

M.Sc. 3rd Semester Examination, 2022

CHEMISTRY

(Org. + Inorg. + Phy.)

PAPER – CEM-301

Full Marks : 40.

Time : 2 hours

The figures in the right hand margin indicate marks

Candidates are required to give their answers in their own words as far as practicable

GROUP – A

Answer any four questions of the following : 2 × 4

- 1. Explain why for UPS study preferable energy of monochromatic ionizing radiation should be within the range of 20 to 50 eV. 2**
- 2. What do you mean by HeI and HeII radiations ? 2**

(Turn Over)

3. ESR spectrum of the complex ion $[\text{Mo}(\text{CN})_6]^{3-}$ consists of one line. If the sample is enriched with ^{13}C , the spectrum consists of nine lines. Explain this fact. 2
4. Draw a schematic diagram of a time correlated single photon counting (TCSPC) instrument. 2
5. How do you obtain stern-volmer quenching constant (K_{sv}) using half quenching method ? 2
6. Use the fundamental law of light absorption to explain that inversion of population in one of the essential criteria of lasing action. 2

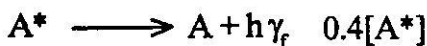
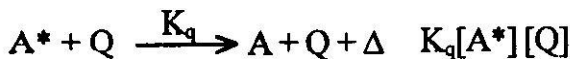
GROUP – B

Answer any four questions of the following : 4×4

7. What is meant by E-type delayed emission ? How do you obtain singlet-triplet energy gap for a molecule showing E-type delayed emission ? 1 + 3
8. Define exciplex emission. Write down the characteristics of exciplex emission. How do you

explain the stability of exciplex formation using frontier orbital interaction ? $\frac{1}{2} + 1\frac{1}{2} + 2$

9. Photo chemistry of a molecule, 'A' is described by the following mechanism.



Intercept at $[Q] = 0$ is 2 for the inverse of fluorescence intensity ($1/I_f$) Vs. $[Q]$ plot. Find the value of I_a . 4

10. Explain the photoelectron spectrum of hydrogen molecule. 4
11. (a) ESR spectrum of benzyl anion, $C_6H_5CH_2^-$ consists of a triplet having relative intensity 1:2:1-Explain.

(b) Define the terms "zero-field splitting" and "Kramer's degeneracy" in EPR spectroscopy. 3 + 1

12. When X-ray is irradiated on malonic acid two products are obtained and their ESR spectrum consist of a dominant doublet and a weak triplet. Identify the products. 4

GROUP - C

Answer any two questions of the following : 2 × 8

13. What is meant by twisted intramolecular charge transfer (TICT) emission? Write down the characteristics of TICT emission. Explain the effect of solvent polarity on TICT emission. 1 + 2 + 5
14. Write down the characteristics of LASER light. "Inversion of population can be achieved for a two level system". Justify or criticize the statement. 2 + 6
15. (a) Considering both weak and strong zero-field splitting, predict the ESR spectrum of Mn(II) octahedral high spin complex. ($I_{Mn} = 5/2$).

- (b) The ESR spectrum of $[(\text{NH}_3)_5\text{Co} - \text{O}_2 - \text{Co}(\text{NH}_3)_5]^{5+}$ shows fifteen lines. What information can you predict from this result? ($I_{\text{Co}} = 7/2$).

5 + 3

16. (a) From photoelectron spectral data explain which of the two isoelectronic species H_2 and He should have greater ionization energy.

- (b) Find the ionization energy of an electron if He(I) radiation liberates it with a kinetic energy of 12.50 eV.

- (c) What do you mean by "adiabatic ionization energy" and "vertical ionization energy"?

4 + 2 + 2