TDC (CBCS) Odd Semester Exam., 2021
held in March, 2022

CHEMISTRY

(1st Semester)

Course No. : CHMHCC–102T

(States of Matter and Ionic Equilibrium)

Full Marks : 50
Pass Marks : 20

Time : 3 hours

The figures in the margin indicate full marks for the questions

SECTION—A

Answer *any* **ten** of the following as directed : 2×10=20

1. Write the two faulty postulates of kinetic theory of gases.

2. Calculate the various degrees of freedom for the following : 1×2=2

(a) H_2

(b) C_2H_2

3. Calculate the most probable velocity of nitrogen molecule at 30 °C.

4. What is Boyle's temperature? State the law of corresponding states. 1+1=2

5. Write the Berthelot equation and explain the terms involved.

6. Define compressibility factor in terms of volume.

7. How does intermolecular force affect vapour pressure and surface tension?

8. Explain the term 'radial distribution function'.

9. The boiling point of liquid increases with increase in pressure. Explain.

10. Frenkel defect is a combination of _____ defect and _____ defect. 1+1=2
(Fill in the blanks)

11. Explain the term 'centre of inversion' with a suitable example.

12. Calculate the (*hkl*) planes for the following intercepts along crystal axes :
(*a*) (2*a*, 3*b*, *c*)
(*b*) (2*a*, −3*b*, −3*c*)

13. Calculate the pH of a 10^{-9} *M* HCl solution.

14. Aqueous solution of NH_4NO_3 is acidic or alkaline. Justify.

15. Write the factors affecting the degree of ionization.

SECTION—B

Answer *any* **five** questions of the following : 6×5=30

16. (*a*) Derive the kinetic gas equation. 3
(*b*) Explain graphically how Maxwell's distribution of velocities vary with change in temperature. 2
(*c*) Explain the term 'mean free path'. 1

17. (*a*) Calculate the kinetic energy of (*i*) 4 gm and (*ii*) 4 mol of CH_4 at 27 °C. 1½+1½=3

(b) Calculate the temperature of the gas if it obeys van der Waals' equation from the following data : 3

A flask of 2·5 L contains 10 moles of a gas under 50 atmosphere. ($a = 5{\cdot}46$ atm L^2 mol^{-1} and $b = 0{\cdot}031$ L mol^{-1})

18. (a) Deduce the relationship between the critical constants and van der Waals' constants. 3

(b) Explain with a proper diagram of the Andrews isotherm of CO_2. 3

19. (a) Calculate the reduced pressure, reduced volume and reduced temperature of one mol of methane gas confined to a volume of 5 dm^3 under a pressure of 5 atm. Also calculate the temperature of the gas. The critical constants of methane are $V_c = 0{\cdot}0988$ dm^3 $mol\ L^{-1}$, $P_c = 54{\cdot}6$ atm, $T_c = 190{\cdot}2$ K. 3

(b) Show that for a van der Waals' gas, the Boyle temperature is $T_B = \frac{a}{R_b}$. 3

(Continued)

20. (a) Illustrate the phenomena of cleansing action of detergent with a suitable diagram. 3

(b) Describe the process of determination of viscosity of a liquid by Ostwald's viscometer. 3

21. (a) The time of flow of water through Ostwald viscometer is 1·48 minutes. For the same volume of a liquid of density 0·792 g/mL, it is 2·42 minutes. Find the viscosity of the liquid relative to that of water and also absolute viscosity at 20 °C. Density and viscosity of water at 20 °C are 0·995 g/mL and 10·02 millipoise respectively. 3

(b) Explain the variation of vapour pressure, surface tension and coefficient of viscosity with temperature. 3

22. (a) Mention the differences between symmetry element and symmetry operation. 2

(b) Explain the various non-Stoichiometric defects with a suitable example. 4

(Turn Over)

23. *(a)* Explain the following with examples : $1\frac{1}{2}\times2=3$

(i) *F*-centre

(ii) Plane of symmetry

(b) Write a short note on 'Bravais lattices'. 3

24. *(a)* Explain the factors affecting the degree of ionization. 2

(b) Deduce the Henderson's equation for a basic buffer. 2

(c) Explain the Ostwald's theory of indicator with reference to acid-base titration. 2

25. *(a)* Calculate the hydrolysis constant, degree of hydrolysis and H^+ ion concentration in 0·1 *N* NH_4Cl solution. [K_b for $NH_4OH = 1{\cdot}8\times10^{-5}$ and $K_w = 10^{-14}$]. 3

(b) Explain the following : $1\frac{1}{2}\times2=3$

(i) Common ion effect

(ii) Buffer capacity

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