

2024

M.Sc. 2nd Semester Examination (Old)

CHEMISTRY (CCAE)

PAPER : CEM-201

Full Marks : 40

Time : 2 hours

GROUP—A

Answer *any four* questions :

2×4=8

1. What is contact time?
2. Define oscillating reaction.
3. Coherent anti-Stokes Raman Spectroscopy can be considered as an alternative technique to give stronger signal than normal Raman spectroscopy criticize or justify.
4. Probability density of 1s electron near the nucleus of hydrogen atom is maximum. Justify.
5. Although micelles are organized assemblies, micellization leads to an overall entropy change towards a positive direction. Explain.

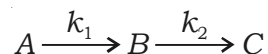
(2)

6. If H be a Hermitian operator of a system (ψ) with eigenvalue E and A be an operator corresponding to any physical observable of the system, then evaluate $\langle \psi | [H, A] | \psi \rangle$

GROUP—B

Answer *any four* questions : 4×4=16

7. Carbon dioxide is IR inactive, but it is Raman active. Explain with the shape of polarization ellipsoid.
8. For consecutive reaction,



Determine the concentration of B at time t from the starting of reaction.

9. Using double sphere activated complex model, derive expression for pre-exponential factor.
10. Give differences between micro and macro emulsions.
11. Show that in the n^{th} eigenstate of a Harmonic Oscillator, the average kinetic energy ($\langle T \rangle$) is equal to the average potential energy ($\langle V \rangle$).
12. State and prove Eckart's theorem.

(3)

GROUP—C

Answer *any two* questions : 8×2=16

13. Derive BET equation for multilayer adsorption process. 8
14. In flow system (for Plug Flow), derive rate equation for 1st order reaction and compare it with static system. 8
15. (i) Give an example of one-electron transfer redox reaction.
- (ii) Write down and explain the stapes of inner-sphere mechanism through which redox reaction proceed. 2+6
16. From the perturbation theory —
- (i) show the first order nondegenerate energy correction is given by; $E_n^{(1)} = \langle \psi_n^0 | H' | \psi_n^0 \rangle$
- (ii) show the first order nongenenerate wave function correction given by;

$$\psi_n^{(1)} = \sum_{m \neq n} \left(\frac{\int \psi_m^0 | H' | \psi_n^0 d\tau}{E_n^0 - E_m^0} \right)$$

where H' is the perturbed Hamiltonian and ψ_n^0 is the orthonormal wave function of an unperturbed system. 3+5

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