RAN-2103000206021004

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T. Y. B. Sc. (Sem. - VI) Examination April - 2023

Physics : Paper - IX (PH-609)

Statistical Mechanics and Special Theory of Relativity (New)

[Total Marks: 50

સૂચના : / Instructions

(1) **નીચે દર્શાવેલ ☛ નિશાનીવાળી વિગતો ઉત્તરવહી પર અવશ્ય લખવી.**
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 (New)**

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) What is the value of C_v of hydrogen gas at room temperature?

2) Define the thermodynamic probability.

3) What do you mean by partition function?

4) Why the fermions and bosons behave as classical particles at high 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 questions: **[07]**

Q. 2. (a) Derive the Fermi Dirac distribution law.

Q. 2. (a) Derive the expression for thermodynamic probability of N-distinguishable particle for a classical statistics.

Answer any one questions: **[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 Bose-Einstein statistics.

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

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

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

Q. 3. (a) Explain the terms spontaneous emission ,stimulated emission and absorption.

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

Q. 3. (b) Derive the equation of Helmholtz free energy in term of partition function.

Q. 3. (b) Derive the expression $S = Nk_B lnz + \beta k_b U$.

Answer any one questions:

Q. 4. Explain in detail why the redefining of momentum in relativity is required. **[10]**

Q. 4. (1) Prove that in relativity acceleration is not parallel to applied force. **[5]**

(2) Explain longitudinal and transverse mass. **[5]**

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

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

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.

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