QL-5247

M. Sc. (Sem. III) Examination, December-2023

CHEMISTRY

PAPER - 3.4

CHEM-634
Photo-inorganic Chemistry
(Inorganic Chemistry Specilization)

Time Allowed : **Three Hours**

Maximum Marks : **70**
Min. Marks : **28**

Note : *This question paper is divided into three sections as under :*

Section-A **Max. Marks - 10**

Will carry 10 marks with 01 compulsory question comprising 10 short answer type questions (maximum 20 words answer) taking two questions from each unit. Each question shall be of one mark.

Section-B ***Max. Marks-25***

Will carry 25 marks with equally divided into five long answer type questions (answer about in 250 words). Students are instructed to attempt five questions by selecting one question from each unit.

Section-C ***Max. Marks-35***

Will carry 35 marks with five long answer type questions comprising one compulsory question of 15 marks and four questions of 10 marks each. Students are instructed to attempt total three questions with one compulsory question (answer about in 500 words) and any two more questions (answer about in 400 words) out of ramaining four questions.

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SECTION - A

1 (i) Define absorption and excitation in the context of light and matter.

(ii) Why the probability of a Frank-Condon transition is higher for transitions with minimal change in internuclear distance ?

(iii) How can the dipole moment of a molecule be affected by electronic transition ?

(iv) How can the presence of a quencher affect the life time of an excited state?

(v) What kind of transitions are observed in charge transfer spectra ?

(vi) In which region of the electromagnetic spectrum are charge transfer spectra typically observed.

(vii) What is the role of light in photo-substitution reaction ?

(viii) What happens to an excited state atom/ molecule if it does not lose energy through another process ?

(ix) What is inter-system crossing (ISC)?

(x) What are the two key components involved in a redox photo-process ?

SECTION - B

UNIT - I

2 (i) What are some factors that can influence the quantum yield of a photochemical reaction ?

(ii) How can the knowledge of quantum yield be beneficial in photochemical research and applications.

$2\frac{1}{2} + 2\frac{1}{2} = 5$

OR

Write a note on photochemical primary and secondary processes. 5

UNIT - II

3 (i) How does the change in dipole moment impact the properties of the excited state?

(ii) What are some applications of understanding the relationship between dipole moment and excited states?

$2\frac{1}{2} + 2\frac{1}{2} = 5$

OR

Discuss the potential applications of bimolecular deactivation (quenching) in photochemistry, and analytical chemistry.

5

UNIT - III

4 How do the energy levels of excited states differ between organic molecule and metal completes?

5

OR

Discuss the application of metal complex sensitizer in fabrication of dye-sensitized solar cells.

5

UNIT - IV

5 (i) Why is the O-O transition considered ideal for spectroscopic analysis?

(ii) How does understanding liability influence the design of photocatalysts for water photolysis?

$2\frac{1}{2}+2\frac{1}{2}=5$

OR

5

(i) What factors determine the energy content of an excited state?

(ii) How does the energy content of an excited state relate to the absorbed/emitted light?

$2\frac{1}{2}+2\frac{1}{2}=5$

UNIT - V

6 Discuss the chemiluminescence and bioluminescence processes with suitable examples.

5

OR

Explain the energy transfer under weak and strong interactions, and exciplex formation.

5

SECTION - C

7 (i) How does the Frank-Condon principle explain the appearance of vibrational structure in electronic spectra?

(ii) What features characterize the structure of electronically excited states compared to the ground state of a molecule?

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(iii) Discuss the nitrogen fixation and the factors influencing the rate of nitrogen fixation.

(iv) Explain the photo-oxidation and photo-reduction reactions with suitable examples.

(v) Write a short note on the transformation of low-energy reactants into high-energy products.

5×3=15

8 Explain the strengths and limitations of flash photolysis and stopped flow techniques. How can these techniques be used to gain a more comprehensive understanding of complex reaction mechanism.

5+5=10

9 (i) What are the main types of electronic transitions in inorganic photochemistry?

(ii) What are some key factors influencing the photochemical properties of inorganic complex?

5+5=10

10 Discuss the redox chemistry of electronically excited states of $[Ru(bpy)_3]^{2+}$ and $[Fe(bpy)_3]^{2+}$.

10

11 Write short nots on :

(i) Electron relay

(ii) Metal colloid systems

5+5=10