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(6th Semester)

PHYSICS

TENTH PAPER

(Nuclear Physics—II)

(Pre-revised)

Full Marks : 75

Time : 3 hours

(PART : A—OBJECTIVE)

(*Marks* : 25)

The figures in the margin indicate full marks for the questions

SECTION—A

(*Marks* : 10)

Tick (✓) the correct answer in the brackets provided :   1×10=10

1. Isotones are nuclei with equal number of

(a) neutrons   (   )   *(b)* protons   (   )

(c) electrons   (   )   *(d)* shells   (   )

2. The charge of nucleus is due to the

(a) electronic configuration (   ) *(b)* neutrons   (   )

(c) protons   (   )   *(d)* electrons   (   )

3. The average life of a radioactive substance and its decay constant are

(a) directly proportional ( )

(b) reciprocal to each other ( )

(c) inversely proportional ( )

(d) not related ( )

4. In radioactive carbon dating, which carbon isotope is used?

(a) C-14 ( )   (b) C-13 ( )

(c) C-12 ( )   (d) C-11 ( )

5. Ultra fast neutron has energy greater than

(a) 0·5 MeV ( )   (b) 5 MeV ( )

(c) 10 MeV ( )   (d) 20 MeV ( )

6. When effective neutron multiplication factor k 1, then the nuclear chain reaction is

(a) not self-sustaining ( )   (b) self-sustaining ( )

(c) increasing in rate ( )   (d) None of the above ( )

7. In linear accelerators, the length of the drift tubes must be proportional to

(a) $1 : \sqrt{3} : \sqrt{5} : \sqrt{7} \ldots$ ( )   (b) $1 : \sqrt{4} : \sqrt{8} : \sqrt{16} \ldots$ ( )

(c) $1 : \sqrt{2} : \sqrt{3} : \sqrt{4} \ldots$ ( )   (d) $1 : 2 : 3 : 4 \ldots$ ( )

8. In 1952, Donald A. Glaser of United States invented the

(a) ionisation chamber ( )   (b) cloud chamber ( )

(c) scintillation chamber ( )   (d) spark chamber ( )

9. In cosmic rays, the penetrating ones are called

(a) hard components ( )   (b) soft components ( )

(c) primary rays ( )   (d) secondary rays ( )

10. How many quarks does baryon have?

(a) 1 ( )   (b) 2 ( )

(c) 3 ( )   (d) 4 ( )

SECTION—B

(*Marks* : 15)

Answer the following questions : 3×5=15

1. Write a note on nuclear charge.

2. What do you mean by half-life of radioactive nuclei?

3. Discuss in brief the origin of stellar energy.

4. Discuss in brief the accelerators in India.

5. Write a note on the concept of anti-particles.

(PART : B—DESCRIPTIVE)

(*Marks* : 50)

The figures in the margin indicate full marks for the questions

1. *(a)* What is binding energy? Explain how binding energy affects the stability of a nucleus. 5

  (b) Describe packing fraction. Write the relation between packing fraction and mass defect. 5

OR

  (a) Explain the concept of nuclear spin. 2

  (b) Discuss semi-empirical mass formula and its simple application. 4

  (c) Draw and explain nuclear stability curve. 4

2. *(a)* Discuss the different types of radioactive decays. 4

  (b) What are radioisotopes? Write the production and uses of radioisotopes. 6

OR

  (a) Describe -rays and their origin. 4

  (b) Explain the three types of -decay processes. 6

3. *(a)* Describe nuclear shell model in detail. 5

(b) Discuss the discovery of neutron. Write the properties of neutron. 5

OR

(a) Write the concept of critical size in nuclear fission reaction. 2

(b) What do you mean by multiplication factor? 2

(c) What is nuclear fusion? Explain how energy is released in fusion reaction. 6

4. Describe the construction, characteristic, working and counting rate of Geiger-Müller (GM) Counter. 10

OR

Explain the following in detail : 5×2=10

(a) Proportional counter

(b) Cerenkov counter

5. *(a)* What are primary and secondary cosmic rays? 2

(b) Explain in detail the latitude effect of cosmic rays. 3

(c) Discuss cosmic ray showers and explain the absorption of secondary rays. 5

OR

(a) What do you understand by leptons? How many leptons are there in total? 4

(b) Describe the following : 2×3=6

   (i) Strangeness

   (ii) Isospin

   (iii) Hypercharge

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