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# 2503N1092

Candidate's Seat No :_____

**M.Sc. Sem.-3 Examination**

**501**

**Chemistry (P)**

**March-2025**

**Time : 2-30 Hours]** **[Max. Marks : 70**

**Instruction:** **Attempt all questions**

**Q-1** **Answer the following**

(a) Explain briefly most probable velocity and derive the equations for the $V_{ave}$ and Vrms. (7)

**OR**

(a) Derive the equation of Maxwell's law of distribution of molecular speeds. (7)

(b) Explain how the molecular velocity is calculated on the basis of temperature? Explain the effect of molecular weight of a gas on pressure at specific temperature. (7)

**OR**

(b) Derive the kinetic gas equation in terms of kinetic energy. Calculate the average kinetic energy of a $H_2$ molecule at 0 $^0$C. ($R = 8.314 \times 10^7$ erg $K^{-1}$ $mol^{-1}$) (7)

**Q-2** **Answer the following**

(a) What is the selection rule for vibrational transition in a simple harmonic oscillator in terms of quantum number? Explain briefly the principle of IR spectroscopy. (7)

**OR**

(a) Discuss the technique of FT-IR spectroscopy. (7)

(b) How the force constant is related to the bond order? Explain the selection rules for all transitions in an anharmonic oscillator. (7)

**OR**

(b) What is the Hooke's law of IR spectroscopy? Derive the equation for evaluating the bond length of a simple molecule using IR spectroscopy. (7)

**Q-3** **Answer the following**

(a) What is the basic principle of Raman spectroscopy? Discuss the quantum mechanical treatment of Raman effect. (7)

**OR**

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(a) Explain the classical theory of Raman scattering. (7)

(b) Discuss the selection rules and some applications of Raman spectroscopy. (7)

**OR**

(b) What are the characteristics of Raman lines? What is the fundamental requirement of substance to be Raman active? Explain pure rotational Raman spectra. (7)

**Q-4** **Answer the following**

(a) Discuss the band theory and some properties of superconductors. (7)

**OR**

(a) Explain the BCS theory superconductors. (7)

(b) Explain the mechanical and electrical properties of solid (7)

**OR**

(b) Discuss the ferro magnetism and anti ferromagnetism. (7)

**Q-5** **Answer the following (Any Seven-Two marks each)** **14**

(i) What is the effect of temperature on root mean square velocity?

(ii) Why the relative decrease in pressure is larger for a gas having high molecular weight at a particular temperature?

(iii) Calculate the probability density at 500 $ms^{-1}$ for the x-component of the velocity of $N_2$ at 21.0 $^0C$.

(iv) How is bond strength determined?

(v) Calculate the kinetic energy of two molecules of $N_2$ at 25 $^0C$.

(vi) How the conductivity of metal changes with temperature?

(vii) What is the effect of on ferromagnetic substances at Curie temperature?

(viii) What is the difference between stokes and anti-stoke in Raman spectroscopy?

(ix) Explain in brief Raman spectra.

(x) How does bond strength affect IR?