

CEMA(HN)-02

West Bengal State University
B.A./B.Sc./B.Com (Honours, Major, General) Examinations, 2015

PART - I
CHEMISTRY — HONOURS
Paper - II

Duration : 2 Hours]

[Full Marks : 50

The figures in the margin indicate full marks.

CEMAT-12-PA

Answer any *two* questions taking *one* from each Unit.

UNIT - I

1. a) The Maxwell's speed distribution is given as

$$P(c) = Ac^2 e^{-mc^2/(2kT)}$$

What does $P(c)$ mean ? Find the dimension of A .

Find $\left\langle \frac{1}{C} \right\rangle$ [Given : $\int_0^{\infty} x \exp(-\beta x^2) dx = \frac{1}{(2\beta)}$] 1 + 1 + 3

- b) What do you mean by 'collision diameter' ? Derive a relation between mean free path (λ) and collision diameter of a gas. How does λ depend on T and P ? 1 + 3 + 1

- c) Apply the equipartition principle to calculate $\gamma (\approx C_p/C_v)$ for a linear, tri-atomic, ideal gas. What is the limiting value of γ when the number of atoms in the molecules becomes very large? 2 + 1

2. a) Obtain an expression for the distribution of translational kinetic energy from Maxwell's distribution of speed. How does it differ if the gas is changed from Helium to Argon? 4 + 1

- b) Calculate the number of binary collision per c.c. of $N_2(g)$ per second, at 2 atm, 30°C . The bond length of the gas molecules is 1.87 \AA . 3

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- c) Two flasks *A* and *B* have equal volumes. *A* is maintained at 300 K and *B* at 600 K. *A* contains hydrogen gas and *B* has equal mass of methane gas. Assuming ideal behaviour for both the gases, calculate (i) the ratio of mean free path in two containers [The collision diameter of methane may be assumed to be twice as that of hydrogen], (ii) the ratio of coefficient of viscosity in two flasks. 5

UNIT - II

3. a) Explain the term 'contact angle' and indicate explicitly the factors which govern its value when a liquid comes in contact with a solid in a gaseous atmosphere. 4
- b) At room temperature iodine is solid, bromine is liquid, chlorine and fluorine are gaseous. Can you explain this on the basis of intermolecular attraction? 2
- c) Write the unit and dimension of van der Waals constants '*a*' and '*b*'. 1 + 1
- d) A steel ball of density 7.9 g/c.c. having diameter of 4 mm is dropped into a column of liquid. It takes 55 seconds to fall through a distance of 1 m. Calculate the viscosity of the liquid. [Given, the density of the liquid is 1.10 g/c.c.] 3
- e) What do you mean by 'Boyle temperature'? 1
4. a) Give the graphical representation of a van der Waals gas explaining the different regions and parts.
Explain critical temperature (T_c) with reference to the curve. 3 + 2
- b) What is 'virial equation of state'? What does the second virial coefficient (B_{2v}) signify? 2
- c) What are viscosity and viscosity coefficient? Explain the unit of the coefficient. 3
- d) Derive Laplace's equation for excess pressure inside a spherical bubble, suspended in air. 2

