Unit-I / FkeâeF-I 11

2. (a) Show that the Lorentz transformation is symmetric between two inertial frames.

oMeeFS ekeâ oe pe[lJeeÙe øeâcee keâ ceOÙe ueejvpe ™heevlejCe meceecele nelee n~

(b) What is the speed at which the length of a rod becomes 3/5th of its original length?

ekeâme Jeie hej Skeâ Ú[keâe uecyeeF Gmekeâe ceue uecyeeF keâe 3/5 ieve ne peeSiee?

3. (a) On the basis of Lorentz transformation, derive expressions for lenght contraction and time dilation.

ueejvpe ™heevlejCe keâ DeeOeej hej oOÙe mekeâeÛe SJe keâeue Jeeæ me$ee keâe JÙelheVe keâeepeS~

(b) What is the difference in the momentum of proton and photon both having 10 GeV energy?

Øeeševe Je heâeševe ØelÙekeâ keâe Tpee 10 GeV n~ Fvekeâ meJeie ce keÙee Delej neiee?

A (Printed Pages 8)

S-607

B.Sc.(Part-III) Examination, 2015

(Regular & Exempted)

PHYSICS

First Paper

(Elements of Classical Relativistic & Statistical Mechanics)

Time Allowed : Three Hours] [Maximum Marks : 75

Note : Attempt Questions No.1 (30 marks), Which is compulsory and one question from each Units I, II, III and IV. Answer Five questions in all.

ØeMve me.1 (30 Dekeâ) DeeveJeeÙe n leLee Skeâ-Skeâ ØeMve ØelÙekeâ FkeâeF I, II, III SJe IV me keâeepeS~ keâue heeÛe ØeMvee keâ Gòej oeepeS~

Answer the following : $3 \times 10 = 30$

evecveeueeKele keâ Gòej oeepeS :

1. (i) Show that at low velocities, the Lorentz transformation reduces to Galilean transformation.

oMeeFS ekeâ Deuhe Jeiee hej ueejvpe ™heevlejCe ieueeeueÙee keâ ™heevlejCe keâ mece™he nele n~

(ii) What is the speed of a particle when its kinetic energy is equal to five times its rest mass energy?

peye ekeâmee keâCe keâe ieelepe Tpee Gmekeâ eJe ece õJÙeceeve Tpee keâ heeÛe ieve keâ yejeyej n leye Gme keâCe keâe Jeie keÙee neiee?

(iii) Give examples of holonomic, nonholonomic, rheonomous and scleronomous constraints.

neueæveeeceekeâ, Deveneueeeveeeceekeâ, ejÙeeveeceme Je mkeue jeveeceme JÙeJejeOee keâ GoenjCe oeepeS~

(iv) Distinguish between the configuration space and phase space of a system of particles.

keâCee keâ evekeâeÙe keâ eJevÙeeme DeekeâeMe leLee keâuee DeekeâeMe ce eJeYeo keâeepeS~

(v) What is brachistochrone problem?

yeekeâmŠe›eâeve Øeeyeuece keÙee n?

(vi) Write down the Hamilton's equations of motion for a three dimensional oscillator.

Skeâ e$e-eJeceeÙe oeuekeâ keâ eueS neceuŠve keâ ieele mecæekeâjCee keâe eueeKeS~

(vii) What are macro and micro states?

mLeue Je me#ce DeJemLeeS keÙee n?

(viii) What are the main features of microcanonical ensemble?

me#ceeJeenle meceoeÙe keâ ceKÙe DeeYeue#eCe keÙee n?

(ix) Show that in the canonical ensemble, the fluctuation in energy is negligible.

oMeeFS ekeâ eJeenle meceoeÙe ce Tpee ce DeemLejlee veieCÙe n~

(x) What is the Fermi energy at T=O for electrons in copper (electron density in copper $=8.4\times10^{28}, m^{-3}$)?

keâehej ce T=O hej FuekeŠeve keâe heâcee Tpee keÙee neiee? (keâehej ce FuekeŠeve keâe leveJe $=8.4\times10^{28}, m^{-3}$)?

oMeeFS ekeâ GÛÛe leehe hej heâcee-e[jekeâ Je yeeme-DeeFvmeševe meeKÙekeâe oevee cekemeJeue–yeeušpeceve meeKÙekeâe keâ mece™he nelee n~

(b) How many photons are present in a room of 100 m^3 at a temperature of 30^0C.

30^0C leehe hej 100 m^3 keâ keâcej ce ekeâleve heâeševe GheemLele neie?

Unit-II / FkeâeF-II 11

4. (a) On the basis of Lagrange's equation of motion, find out the equation of motion of a bead sliding on a uniformly rotating wire in a free space.

ue«eepee ieele meceekeâjCe keâ DeeOeej hej ceòeâ DeekeâeMe ce Skeâ meceeve leCeve keâjle nS leej hej mejkeâle nS cevekeâe keâ ieele meceekeâjCe keâe Øeehle keâeepeS~

(b) Obtain the equation of the curve which produces minimum surface of revolution.

leCeve keâe vÙevelece melen Glheve keâjve Jeeue â keâe meceekeâjCe Øeehle keâeepeS~

5. (a) Discuss the motion of a double pendulum moving in a plane.

meceleue ce ieele keâjle nS Skeâ oeJekeâ ueeuekeâ keâe ieele keâe eJeJeÛevee keâeepeS~

(b) Solve the Hamiltonian's equations of motion for a rigid rotating body.

le

meceekeâjCee keâe nue keâeepeS~

Unit-III / FkeâeF-III 11

6. (a) Show that the conservation of angular momentum is equivalent to constancy of areal velocity.

oMeeFS ekeâ keâeCeeÙe meJeie keâe mej#eCe #e$eeÙe Jeie keâe emLejlee keâ mecelеuÙe n~

(b) State and explain the ergodic hypothesis.

Sieee[keâ heejkeâuhevee keâe keâLeve oeepeS SJe JÙeeKÙee keâeepeS~

7. (a) Obtain first integrals of motion for a conservative central force acting on a single particle of mass m.

õJÙeceeve m keâ Skeâ keâCe keâe mej#ee keâvõeÙe yeue keâ Devleiele ieele keâ eueS ØeLece meceekeâue Øeehle keâeepeS~

(b) Establish the condition, under which the density distribution function is time independent.

Gme DeJemLee keâe mLeeehele keâeepeS epemece levelJe eJeleјCe heâueve meceÙe me mJele$e nelee n~

Unit-IV / FkeâeF-IV 12

8. (a) State and prove law of equipartition of energy.

Tpee keâ mece eJeYeepeve keâ eveÙece keâe keâLeve oeepeÙe SJe Fme emeæ keâeepeS~

(b) Using Bose-Einstein statistics, derive Stefan Boltzmann law.

yeeme-DeeFvmeševe meeKÙekeâe keâe ØeÙeeie keâjle nS mšeheâve-yeeušpeceve eveÙece JÙelheVe keâeepeS~

9. (a) Show that at high temperature both Fermi-dirac and Bose-Einstein statistics reduce to Maxwell-Boltzmann statistics.