

2015

(6th Semester)

PHYSICS

TENTH PAPER

(Nuclear Physics—II)

Full Marks : 75

Time : 3 hours

(PART : B—DESCRIPTIVE)

(Marks : 50)

*The figures in the margin indicate full marks
for the questions*

1. (a) Explain the terms 'mass defect' and 'binding energy' of a nucleus. 2
- (b) Describe graphically the variation of binding energy per nucleon as a function of mass number of nuclei. From this curve, explain the energy release in nuclear fission and fusion reactions. 3+2=5
- (c) Calculate the binding energy per nucleon for α -particle, given masses of proton $m_p = 1.007276$ amu, neutron $m_n = 1.008665$ amu and $m_\alpha = 4.001506$ amu. [1 amu = 931 MeV] 3

Or

Establish the semiempirical mass formula and mention the significance of various terms in it.

3+7=10

2. (a) Define 'decay constant' and 'half-life' of a radioactive substance and deduce a relation between them. 2+3=5

- (b) What is the cause of alpha decay? State and explain Geiger-Nuttall law in alpha decay. 2+3=5

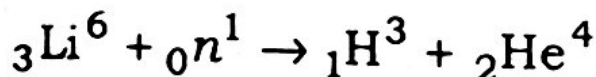
Or

- (a) What are different types of β -decay? Explain each with representative reactions. 6

- (b) Explain the process of γ -emission and nuclear isomerism. 4

3. (a) Derive an expression of Q-value of a nuclear reaction and hence explain exoergic and endoergic reactions. 6+2=8

- (b) Find the Q-value of the following reaction : 2



Given masses (in amu) of
 ${}_3\text{Li}^6 = 6.015123$, ${}_0n^1 = 1.008665$,
 ${}_1\text{H}^3 = 3.016029$ and ${}_2\text{He}^4 = 4.002603$.

Or

- (a) Discuss Bohr-Wheeler theory of nuclear fission. 6
- (b) Explain nuclear fusion as the source of stellar energy. 4

4. Describe the construction and working principle of a cyclotron. Obtain the expression for maximum kinetic energy obtained from it. 6+4=10

Or

Describe the construction and working of a Geiger-Muller counter. What do you mean by 'counter efficiency' and 'dead time' of a GM counter? 8+2=10

5. (a) Discuss (i) latitude effect, (ii) altitude effect and (iii) east-west effect in cosmic rays. 3+3+3=9
- (b) Write down the names of 6 quarks. 1

Or

- (a) Distinguish between primary and secondary cosmic rays. 3
- (b) What do you mean by baryon number (B), hypercharge (Y) and strangeness (S) of elementary particles? What is the relation among them? 7

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2015

(6th Semester)

PHYSICS

TENTH PAPER

(Nuclear Physics—II)

(PART : A—OBJECTIVE)

(Marks : 25)

The figures in the margin indicate full marks for the questions

Answer all questions

SECTION—A

(Marks : 10)

Put a Tick (✓) mark against the correct answer in the
brackets provided : 1×10=10

1. Nuclei having equal number of neutrons are called

(a) isotopes ()

(b) isobars ()

(c) isotones ()

(d) isomers ()

2. The density of a nucleus is of the order of

(a) 10^{16} kg / m^3 ()

(b) 10^{17} kg / m^3 ()

(c) 10^{18} kg / m^3 ()

(d) 10^{19} kg / m^3 ()

3. As a result of radioactive decay, a ${}_{92}\text{U}^{238}$ nucleus is changed into ${}_{91}\text{Pa}^{234}$ nucleus. The particles emitted are

(a) one α and one β^- particles ()

(b) one α and two β^- particles ()

(c) two β^- particles ()

(d) two α particles ()

4. Which of the following rays are not affected by electric or magnetic fields?

(a) Alpha rays ()

(b) Beta rays ()

(c) Gamma rays ()

(d) Cathode rays ()

5. The high stability of magic number nuclei can be explained by

- (a) liquid-drop model ()
- (b) shell model ()
- (c) collective model ()
- (d) alpha particle model ()

6. Threshold energy is applicable

- (a) only for endoergic reactions ()
- (b) only for exoergic reactions ()
- (c) for all reactions ()
- (d) only for endothermic reactions ()

7. In a linear accelerator, the successive tubes have lengths proportional to

- (a) $1 : 2 : 3 : 4$ ()
- (b) $1 : \sqrt{2} : \sqrt{3} : \sqrt{4}$ ()
- (c) $1 : 4 : 9 : 16$ ()
- (d) $1 : 1 : 1 : 1$ ()

8. The machine in which the frequency of the electric field is kept constant and the magnetic field is varied, is called

- (a) cyclotron ()
- (b) synchrotron ()
- (c) synchrocyclotron ()
- (d) betatron ()

9. Which of the following particles is a lepton?

- (a) Proton ()
- (b) Neutron ()
- (c) Electron ()
- (d) Pion ()

10. A proton is made up of

- (a) one u and two d quarks ()
- (b) two u and one d quarks ()
- (c) one u and one d quarks ()
- (d) two u and two d quarks ()

(8)

SECTION--B

(Marks : 15)

Answer the following questions :

3×5=15

1. Show that nuclear density is constant for all nuclei.

2. Discuss about radiocarbon dating.

3. Write the elements of a nuclear reactor and their functions.

4. Describe briefly about ionization chamber.

8. What are hadrons? Discuss various types of hadron based on their quark structures

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