2018

Time : 3 hours

Full Marks : 80

Answer from **both** the Sections as per directed

The figures in the right-hand margin indicate marks

Candidates are required to answer in their own words as far as practicable

(BASIC NUCLEAR PHYSICS)

SECTION – A

1. Answer any *four* of the following :   4 × 4

   (a) Write the ground state properties of the deuteron. How these properties suggest that the two nucleon interaction has a tensor component ?

   (b) Define the mass defect and binding energy of nucleous. Discuss the binding energy per nucleon curve.

(c) Define scattering length and discuss its physical significance.

(d) Write short note on rotational model of nucleus.

(e) Define the magic numbers. Explain how shell model of the nucleus reproduces the magic members.

(f) Estimate the Fermi energy of neutron and proton in ^{238}U nucleus. The nuclear matter density can be taken as 2×10^{44} nuclei/m^3.

Or

2. Answer *all* questions : 2 × 8

(a) Show that the nuclear density is same for all the nuclei.

(b) A deuteron potential well depth is 35 MeV and its radius is 2 Fermi. Find the kinetic energy of the nucleus.

(c) Define the scattering cross section.

(d) Write the characteristic properties of nuclear forces.

(e) What are the essential features of liquid drop and shell model of nucleus ?

(f) Using shell model, find out the spin and partities of ground state of ^{17}O and ^{41}Ca.

(g) Explain the fusion reactions.

(h) Define the compound nuclear reactions.

SECTION – B

Answer all questions : 16 × 4

3. (a) Discuss the quantum mechanical theory of deuteron wave functions. Obtain the expression for nuclear potential well depth.

Or

(b) Explain electric quadrupole moment and magnetic moment of nuclei. Establish the relation for quadrupole moment of deuteron.

4. (a) Explain the effective range theory for n-p scattering. Using this theory show that nuclear forces are short range in nature.

Or

(b) Discuss the meson theory of nuclear force and find the expression for Yukawa potential.

5. (a) Define resonance scattering and potential scattering. Derive the Breit-Wigner one level formula for resonance scattering.

Or

(b) What do you understand from spontaneous fission ? Using liquid drop model explain the fission process.

6. (a) Define the single particle model of nucleus. Describe the role of spin-orbit interaction in the shell model. What problem was solved

by the inclusion of spin-orbit interaction into the shell model of nucleus, and how ?

Or

(b) What are the Schmidt line ? Find out the magnetic moment of even N- odd Z nuclei.

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