

LOYOLA COLLEGE (AUTONOMOUS), CHENNAI – 600 034

M.Sc. DEGREE EXAMINATION – PHYSICS

FOURTH SEMESTER – APRIL 2010

PH 4808 / 4804 - NUCLEAR PHYSICS

Date & Time: 20/04/2010 / 9:00 - 12:00 Dept. No.

Max. : 100 Marks

PART A

Answer all questions:

(10x2=20)

1. Define nuclear magneton.
2. Calculate the mass number of the nucleus whose radius is $3.5F(r_0=1.2F)$
3. What information do we get from the electric Quadrupole moment?
4. What are the two major competing forces in the liquid drop model?
5. Calculate the angular momentum and parity of C^{11} and O^{17}
6. What is level width of resonance? How is it connected with lifetime of the nucleus?
7. With strong evidence, explain why electrons do not exist in the nucleus.
8. When F^{19} is bombarded with protons a (p,n) reaction with subsequent alpha emission occurs. Calculate the excitation energy of the compound nucleus, that corresponds to the resonance with a proton energy of 4.72 MeV
9. Classify the following reactions as allowed (or) forbidden, under the conservation of strangeness, conservation of baryon number and conservation of charge.
$$\pi + n \rightarrow \Lambda^0 + K^+ \quad \text{and} \quad \pi^- + p \rightarrow \Lambda^0 + \pi^0$$
10. What are leptons? Name any two leptons and their antiparticles?

PART B

Answer any **FOUR** questions:

(4x7.5=30)

11. Discuss the meson theory of nuclear forces.
12. What are magic numbers? How does the shell model explain them?
13. What energy must be imparted to an alpha particle to force it into the nucleus of Bismuth? What energy will be required to obtain proton penetration in to the same radius?
14. Outline Gamow's theory of alpha decay.
15. Give a detailed account on conservation laws which govern the elementary particle decay reactions with suitable examples.

PART C

Answer any **FOUR** Questions

(4x12.5=50)

16. Discuss the neutron-proton scattering cross-section at low energies and obtain an expression for total scattering cross section for $l=0$.
17. Explain the theory of nuclear fission on the basis of liquid drop model and derive the condition of spontaneous fission.
18. Obtain Breit-wigner single level formula ($l=0$) and hence discuss the absorption cross section.
19. Explain Fermi theory of β -decay and deduce selection rule for β -transitions.
20. What are quarks? Give the quark model for mesons and baryons.
