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B.Sc. (Part-III) Back-Paper

Examination, 2021

PHYSICS

First Paper

(Relativity and Statistical Physics)

Time : 1½ Hours] *[Maximum Marks : 75*

Note : Attempt questions from **all** sections as per instructions.

Section - A

(Very Short Answer Type Questions)

Note : Attempt **all** parts of this question. **All** parts of this question must be attempted simultaneously. Give answer of each part in about 40 words. 10×2=20

(i) What are inertial and non-inertial frames?

(ii) Discuss the concept of simultaneity.

P.T.O.

(iii) Write down Galilean transformation equations. What is Galilean invariance.

(iv) State and explain the principle of equal a priori probability.

(v) What are microstates and macrostates in phase space system.

(vi) What are the main differences between classical and quantum statistics?

(vii) State the Liouville's theorem.

(viii) What do you understand by the term partition function?

(ix) Which of the following particles are fermions and which are bosons-electron, proton, neutron, photon, phonon, α particle.

(x) What is the ratio of root mean square (rms) velocity of H_2 and N_2 at the same temperature?.

Section - B

(Short Answer Type Questions)

Note : Attempt any **three** questions. Give answer of each question in about 150 words.

3×12=36

2. Derive the formula for the variation of mass of a particle with the velocity. Hence show that no-particle can move with a velocity greater than the velocity of light in an inertial frame.

3. Deduce Einstein's mass-energy relation $E=mc^2$ and discuss it.

4. Obtain the relativistic formula for the addition of velocities. Hence show that the velocity of light is an absolute constant, independent of the frame of reference.

5. A rocketship is 100m long on the ground. When it is in the flight, its length is 99 meters to an observe on the ground. What is its speed? (Velocity of light $C=3\times10^8$ m/sec.).

6. (a) What are the constraints of a system in distribution of molecules in phase space?
   (b) What do you mean by accessible and inaccessible microstates?

7. What is an ensemble? What do you mean by ensemble average properties of a system?

Section - C

(Long Answer Type Questions)

Note : Attempt any **one** question. Give answer of each question in about 400 words.

1×19=19

8. Describe the Michelson-Morley Experiment and explain the physical significance of negative results.

9. State the fundamental postulates of Einstein's special theory of relativity and deduce from them the Lorentz-transformation equations.

10. Define Thermodynamic probability. Find general expression for Thermodynamic probability.

11. Deduce Boltzmann's entropy-probability relation $S=k \log_e \Omega(E)$, where S is entropy, $\Omega(E)$ is the microstates in the energy interval between E and $E+\delta E$ and k is a constant.