B.A. / B.Sc. SEMESTER 4 EXAMINATION, 2020
<u>FAKIR CHAND COLLEGE CENTRE (551)</u>

<u>INSTRUCTIONS FOR CANDIDATES</u>

READ ALL THE INSTRUCTIONS CAREFULLY BEFORE WRITING ANSWERS

1. Total **TIME OF EXAMINATION: <u>2 HOURS</u>**

2. **<u>Question Paper Comprises Of Three Separate Questions – Theoretical (25 Marks), Practical (15 Marks) And Internal Examination (10 Marks). Candidates Must Have To Answer All The Three Separately And Finally Have To Prepare A Single pdf File By Scanning All The Papers Clearly And Serially (According To Page Numbers).</u>**

3. **ATTACH ANYONE PREVIOUS SEMESTER ADMIT CARD** As The Last Page Of The pdf File

4. Use Only **WHITE PLAIN A4 PAPERS** For Writing Answers

5. Use **ONLY BLACK INK** For Writing Your Answers

6. Give **A TOP PAGE** With Clear Mention Of University **REGISTRATION NO. AND UNIVERSITY ROLL NO.** Of Anyone Previous Semester

7. **GIVE PAGE NO.** At The Top Right/Middle Of Each Page

8. Give **AT LEAST 1CM MARGINS** In All The Four Sides Of Each Page

2020
B.Sc. Semester 4 Examination
University of Calcutta
CHEMISTRY – HONOURS
THEORETICAL
Paper : CC 9 (Physical)   F.M. 25
FAKIR CHAND COLLEGE CENTRE (551)

*1. Answer briefly **any four** questions from the following:*   *1×4*

    a) Name a system, which has both upper and lower critical solution temperature.

    b) Explain with reasons, whether each of the following functions is acceptable or not as a wave function over the indicated intervals: e^{-x} $(-\infty, \infty)$

    c) Sketch the wave function ψ for $n = 1\&2$ state of a particle in a one-dimensional box of length $8\ \mu m$.

    d) Calculate the distance between (212) plane in a cubic lattice of edge length "a".

    e) Give an example of Azeotrope.

    f) State Dulong and Petit's law.

*Answer **any three** questions from the following:*

1. a) Elevation of boiling point is an entropy effect – comment.   3

   b) Derive thermodynamically a relation between the osmotic pressure of a dilute solution of a solute and its molar concentration.   4

2. a) Examine whether $\psi, -\psi \ \& \ 2i\psi$ represent the same state if ψ is a real function.   3

   b) Two Eigen functions of a particle are, $\psi_m(x) = \sqrt{\left(\dfrac{2}{B}\right)}\ Sin\dfrac{m\pi x}{B}$ $(m = 1, 2)$, where x is defined within $0 \le x \le B$. Show that these Eigen functions are orthogonal to each other.   4

3. a) Evaluate $\left[\hat{x},\ \hat{p}_x\right]$ where the symbols have their usual meaning.   3

   b) The wave function of a particle in a one-dimensional box of length L is $\psi_m(x) = A\ Sin\dfrac{m\pi x}{L}$ $(m = 1, 2, 3....)$, where x is defined within $0 \le x \le L$. Find the value of A.   4

4. a) Draw the phase-diagrams of CO_2 and indicate its differences with the H_2O phase diagrams.   3

   b) Starting from the appropriate form of the Duham-Margule's equation deduce Konowaloff's rule and discuss its significance.   4

5. a) What is Vant Hoff's "i" factor?   3

   b) The element polonium (at wt. 210) crystallizes in the cubic system. Bragg first order reflections using X-ray of wavelength 0.154 nm occur at $sin\theta$ values of 0.225, 0.316, 0.388 for reflection from (100), (110) and (111) type planes respectively. Calculate the value of the side 'a' of the unit cell and also the density of the polonium.   4

2020
B.Sc. Semester 4 Examination
University of Calcutta
CHEMISTRY – HONOURS
PRACTICAL
Paper : CC 9 (Physical)   F.M. 15

> **FAKIR CHAND COLLEGE CENTRE (551)**

1. a) Write down the theory for "**Determination of Partition Coefficient for the distribution of Iodine between Water and Chloroform"** covering the following points:

   i)   Write the working formula of the partition coefficient, K_d for distribution of Iodine between Water and Chloroform by mentioning all the terms (detailed derivation is not required).

