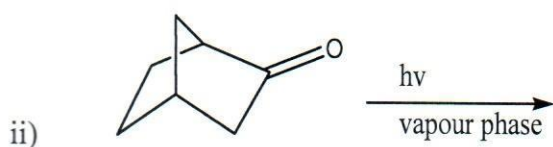
a) State four requirements of a sensitizer in photosensitized reactions. [4mks]

c) Briefly explain the Mechanism of Photosensitization and Quenching [4mks]

### Question 3

a. State four possible type of electronic transitions in excited organic molecules giving an example of functional group in each. [6mks]

b. Complete the following reactions by drawing the structure of the major product and provide the reaction mechanism in each. [14mks]



### Question 5

a. Write the mechanism of photo formation of ozone. [4 mks]

a) Discuss atmospheric formation of Photochemical Smog. [12mks]

b) Explain important effects of photochemical smog [4mks]