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63/1 (SEM-1) CC2/CHMHC1026

2024

**CHEMISTRY**

Paper : CHMHC1026

**(Physical Chemistry-I)**

Full Marks : 60

Pass Marks : 24

Time : Three hours

**The figures in the margin indicate full marks for the questions.**

1. Choose the correct answer : **(any five)**

1×5=5

(i) For one mole of a gas, the kinetic energy is given by

(a)  $E = \frac{3}{2}RT$

(b)  $E = \frac{1}{2}RT$

(c)  $E = \frac{5}{2}RT$

(d)  $E = \frac{7}{2}RT$

- (ii) The collision frequency of a gas is —
- directly proportional to the square root of the absolute temperature
  - inversely proportional to the pressure of the gas
  - directly proportional to the absolute temperature
  - inversely proportional to the absolute temperature

- (iii) The average velocity of a gas is given by—

(a)  $\bar{c} = \sqrt{\frac{3RT}{\pi M}}$

(b)  $\bar{c} = \sqrt{\frac{8RT}{\pi M}}$

(c)  $\bar{c} = \sqrt{\frac{2RT}{\pi M}}$

(d)  $\bar{c} = \sqrt{\frac{RT}{\pi M}}$

- (iv) With the rise in temperature the surface tension of a liquid —
- increases
  - decreases
  - remains the same
  - first increases and then decreases

- (v) The shape of a tiny liquid drop is spherical due to —

- adsorption
- viscosity
- surface tension
- conductivity

- (vi) In an ionic crystal, a cation and an anion leave the lattice to cause two vacancies. The defect is called —

- Schottky defect
- Frenkel defect
- Interstitial defect
- None of the above

- (vii) The Miller indices of crystal plane which cut through the crystal axes at  $(6a, 3b, 3c)$  is :

- (1, 1, 1)
- (6, 3, 3)
- (1, 2, 2)
- (2, 1, 1)

(viii) Which liquid crystal is used as data displays in LCDs ?

- (a) Smectic
- (b) Nematic
- (c) Polymeric
- (d) Cholesteric

(ix) Ostwald's dilution law is applicable to—

- (a) weak electrolyte only
- (b) strong and weak electrolytes
- (c) strong and weak electrolytes
- (d) Non-electrolytes

(x) When  $NH_4Cl$  is added to  $NH_4OH$  solution, the dissociation of  $NH_4OH$  is reduced. It is due to—

- (a) common ion effect
- (b) hydrolysis
- (c) oxidation
- (d) reduction

2. Answer the following questions : **(any five)**  
2×5=10

- (a) Why the volume of gas molecules is taken as negligible as compared to total volume occupied by the gas ?
- (b) Write the mathematical form of Maxwell's distribution equation and mention the various terms in it.
- (c) Define mean free path. How does it depend on temperature ?
- (d) Show that SI unit of co-efficient of viscosity is ten times of its CGS unit.
- (e) Write *two* differences between amorphous and crystalline solid.
- (f) What are the effects of temperature and pressure on surface tension of a liquid ?
- (g) Calculate the pH of a  $1 \times 10^{-8} M HCl$  solution.

3. Answer the following questions : **(any five)**  
5×5=25

- (a) Based on the postulates of kinetic theory of gases, derive the equation  
$$PV = \frac{1}{2} mnc^2$$
 (The symbol signifies usual meaning).

(b) Define critical constants,  $P_c$ ,  $T_c$  and  $V_c$ . Derive expressions for them.

(c) What is viscosity? Describe *one* method of experimental determination of co-efficient of viscosity of a liquid.

1+4=5

(d) State and explain the law of corresponding state. Derive the expression—

$$\left(\pi + \frac{3}{\phi^2}\right)(3\phi - 1) = 8\theta$$

(The symbols signify usual meaning)

2+3=5

(e) What is H-bonding? What are the various types of it? Define each of them with examples.

1+2+2=5

(f) State Bragg's law and derive the equation  $2d \sin \theta = n\lambda$  (The symbols signify usual meaning).

X-ray of wavelength  $0.134 \text{ nm}$  gives a first order diffraction from the surface of a crystal when the value of  $\theta$  is  $10.5^\circ$ . Calculate the distance between the planes in the crystal parallel to the surface.

1+2+2=5

(g) What are surface active agents? Explain cleansing action of soap.

2+3=5

(h) Write short notes on the following :

$2\frac{1}{2} + 2\frac{1}{2} = 5$

(i) Schottky defect

(ii) Frenkel defect

(i) What is solubility product? Describe the applications of solubility product principle to inorganic salt analysis.

1+4=5

4. Answer the following questions : (**any two**)

$10 \times 2 = 20$

(a) What are real gases? What are the chief causes of deviations of real gases from ideal behaviour? Derive van der Waal's equation of state for  $n$  moles of real gases. Mention the limitations of van der Waal's equation.

1+2+5+2=10

(b) What is surface tension? What are its CGS and SI units? Mention the factors affecting surface tension. Describe an experimental method for determining surface tension.

1+2+2+5=10

- (c) What are liquid crystals ? Describe their different types. Write *five* applications of liquid crystals. 1+4+5=10
- (d) (i) Derive the Henderson-Hasselbalch equation for the calculation of pH of a buffer solution of weak acid and its salt. 4
- (ii) How much sodium acetate ( $M=82.03g\ mol^{-1}$ ) do you need to add in 400 ml of 1.00M acetic acid for a pH 3.5 buffer ? 2  
( $K_a=1.77\times 10^{-4}$ ).
- (iii) State and explain the common ion effect taking a suitable example. 4
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