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Reg. No. : .....

Name : .....

Fifth Semester B.Sc. Degree Examination, December 2022

First Degree Programme under CBCSS

CHEMISTRY

Core Course V

CH 1541 – PHYSICAL CHEMISTRY I

(2020 Admission)

Time : 3 Hours Max. Marks : 80

PART A

Answer **all** questions. Each question carries **1** mark.

1. Write expressions for the average translational kinetic energy
   (a) per mole and
   (b) per molecule of an ideal gas.
2. What is meant by compressibility factor?
3. Calculate the RMS velocity of oxygen molecules at 25°C.
4. Why are Frenkel defects not found in pure alkali metal halides?
5. Calculate the molality of a 12% (w/w) solution of H_2SO_4.
6. A 0.2 molal aqueous solution of a non-volatile solute boils at 100.104°C. Calculate the *ebullioscopic constant* of water.
7. How many Bravais lattices are permitted in orthorhombic system?
8. Which cubic cell is represented by the $d_{200} : d_{220} : d_{111} = 1 : 0,707 : 1.154$?
9. What is meant by a *reference electrode*? Give one example.
10. Give the *Debye-Huckel-Onsager* equation and explain the terms involved.

(10 × 1 = 10 Marks)

P.T.O.

SECTION B

Answer any **eight** questions. Each question carries **2** marks.

11. The vander Waal's constants for nitrogen are a = 1.38 atm dm^6/mol^2 and b = 0.0391 dm^3/mol. Find the critical constants.

12. State the Virial equation of state and the terms involved.

13. Under what conditions does a real gas approach ideal behaviour?

14. State the law of rationality of indices.

15. How is the interplanar distance d_{200} related to the unit cell edge 'a' for a *fcc* lattice?

16. What is meant by a *space lattice*?

17. Methanol and ethanol form a nearly ideal solution at 300 K. A solution is made by mixing 32 g of methanol and 23 g of ethanol. Calculate the partial pressures of its constituents and the total pressure of the solution at 300 K. Also calculate the mole fractions of the components in the vapor phase.

18. At a certain temperature, an aqueous solution of urea has the same molarity as an aqueous solution of glucose. Will their osmotic pressures be equal or different? Why? Their osmotic pressures will be the same; when such a pair of solutions are separated from each other, they would produce no osmotic flow.

19. What is meant by lowering of vapour pressure and relative lowering of vapour pressure?

20. KCl crystal is colourless. But on heating it in an atmosphere of potassium vapour, it become violet in colour. Account for this.

21. State and explain *Kohlrausch 's law*.

22. How may the conductivity of an intrinsic semiconductor be increased?

23. What type of point defect is produced when AgCl is doped with $CdCl_2$? How are such defects produced?

24. Write down the *Nernst equation* for the EMF of a cell.

25. What is a *calomel electrode*?

26. The resistance of 0.05 N NaCl solution taken in a conductivity cell is found to be 203 ohms at 18°C. The cell constant is found to be 0.9715 cm^{-1}. Calculate the equivalent conductance of the solution.

(8 × 2 = 16 Marks)

SECTION C

Answer **six** questions. Each question carries **4** marks.

27. How does collision frequency of a gas depend upon pressure and temperature?

28. How are the critical temperature and critical pressure of a gas determined?

29. Derive an expression relating the density of a known crystal and its unit cell edge-length.

30. Differentiate between *hexagonal close packing* and *cubic close packing*.

31. Explain the laws of osmotic pressure.

32. What is meant by reverse osmosis? Discuss its applications.

33. Calculate the freezing point of an aqueous solution of a non-volatile solute which boils at 373.13 K. For water, K_r =1.86 K kg/mol, K_b = 0.52 K kg/mol.

34. A compound is formed from the elements X and Y. The atoms of element X (as anions) form a ccp structure and those of element Y (as cations) occupy all the octahedral voids. Find the formula of the compound.

35. What are *smectic liquid crystals*? What are their structural characteristics?

36. An element occurs in the BCC structure with a cell edge of 275 *pm*. The density of the element is 7.0 g/cm^3. How many atoms of the element does 200 g of the element contain?

37. The EMF of the cell *with transference* : Ag/AgCl/HCl (mean ionic activity = 0.01751)/HCl (mean ionic activity = 0.009049)/AgCl/Ag is 0.02802 V. The corresponding cell without transference has an EMF of 0.01698 V. Calculate the

    (a) the *liquid junction potential*

    (b) the transport number of H^+.

38. Write the theory and advantages of conductometric titrations.

(6 × 4 = 24 Marks)

SECTION D

Answer any **two** questions. Each question carries **15** marks.

39. Discuss the deviations of real gases from Boyle's and Charle's law.

40. Derive the Bragg's law and give the significance of the equation.

41. (a) Discuss the moving boundary method for the measurement of transport number.

    (b) A solution of copper sulphate containing 100 g of the anhydrous salt in 1,000 g of the solution was electrolysed between copper electrodes. After electrolysis, 55 g of the anode solution was found to contain 5.75 g of the salt. During electrolysis, 0.0047 g equivalent of silver was found deposited in a silver coulometer connected in series. Calculate the transport number of cupric and sulphate ions. Equivalent mass of copper sulphate is 79.77.

42. (a) Explain what is meant by van't Hoff factor? How is it useful in the determination of degree of dissociation and degree of association of non-volatile solutes showing abnormal values of molar masses?

    (b) A solution of barium chloride (molar mass = 208.26 g/mol) containing 2.474 g/L has an osmotic pressure of 8.828×10^4 N/m^2 at 298 K. Calculate the apparent molar mass of barium chloride and its degree of dissociation at this concentration.

43. Describe the construction of quinhydrone electrode and glass electrode. How can you determine the pH of a solution using these electrodes?

44. Discuss the different kinds of *non-stoichiometric defects* found in crystals.

(2 × 15 = 30 Marks)

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