

2018

(CBCS)

(5th Semester)

PHYSICS

SEVENTH PAPER

(Classical Mechanics and Nuclear Physics—II)

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)

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

1. The reduced mass of two particles of masses m_1 and m_2 is

(a) $m_1 m_2$ () (b) $\sqrt{m_1 m_2}$ ()

(c) $\frac{m_1 m_2}{m_1 + m_2}$ () (d) $\frac{m_1 m_2}{m_1 - m_2}$ ()

2. The Lagrange's equation for LC current is

(a) $L \frac{d^2 q}{dt^2} + \frac{q}{C} = 0$ ()

(b) $L \frac{d^2 q}{dt^2} - \frac{C}{q} = 0$ ()

(c) $L \frac{d^2 q}{dt^2} - \frac{q}{C} = 0$ ()

(d) $L \frac{d^2 q}{dt^2} - \frac{C}{q} = 0$ ()

3. Nuclei having equal number of neutrons are called

(a) isotopes ()

(b) isobars ()

(c) isotones ()

(d) isomers ()

4. Which of the following rays have the highest penetrating range in air?
- (a) Alpha rays ()
 (b) Beta rays ()
 (c) Gamma rays ()
 (d) Cathode rays ()
5. Nuclear Fission results in the division of heavy nucleus into
- (a) two nuclei ()
 (b) three nuclei ()
 (c) four nuclei ()
 (d) five nuclei ()
6. If two light nuclei fuse together to produce a relatively heavier nucleus, there would be
- (a) considerable increase in nuclear mass ()
 (b) no change in the nuclear mass ()
 (c) considerable decrease in the nuclear mass ()
 (d) considerable decrease in the binding energy ()
7. No magnetic field is necessary for the working of a
- (a) cyclotron ()
 (b) linear acceleration ()
 (c) betatron ()
 (d) proton synchrotron ()
8. Which one of the following is an X-ray generator?
- (a) Fixed frequency cyclotron ()
 (b) Synchro-cyclotron ()
 (c) Proton synchrotron ()
 (d) Betatron ()
9. Which among the following is a lepton?
- (a) Neutron ()
 (b) Proton ()
 (c) Electron ()
 (d) Meson ()
10. The strangeness $S = -3$ is true for
- (a) Λ -hyperon ()
 (b) Σ^0 -hyperon ()
 (c) K ()
 (d) π ()

SECTION—B

(Marks : 15)

Answer the following :

3×5=15

1. Explain constraints with suitable examples.

OR

2. State Kepler's law of planetary motion.

3. What is the main concept of binding energy?

OR

4. How are nuclei classified?

5. What is the main assumption of liquid-drop model of the nucleus?

OR

6. Explain chain reaction in nuclear fission.

7. Mention six important names and location of accelerators in India.

OR

8. What is an electron synchrotron?

9. Explain the conservation of lepton numbers.

OR

10. What are primary and secondary cosmic rays?

(PART : B—DESCRIPTIVE)

(Marks : 50)

The figures in the margin indicate full marks for the questions

1. (a) State and explain d'Alembert's principle. 6

- (b) Deduce Hamilton's canonical equations from Lagrange's equation. 4

OR

2. (a) Define central force. Show that momentum is conserved in a central force motion. Also, show that the equation of the orbit in a central force is given by

$$\frac{d^2u}{d^2} u = \frac{m}{J^2 u^2} F \frac{1}{u}$$

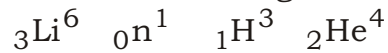
where the symbols have their usual meanings. 2+4=6

- (b) Deduce Lagrange's equation for a simple pendulum. 4

3. (a) What is semi-empirical mass formula? Explain its applications for determination of nuclear stability against α decay. 2+3=5
 (b) What is the cause of alpha decay? State and explain Geiger-Nuttall law in alpha decay. 2+3=5

OR

4. (a) What is quadrupole moment? Derive an expression for the electric quadrupole moment of a nucleus. 6
 (b) Describe a method of the measurement of gamma rays. 4
- 5 (a) Discuss the discovery of neutron. What are the properties of neutron? Discuss the classification of neutron according to their kinetic energy. 2+3+3=8
 (b) Calculate the Q-value of the following reaction : 2



Given masses (in a.m.u.) of ${}_3\text{Li}^6$ 6.015123, ${}_0\text{n}^1$ 1.008665,
 ${}_1\text{H}^3$ 3.016029, ${}_2\text{He}^4$ 4.002603

OR

6. (a) Explain nuclear fission and nuclear fusion. Also, discuss the energy released in fission and fusion processes by giving suitable reactions. 3+3=6
 (b) Discuss Bohr-Wheeler theory of nuclear fission. 4
7. (a) Describe the construction and working principle of an electrostatic accelerator. 5
 (b) Discuss the construction and working principle of cyclotron. 5

OR

8. (a) Discuss the construction and working principle of Cerenkov counter. 5
 (b) Describe the construction and working principle of scintillation counter. 5
9. (a) Discuss extensive air shower of cosmic rays. Show the decay scheme of air shower production. 3+3=6
 (b) What are cosmic rays? How does altitude affect the nature and origin of cosmic rays? 4

OR

10. (a) What is quark? Discuss different quarks and their properties. What are flavor and colour in quarks? 1+3+2=6
 (b) What are elementary particles? How are they classified? 1+3=4

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