

B.Sc. (Honours) Examination, 2019
Semester-IV
Chemistry (Honours)
Course: BCHC-43
(Physical Chemistry)

Time: Three Hours

Full Marks: 30

Questions are of value as indicated in the margin.
Symbols and notations have usual meaning
Answer **any three** questions.

1. a) Derive the selection rule for allowed transitions for LHO. Given that

$$\psi_v(\sqrt{\beta}x) = \left(\frac{\beta^{1/2}}{2^v v! \sqrt{\pi}} \right)^{1/2} H_v(\sqrt{\beta}x) e^{-\beta x^2/2}, \text{ where } \beta = \frac{\sqrt{mk}}{\hbar}. \quad 4$$

- b) Deduce the value of $\langle x \rangle$ for a LHO. What is the physical reason behind the value you obtained? 3
- c) Deduce a range of classically allowed region for a LHO with proper reasoning. 3
2. a) The eigenstates of particle on a ring are doubly degenerate except the ground state – explain. 2
- b) Derive the spectroscopic selection rule for particle on a ring. 4
- c) The ϕ -equation for particle on a sphere is given by $\frac{d^2 T(\phi)}{d\phi^2} + m^2 T(\phi) = 0$. Derive the normalized $T(\phi)$ and find out the allowed values of m with proper arguments. 2+2
3. a) Determine the variance of a one-component system having number of phases equal to one, two and three, respectively. 2
- b) Describe the type of phase diagram that is expected for the phenomena enantiotropy and monotropy. 2
- c) How does a binary solid solution differ from a solid mixture? 2
- d) Draw a typical phase diagram with complete labelling of a two-component system exhibiting a single congruent melting point. 4
4. a) Show with the help of the phase rule that at a given pressure the critical solution temperature is a non-variant point. 3
- b) Starting from the Gibbs-Duhem equation, derive the Duhem-Margules equation applicable to a binary liquid mixture. 5
- c) How many degrees of freedom, number of phases and number of components are present in the system where CaCO_3 is heated in a sealed tube? 2
5. a) What do you mean by activation energy of a reaction? Show activation energy plot for endothermic and exothermic reactions. 1+1
- b) Explain the steric factor 'p' in the collision theory of reaction rate. 2
- c) Describe Lindemann mechanism for unimolecular reaction. 4
- d) What do you actually mean by 'reaction coordinate'? 2
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