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**RAN-2103000206021004****T.Y.B.Sc. (Sem. VI) Examination October - 2023****Physics : Paper IX (PH-609) : Statistical Mechanics and Special  
Theory of Relativity****[ Total Marks: 50****सूचना : / Instructions**

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नीचे दशविवेक निशानीवाणी विगतो उत्तरवली पर अवश्य लपववी.

Fill up strictly the details of signs on your answer book

Name of the Examination:

T.Y.B.Sc. (Sem. VI)

Name of the Subject :

Physics : Paper IX (PH-609) : Statistical Mechanics and  
Special Theory of Relativity

Subject Code No.: 2103000206021004

Seat No.:

Student's Signature

- (2) Draw neat diagrams wherever necessary.  
(3) Symbols used in the paper have their usual meaning.  
(4) Question 1 is compulsory and figures to the right indicate full marks of the question.

**Q-1 Answer the following questions in brief.****[10]**

- 1) Explain the degeneration of gases.
- 2) Define the thermodynamic probability.
- 3) What do you mean by partition function?
- 4) What is the value of  $C_v$  of hydrogen gas at room temperature?
- 5) What do you mean by chemical potential?
- 6) Give the transformation equations for the component of force.
- 7) Give the Ehrenfest explanation of variation of sp. Heat verses temperature of Hydrogen atom.
- 8) Write a four or five sentences on mass in relativity.
- 9) Explain how the kinetic Energy varies with velocity.
- 10) What is the difference between kinematics and dynamics?

**Answer any one question:** [07]

Q-2 (a) Derive the Bose Einstein distribution law.

Q-2 (a) Derive the expression for beta.

**Answer any one question:** [03]

Q-2 (b) The system consisting of two particles which can exist in three different energy state. Calculate the number of ways in which these particles can be distributed in a given state for Fermi- Dirac statistics.

Q-2 (b) For a gaseous molecule, the wave number is  $540 \text{ cm}^{-1}$ . Calculate the relative probabilities of first two vibrational mode at  $T= 1000\text{K}$ .

**Answer any one question:** [07]

Q-3 (a) Derive the equation of state of an ideal gas.

Q-3 (a) Why the laser action is more difficult at higher temperature? Explain.

**Answer any one question:** [03]

Q-3 (b) Derive the expression  $S=Nk_B \ln z + \beta k_B U$ .

Q-3 (b) Calculate the average energy of the molecule of an ideal gas at  $300\text{K}$ .

**Answer any one question:** [10]

Q-4 (1) Derive the expression  $E= C \sqrt{P^2 + M_0^2 C^2}$  [07]

(2) Explain longitudinal and transverse mass. [03]

Q-4 Explain in detail why the redefining of momentum in relativity is required.

**Answer any one question:** [10]

Q-5 'Whether an electromagnetic field is purely magnetic or purely electric, or electric and magnetic, depends on the inertial frame in which the sources are observed' justified the statement in detail.

Q-5 'The component of B parallel to relative velocity of the two frame is unchanged, Whereas the component of B perpendicular to the relative velocity transform to mixed electric and magnetic field' justified the statement in detail.