MACHAKOS UNIVERSITY

University Examinations 2021/2022

SCHOOL OF PURE AND APPLIED SCIENCES

DEPARTMENT OF PHYSICAL SCIENCES

THIRD YEAR SECOND SEMESTER EXAMINATION FOR

BACHELOR OF SCIENCE IN ANALYTICAL CHEMISTRY

SAN 305: PHOTOCHEMISTRY

DATE: **TIME:**

INSTRUCTIONS:

- The paper consists of **two** sections.
- Section **A** is **compulsory** (30 marks).
- Answer any **two** questions from section **B** (each 20 marks).

QUESTION ONE (COMPULSORY)(30 MARKS)

(a) Define the terms:

(i) photochemical reaction

(ii) photosensitized reaction as applied in photochemistry (2 marks)

(b) For a reaction that strictly obeys the Einstein law, one molecule decomposes per photon, the quantum yield is equal to one. When two or more molecules are decomposed per photon, the reaction is said have high quantum yield. Using relevant examples name and explain two main cause of high quantum yield. (8 marks)

(c) The numerical value of Einstein varies inversely as the wavelength of radiation. The higher the wavelength, the smaller will be the energy per Einstein. Calculate the values of:

(i) Frequency

(ii) Quantum energy

(iii) Einstein for 500 nm radiation (9 marks)

(d) With the aid of diagrams name and explain the working of any three detectors used for the measurement of intensity of transmitted light in photochemistry. (9 marks)

(e) Name and define two main characteristics of a wave. (2 marks)

QUESTION TWO (20 MARKS)

(a) Using relevant examples differentiate between a primary reaction and secondary reaction as applied in photochemical reactions. (5 marks)

(b) For a photochemical reaction A-B 1.0×10^{-5} mole of B were formed on absorption of 6.0×10^{7} ergs at wavelength 3600×10^{-8} cm. Calculate the quantum efficiency of the reaction. N= 6.62×10^{23}, h= 6.62×10^{-27} erg sec. (5 marks)

(c) Using examples in each case, explain your understanding of the three photophysical processes as applied in photochemistry. (9 marks)

(d) The Aufbaus principle enables us to understand and find the location of electrons present in an atom. In the same understanding, explain the Paulis exclusion principle. (1 mark)

QUESTION THREE (20 MARKS)

(a) Name and state the two laws used in explaining the theory of photochemical equivalence. (4 marks)

(b) The magnitude of a quantum or photon of energy is directly proportional to the frequency of the radiant energy, or is inversely proportional to its wavelength. Calculate the magnitude of the energy of the photon (or quantum) associated with light of wavelength 4800×10^{-8} cm, were, h= 6.62×10^{-27} erg sec, C = 3×10^{10} cm/sec. (4 marks)

(c) With an aid of diagram explain how photoelectric effect can be determined. (6 marks)

(d) It is necessary to determine the absorbed intensity of light for a study of the rate of reaction. Using a well labelled diagram explain how intensity of light can be measured. (6 marks)

QUESTION FOUR (20 MARKS)

(a) State the Hund`s rule of maximum multiplicity. (3 marks)

(b) The wavelength of a violet light is 400 nm. Calculate its frequency and wave number. (5 marks).

(c) With the aid of a diagram, explain the Compton effect as a proof of the quantum theory or photon theory. (5 marks)

(d) State and derive the Schrodinger's wave equation. (7 marks)

QUESTION FIVE (20 MARKS)

(a) Outline five differences between photochemical reactions and thermochemical reactions. (5 marks)

(b) Kasha`s rule is a principle in the photochemistry of electronically excited molecules. Using a clearly labelled diagram explain the exceptions of the rule. (8 marks)

(c) With aid of a diagram explain how photo-ionization method can be used to determine ionization energy. (7 marks)