



RAN - 2103000205021004

RAN-2103000205021004**T.Y.B.Sc. (Sem.-V) Examination November - 2023****Physics : Paper - IX (PH509)****Statistical Mechanics and Special Theory of Relativity****સૂચના : / Instructions**

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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 (PH509) Statistical mechanics and special theory of relativity

Subject Code No.: 2103000205021004

Seat No.:

Student's Signature

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

1. What is the dimension of phase space for a two particles which are moving in randomly?
2. What do you mean by adiabatic process?
3. How many ways, 'n' distinguishable particles can be distributed in two identical compartment?
4. The energy density is a function of. (entropy, temperature)
5. What is the difference between kinetic theory and thermodynamics?
6. Give the statement of Newton's law of cooling.
7. How can you obtain the inverse Lorentz transformation?
8. If the value of $(1-\beta^2)^{1/2} = 0.995$ than velocity $v =$ _____
9. In a Michelson - Morley experiment if we move one mirror by a distance $\lambda/2$ which corresponds to path difference of _____
10. Why should we choose the electromagnetic signal to synchronize the clock.

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

1. State and prove Stefan's law.
2. Derive the Rayleigh- Jeans formula for the distribution of energy in black body radiation.

- Q-2 (b) Attempt any one.** [03]
1. Discuss the postulates given by Plank for the explanation of black body radiation.
 2. A spherical blackbody of radius 4 cm is kept at a temperature of 227 degree Celsius. Calculate the wavelength at which maximum energy is radiated.
Given $\sigma = 5.672 \times 10^{-8} \text{Jm}^{-2}\text{K}^{-4}\text{S}^{-1}$.
- Q-3 (a) Attempt any one.** [07]
1. 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 to the length of the interval.
 2. Deduce the wave function equation and energy eigen equation for a free particle in a one dimensional box and using it explain how the electron between the lattice point can be described.
- Q-3 (b) Attempt any one.** [03]
1. Write a short note on statistical interpretation on entropy.
 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 per cent likelihood that will end up standing on its edge?
- Q-4 (a) Attempt any one.** [07]
1. Describe the Michelson Morley experiment. Why was the experiment performed?
 2. Describe the importance of reference frame and prove that for a Galilean transformation Newton's law of motion is invariant.
- Q-4 (b) Attempt any one.** [03]
1. Lorentz - Fitzgerald contraction hypothesis.
 2. A passenger walks forward along the aisle of a train at a speed of 2.2km/hr as the train moves along a straight track at a constant speed of 57.5km/hr with respect to the ground. What is the passenger speed with respect to ground?
- Q-5 (a) Attempt any one.** [07]
1. Derive the Lorentz transformation equation.
 2. Using Lorentz transformation equations derive the formula for relativistic addition of velocities.

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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