**BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI**
**(END SEMESTER EXAMINATION)**

**CLASS: IMSC** **SEMESTER : I**
**BRANCH: Chemistry** **SESSION : MO/19**

**SUBJECT: CH104 PHYSICAL CHEMISTRY-I: STATES OF MATTER & IONIC EQUILIBRIUM**
**TIME:3:00 HOURS** **FULL MARKS: 50**

**INSTRUCTIONS:**
**1. The question paper contains 5 questions each of 10 marks and total 50 marks.**
**2. Attempt all questions.**
**3. The missing data, if any, may be assumed suitably.**
***4*. Before attempting the question paper, be sure that you have got the correct question paper.**
**5. Tables/Data hand book/Graph paper etc. to be supplied to the candidates in the examination hall.**

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Q.1(a) From Maxwell velocity distribution derive the expression for most probable velocity. [5]

Q.1(b) For $O_2$ molecules, the root mean square velocity at $T_1$, the average velocity at $T_2$ and most probable velocity at $T_3$ are all equal to 1.5 X $10^3$ m/s. Calculate $T_1$, $T_2$ and $T_3$. [5]

Q.2(a) Derive the expression for Boyle temperature ($T_B$) and show that $T_B > T_C$ [5]

Q.2(b) Using van der Waals equation, find the temperature at which 3 mol of $SO_2$ will occupy a volume of 10 $dm^3$ at a pressure of 1.52 MPa. [Given, a = 678 $dm^6$ kPa $mol^{-2}$ and b = 5.6 X $10^{-2}$ $dm^3$ $mol^{-1}$] [5]

Q.3(a) Why excess pressure inside a soap bubble is twice the excess pressure of a liquid drop of the same radius? [5]

Q.3(b) A spherical drop of a liquid weighing 0.04 gm is dispersed into 1000 homogeneous microglobules of radius 0.02 cm each. Find the resultant increase in surface energy. [Given, density = 0.8 gm/cc, γ = 27 dyne/cm] [5]

Q.4(a) Derive the Bragg's diffraction law, $n\lambda = 2d \sin\theta$ [5]
Calculate the longest wavelength of *x*-ray that may be used to determine a lattice spacing of 1 Å by the Bragg's diffraction method.

Q.4(b) In the cubic crystal of CsCl (d = 3.97 gm/cc) the eight corners are occupied by $Cl^-$ ions with a $Cs^+$ at the centre and vice-versa. Calculate the distance between the neighbouring $Cs^+$ and $Cl^-$ ions. [At. wt. of Cs = 132.91 and Cl = 35.45] [5]

Q.5(a) Determine the expression of pH at the end point of titration when $CH_3COOH$ is titrated with NaOH. [5]

Q.5(b) You are supplied with 0.1 (N) $NH_4OH$ and 0.1 (N) HCl solutions. Show how you will you use these to prepare 100 mL of a buffer solution of pH = 9.0 [$K_b$ for $NH_4OH$ = 2 X $10^{-5}$] [5]

**::::::02/12/2019::::::E**