RAN-2103000205021004

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T. Y. B. Sc. (Sem. - V) Examination March - 2023

Physics : Paper - IX (PH - 509)

Statistical Mechanics and Special Theory of Relativity (New Course)

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. - V)**

Name of the Subject :

☛ **Physics : Paper - IX (PH - 509) Statistical Mechanics and Special Theory of Relativity (New Course)**

Subject Code No.: **2103000205021004**

Seat No.:

Student's Signature

Q-1 Each question carries one mark only. [10]

(1) Give the statement of Stefan's law.

(2) What do you mean by phonon ?

(3) The dimension of a phase space for a proton moving inside nucleus is _____.

(4) What do you mean by time average ?

(5) What is the difference between kinetic theory and thermodynamics?

(6) The stone at rest falls freely the trajectory of a phase point is _____.

(7) In a Michelson – Morley experiment if we move one mirror by a distance $\lambda/2$ which corresponds to path difference of _____.

(8) If the value of $(1-\beta^2)^{1/2} = 0.995$ than velocity v = _____.

(9) Define none inertial reference frame?

(10) A beam of light moves along right with speed c. If the earth also moves along right with speed v then the speed of beam of light relative to earth is _____.

Q-2 (a) **Attempt any one.** **[07]**

(1) Prove that λT = constant, for black body radiation.

(2) Derive the Planck's law for black body radiation.

Q-2 (b) **Attempt any one.** **[03]**

(1) Derive the Stefan's law from Planck's law.

(2) A spherical blackbody of radius 4 cm is kept at a temperature of 227K. Calculate the power radiated.

Q-3 (a) **Attempt any one.** **[07]**

(1) Deduce the relation $S = K_b 1n\Omega$.

(2) Explain the concept of phase space and prove that the number of quantum states included in any interval of any of the co-ordinate is directly proportional of the length of the interval.

Q-3 (b) **Attempt any one.** **[03]**

(1) Write a short note on macroscopic state and microscopic state.

(2) Suppose you flip ten thousands identical coins and find that two of them end up standing on edge. If you flip one more such coin, what is the percent likelihood that will end up standing on its edge?

Q-4 (a) **Attempt any one.** **[07]**

(1) Describe the Michelson Morley experiment. Derive the expression for giving the fringe-shift expected. How does the special theory of relativity explain the unexpected result of Michelson Morley experiment?

(2) Derive Galilean transformation and show that Newton's law of motion is invariant under Galilean transformation.

Q-4 (b) **Attempt any one.** **[03]**

(l) Write a short note on Steller aberration.

(2) When the movable mirror of a Michelson Interferometer is shifted through 0.0589 mm, 200 fringes cross the field. What is the wavelength of the light?

Q-5 (a) **Attempt any one.** **[07]**

(1) Show that the addition of the velocity to the velocity of light gives the velocity of light.

(2) Derive the Lorentz transformation equation.

Q-5 (b) **Attempt any one.** **[03]**

(1) State and explain the basic postulate of special theory of relativity.

(2) The length of the spaceship is measured to be exactly the half of its proper length. What is the speed of the spaceship relative to observer on earth?

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