



VI Semester B.Sc. Examination, May/June 2013
(Semester Scheme)

PHYSICS – VIII

Relativity, Astrophysics and Nuclear Physics

Time : 3 Hours

Max. Marks : 60

- Instructions :** 1) Part – A, answer **any five** of the following (5×6=30).
2) Part – B, answer **any four** of the following (4×5=20).
3) Part – C, answer **any five** of the following (2×5=10).

PART – A

Answer **any five** of the following : (5×6=30)

1. a) What is proper time ? Write an expression for proper time in terms of relativistic time and velocities.
b) Derive Einstein's mass-energy relation. (2+4)
2. Describe with a diagram the Michelson-Morley experiment and explain the physical significance of negative results. Derive an expression for fringe shift. 6
3. State and prove Virial theorem. 6
4. a) What is photon diffusion time ?
b) Derive an expression for gravitational potential energy of a star. (1+5)
5. a) What are the probable end stages in the life time of a star ?
b) Show that luminosity of a star is directly proportional to cube of its mass. (2+4)
6. Assuming the relation between impact parameter and scattering angle derive Rutherford's formula. 6
7. a) Write the conditions for alpha decay.
b) State Geiger-Nuttal law.
c) Write a note on Pauli's neutrino hypothesis. (2+1+3)
8. Explain with a diagram, the principle, construction and working of a cyclotron. Obtain an expression for the maximum energy of a particle coming out of a cyclotron. 6

P.T.O.



PART – B

Answer **any four** of the following :

(4×5=20)

9. The star nearest to the earth is at a distance of 4.32 light years. If a space traveller were to make a trip from the earth to the star at a uniform speed of $0.9c$ how long would it take according to an earth clock ? How long would it take according to the space traveller's clock ?
10. An electron at rest mass 9.1×10^{-31} kg is moving with a speed of $0.99c$. What is total energy ? Find the ratio of Newtonian kinetic energy to the relativistic energy.
11. If the apparent and absolute magnitudes of the star white dwarf-sirius B are +8.6 and +11.4 respectively, calculate its distance from the earth.
12. The luminosity of a star is 10^4 times that of the sun and its surface temperature is 3000 K. How much larger is the radius of the star compared to that of the sun ?
13. Find the kinetic energy of the alpha particle emitted in the alpha-decay of Ra^{226} . Given $m(\text{Ra}^{226}) = 226.0254064$ u, $m(\text{Rn}^{222}) = 222.017574$ u.
14. The Q value of the $\text{Na}^{23}(n, \alpha)\text{F}^{20}$ reaction is – 6.4 MEV. Determine the threshold energy of the neutrons for this reaction. Given $m_n = 1.008665$ u, $m_\alpha = 4.001506$ u.

PART – C

15. Answer **any five** of the following :

(5×2=10)

- a) A moving clock ticks more slowly than a clock at rest. Justify.
- b) Can massless particle exist ? Comment.
- c) Can a material particle move with a velocity equal to c ? Explain.
- d) Is apparent magnitude of a star smaller or larger than its absolute magnitude if it is closer than 10 par secs ? Explain.
- e) Greater the mass of a star, shorter its lifetime. Justify.
- f) Why is Aston's mass spectrograph called a velocity focussing mass spectrograph ?
- g) Why is quenching necessary in a GM counter ? Explain.
- h) Not all nuclei are radioactive. Comment.