**ST. JOSEPH'S COLLEGE (AUTONOMOUS), BANGALORE - 27**

**B.Sc. CHEMISTRY - II SEMESTER**

**END-SEMESTER EXAMINATION - APRIL 2019**

**CH 218 - CHEMISTRY II**

Time: 2 1/2 hours Maximum marks: 70

**Note: This question paper has three parts. All parts are compulsory. .**

[R = 8.314 JK-1mol-1; h = 6.626 x 10 -34 Js; c = 3 x 108 ms-1]

**Part A**

Answer any **SIX** questions from the following. (2 x 6 = 12 marks)

1. State the third law of thermodynamics.

2. What are the differences between Helmholtz function and Gibbs function?

3. Give the mathematical expression of Born-Oppenheimer approximation.

4. What are freezing mixtures? Give an example.

5. Give the gross and quantum selection rule for vibrational spectroscopy.

6. Why are stokes' lines more intense than anti-stokes' lines?

7. What are azeotropes?

8. Mention any two uses of radioactive isotopes in the field of medicine.

**Part B**

Answer any **EIGHT** questions from the following. (6 x 8 = 48 marks)

9. a) Based on the concept of entropy, derive the expression for the efficiency of Carnot cycle.

b) Write any two limitations of the first law of thermodynamics. [4 + 2]

10. a) Derive Gibbs-Helmholtz equation starting from the relation dG = VdP - SdT for a constant pressure process.

b) Calculate the equilibrium constant for the reaction 1/2 N2(g) +3/2 H2(g)⇌NH3(g)

at 300K, given ΔGo = 16.65 kJ mol-1. [4 + 2]

11. a) The bond length of CO molecule is 1.13 x 10-10 m. Calculate the reduced mass and moment of inertia of the molecule. Given: atomic masses are 12C = 1.99 x 10-26 kg and 16O = 2.66 x 10-26 kg. b) Which of the following exhibit microwave spectra: H2, N2, HCl, CO. [4 + 2]

12) a) Give the pictorial representation of the fundamental vibrations of CO2 molecule and indicate the IR active modes.

b) The fundamental vibrational frequency of HCl is 2890 cm-1. Calculate the force constant of this molecule. Given: reduced mass = 1.626 x 10-27 kg; c = 3 x 108 ms-1. [4 + 2]

13. a)Explain (i) Bronsted -Lowry theory (ii) Lewis theory of acids and bases. NH3 is a base according to Bronsted-Lowry theory and also according to Lewis theory. Explain.

b) Give reasons: (i) A strong acid like HNO3 behaves as a base in liquid HF. (ii) NH4Cl is a strong acid and KNH2 is a strong base in liquid NH3. [4 + 2]

14. State HSAB (Hard and Soft Acids and Bases) principle. Discuss any two of its applications. [4 + 2]

15. a) Derive the rate expression for a second order reaction when both reactants are the same (a = b).

b) The rate constant for a second order reaction is 3.33 x 10-2 dm3 mol-1 s-1. If the initial concentration of the reactant is 0.05 mol dm-3, calculate its half life. [4 + 2]

16. a) Define (i) number-average molar mass and (ii) mass-average molar mass of a polymer.

b) A polymer sample is composed of equal number of species of molecular weights 105 g mol-1 and 106 g mol-1. Calculate number-average molar mass and mass-average molar mass. [4 + 2]

17. a) The van der Waal's constants for a gas are : a = 0.751 dm6 atm mol-2 and b = 0.0226 dm3 mol-1. Calculate the critical temperature and critical pressure of the gas, given R = 0.0821 dm3 atm K-1 mol-1. b) Define the terms : (i) collision number (ii) mean free path. [4 + 2]

18. Draw the vapour pressure - composition and boiling point - composition diagrams for solutions of type-1. Give an example. Discuss the fractional distillation of this liquid mixture. [4 + 2]

**Part C**

Answer any **TWO** questions from the following. (5 x 2 = 10 marks)

19. a) Compare the maximum efficiency of a reversible heat engine in which working substances are (i) water [boiling point = 100oC] (ii) Hg [boiling point = 375oC]. The heat sources are at their respective boiling points at 1 Nm-2 pressure. The temperature of the sink is 25oC in each case.

b) The thermal and residual entropy values of CO are different. Give reasons. [3 + 2]

20. a) With suitable explanation, arrange the following in their increasing order of stretching frequency of vibration: (i) C ≡ C (ii) C = C (iii) C ─ C

b) Among the molecules H ─ F, H ─ Cl, H ─ Br and H ─ I, identify the one with the lowest zero point energy and account for your choice. [3 + 2]

21. The following results were obtained for the saponification of ethyl acetate when equal concentrations of ester and alkali were taken. : CH3COOC2H5 + NaOH → CH3COOH + C2H5OH

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| --- | --- | --- | --- | --- | --- |
| time  (minutes) | 0 | 4.89 | 10.07 | 23.66 | ꝏ |
| Volume of acid used  (cm3) | 47.65 | 38.92 | 32.62 | 22.58 | 11.84 |

Show that the reaction is of second order.

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