TDC (CBCS) Odd Semester Exam., 2020
held in March, 2021

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

1. Answer any *ten* of the following questions : 2×10=20

(a) Write two postulates of kinetic molecular theory of gases.

(b) Calculate the various degrees of freedom for the following :

(i) CO_2

(ii) H_2O

(c) What is the law of equipartition of energy?

(d) What is the effect of temperature and pressure on the coefficient of viscosity?

(e) Write the Berthelot equation and explain the terms.

(f) What is compressibility factor? Name the gases which show positive deviations at all pressures.

(g) Write the van der Waals' constants a and b in terms of critical constants.

(h) Draw the PV issotherm curve for CO_2 molecule.

(i) What is surface tension of a liquid? How does surface tension of a liquid vary with temperature?

(j) Write in brief about the structure of liquid.

(k) Explain the term 'cybotactic group'.

(l) What is detergent? Give two examples.

(m) What is the difference between symmetry element and symmetry operation?

(n) Define liquid crystal. Give two examples.

(o) Write the Bragg's equation and explain the terms.

(p) Explain the law of constancy of interfacial angle.

(q) Aqueous solution of Na_2CO_3 is alkaline in nature. Explain.

(r) Define strong and weak electrolytes with suitable examples.

(s) Give reason for the following acid dissociation constant order for polyprotic acid :

$$K_{a_1} > K_{a_2} > K_{a_3}$$

(t) Define the following terms :

(i) Buffer capacity

(ii) Buffer range

SECTION—B

Answer *any* **five** questions

2. (a) Explain Maxwell-Boltzmann distribution law of molecular velocities with an appropriate graph. 2+1=3

(b) Calculate the mean free path of oxygen gas at 28 °C and 1 atm pressure. Collision diameter of the gas molecule, $\sigma = 3 \cdot 72$ Å. 3

3. (a) What is collision frequency? Write the mathematical expression and explain the terms involved. 2

(b) Write the factors affecting collision frequency. 2

(c) Calculate the total energy in joules associated with SO_2. 2

4. (a) One mole of CO_2 was found to occupy a volume of 1·32 L at 48 °C and at a pressure of 16·40 atmosphere. Calculate the pressure that would have been expected from *(i)* ideal gas equation and *(ii)* van der Waals' equation. 2

(b) Derive the relation $P_c V_c = \frac{3}{8} RT_c$. 2

(c) Explain the terms 'critical temperature' and 'critical pressure'. 2

5. Comment on the following statements : 2×3=6

(a) Molecules attract one another and causes a gas to deviate from ideal behaviour.

(b) Actual volume occupied by molecules is not negligible to cause a gas to deviate from ideal behaviour.

(c) The molecular attraction between the gas molecules is high at low temperature.

6. (a) Explain the mechanism of cleansing action of detergent. 3

(b) What is radial distribution function? 1

(c) Mention the different physical properties of a liquid. 2

7. (a) Describe the process of determination of surface tension of a liquid by stalagmometer. 3

(b) At 25 °C the surface tension of a liquid is 18·5 dynes/cm. The densities of the liquid and its vapours at the same temperature are 0·9256 gm/mL and 0·015 gm/mL. If the radius of the capillary tube is 0·012 cm, what would be the height of the liquid in the capillary, angle of contact being zero? 3

8. *(a)* Explain the following with example : 1½×2=3

(i) Axis of symmetry

(ii) Centre of inversion

(b) Mention the characteristic features of Schottky and Frenkel defects. 1½×2=3

9. *(a)* Define the following with examples : 2×2=4

(i) Glasses

(ii) Liquid crystal

(b) Deduce the Bragg's equation with reference to X-ray diffraction. 2

10. *(a)* Calculate the pH obtained by mixing equal volume of 0·015 *N* NH_4OH and 0·15 *N* NH_4NO_3 solution. (K_b for $NH_4OH = 1 \cdot 8 \times 10^{-5}$) 3

(b) Derive the expression for the hydrolysis constant, degree of hydrolysis and pH for hydrolysis of a salt of weak acid and strong base. 3

11. *(a)* The solubility product of magnesium hydroxide at 25 °C is $1 \cdot 4 \times 10^{-11}$. Calculate the solubility of magnesium hydroxide in g/L. 2

(Continued)

(b) Explain an acid-base titration curve between a strong acid versus strong base by pH metric titration with reference to *(i)* pH value against volume of base added and *(ii)* differential curve for the same. 2+2=4

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