

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

CLASS: IMSC  
BRANCH: CHEMISTRY

SEMESTER : I  
SESSION : MO/18

SUBJECT: CH104 PHYSICAL CHEMISTRY - I

TIME: 3 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) What is collision frequency,  $Z_{1(1)}$ ? Derive the expression for  $Z_{1(1)}$  and show its relationship with mean free path ( $\lambda$ ) for an ideal gas. [5]
- Q.1(b) The mean free path of the molecule of a certain gas at 300 K is  $2.6 \times 10^{-5}$  m. The collision diameter of the molecule is 0.26 nm. Calculate (a) pressure of the gas, and (b) number of collisions per unit volume of the gas. [5]
- Q.2(a) What is Boyle temperature ( $T_B$ )? Derive the Boyle temperature ( $T_B$ ) from the expression of compressibility factor ( $Z$ ) of a van der Waals gas. [5]
- Q.2(b) Van der Waals constant ' $b$ ' for a certain gas is  $4.42 \times 10^{-2}$  litre/mole. What is the minimum distance of approach between the centres of two molecules? [5]
- Q.3(a) Show that the excessive pressure inside a spherical bubble is given by  $\Delta p = (P-p) = 2\gamma/r$ . Explain why the formation and maintenance of smaller bubbles will need greater values of excess pressure compared to the larger one. [5]
- Q.3(b) The viscosity of a liquid is  $0.05 \text{ N m}^{-2} \text{ s}$  and its density is  $0.97 \text{ g cm}^{-3}$  at 298 K. How long a given volume of the liquid will take to flow through a viscometer if the same volume of water takes 50 s? [Viscosity and density of water are  $0.00089 \text{ N m}^{-2} \text{ s}$  and  $1.0 \text{ g cm}^{-3}$  respectively] [5]
- Q.4(a) Describe the combination of symmetry elements required to describe the point symmetry in a crystal lattice. [5]
- Q.4(b) Derive Bragg's equation for diffraction of X rays by crystals. [5]
- Q.5(a) What is indicator constant and its significance? Explain why the titration of a weak acid with weak base is not carried out using an acid-base indicator. [5]
- Q.5(b) Calculate the pH value of 0.04 M solution of anilinium chloride. [ $K_b^\circ$  for aniline is  $4 \times 10^{-10}$ ] [5]

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