   2+2

   b) The following data were obtained for partition of Iodine between Chloroform (organic layer) and water (aqueous layer) by adding 30 ml saturated solution of Iodine in Chloroform with100ml of pure water in a **single stoppered glass bottle** (Bottle 1) and after moderate shaking for ~ 40 minutes.

   Bottle 1(Org. layer): **5 ml** of organic layer was titrated each time against **(N/20)** Thiosulphate solution, then two successive burette readings were **20.1 ml** and **20.2 ml**

   Bottle 1(Aq. layer): **25 ml** of aqueous layer was titrated each time against **(N/100)** Thiosulphate solution then two successive burette readings were **5.2 ml** and **5.2 ml**

   Represent the data in <u>proper tabular forms</u>.   2+2

   c) Determine the partition coefficient of Iodine in bottle 1 at the experimental temperature.   4

2. Laboratory Notebook / Laboratory Performance   3

2020
B.Sc. Semester 4 Examination
University of Calcutta
CHEMISTRY – HONOURS
INTERNAL EXAMINATION
Paper : CC 9 (Physical)   F.M. 10
FAKIR CHAND COLLEGE CENTRE (551)

*Answer **any ten** questions from the following:*   *1×10*

I. Following are the examples of Colligative properties:
   a) Elevation of boiling points   b) Depression of Freezing points   c) Osmotic Pressure
   d) All of these

II. For mixing of different ideal gases
   a) $\Delta S_{Mix} = 0$ b) $\Delta H_{Mix} = 0$ c) both are zero   d) none of them is zero

III. In a phase diagram of any system at Triple point, the value of degrees of Freedom is
   a) 0   b) 1   c) –1   d) undefined

IV. The wave nature of electron is observed in the following experiment
   a) Photo-electric effect   b) Compton effect   c) Diffraction   d) Black body radiation

V. Quantum mechanical operator for momentum along x-axis is
   a) $-i\hbar\dfrac{d}{dx}$ b) $i\hbar\dfrac{d}{dx}$ c) $\dfrac{\hbar}{i}\dfrac{d}{dx}$ d) both a) and c)

VI. The energy of the particle of mass, "m" in a one-dimensional box of length "L" at "n = 2" level is
   a) $\dfrac{h^2}{8ma^2}$ b) $\dfrac{h^2}{2mL^2}$ c) $\dfrac{h^2}{4mL^2}$ d) $\dfrac{h^2}{8mL^2}$

VII. The maximum in the probability density plot of the particle of mass, "m" in a one-dimensional box of length "L" at ground state is found at
   a) $\dfrac{1}{4}L$ b) $\dfrac{3}{4}L$ c) $\dfrac{1}{2}L$ d) $\dfrac{1}{3}L$

VIII. What is the Miller indices of the plane whose Weiss indices are represented as (2a : b : ∞ c)
   a) 1: 2: 1   b) 2: 1: ∞   c) 2: 1: 0   d) 1: 2: 0

IX. The effective average number of atoms present in a BCC lattice unit cell is
   a) 2   b) 1   c) 4   d) 9

X. For determination of lattice spacing in a crystalline solid which light is used as an irradiating source
   a) Gama ray   b) X-ray   c) IR ray   d) UV ray

XI. Debye's T^3 law is valid at
   a) moderate T   b) very high T   c) very low T   d) does not depend on T

XII. The degree of degeneracy associated with the energy level $\dfrac{17h^2}{8ma^2}$ of a particle in a cubical box is
   a) 1   b) 2   c) 4   d) 3