

B.Sc. (Honours) Examination, 2017

Semester-IV

Chemistry (Honours)

Course: BCHC-43

(Physical Chemistry)

Time: Three Hours

Full Marks: 30

Questions are of value as indicated in the margin.

Answer **any three** questions.

1. a) The wave function for v-th state of LHO is given by:

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

Show that $\langle x^2 \rangle = \frac{\hbar}{\sqrt{mK}} \left(v + \frac{1}{2} \right).$ 5

- b) Derive the selection rule for the dipole allowed transitions in LHO. 3
- c) Determine the range of classically allowed zone in LHO. 2
2. a) Derive the expressions of energy and normalized wave function for particle on a ring choosing any arbitrary point on the ring as origin ($x = 0$). 4
- b) Derive the selection rule for the dipole allowed transitions in particle on a ring. 3
- c) Discuss the aspect of space quantization of angular momentum vector in the context of particle on a sphere. 3
3. a) Justify the statement that – “The vapour phase is richer in the component whose addition to the liquid mixture causes a decrease in the boiling point” – with the help of Konowaloff’s rule. 2.5
- b) Show that it is not possible to separate the constituents from an azeotropic mixture following the ordinary fractional distillation. 2.5
- c) Predict the sequences of steps that takes place when the pressure on the binary liquid mixture at constant temperature is gradually lowered. 2
- d) The addition of n-heptane to ethyl alcohol or ethyl alcohol to n-heptane lowers the boiling point of the solvent – explain. 3
4. a) Show that the vapour pressure of the metastable form is greater than that of the stable form at the same temperature. 3
- b) The phase that is stable at equilibrium with the vapor is the phase that has the lower equilibrium vapour pressure – Explain. 2
- c) What are the number of components and the variance at the congruent melting point of a system consisting of two constituents? 1
- d) How boiling solid solutions differ from a solid mixture? 2
- e) What are the end products of fractional crystallization of a system exhibiting ascending type solid solution? 2
5. a) What is activation energy and activated complex? What do you mean by reaction coordinate? 1+2
- b) Discuss Lindemann mechanism for the rate of unimolecular reaction. 4
- c) For a reaction the following first-order constants are found:

Temp (°C)	120	130	140
k (sec ⁻¹)	5.0	11.5	26.4

Calculate (i) the activation energy, (ii) frequency factor and (iii) the entropy of activation. 3