MPH32 — NUCLEAR AND PARTICLE PHYSICS

Time : Three hours   Maximum : 75 marks
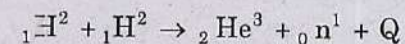
SECTION A — (5 × 6 = 30 marks)

Answer ALL questions.

1. (a) What do you mean by tensor forces? Comment on the experimental evidence of the existence of tensor forces.

Or

   (b) Give a brief account of spin dependence of nuclear forces.

2. (a) Explain the Q-value of nuclear reaction. Calculate the Q-value of the reaction given below

$$_1H^2 + _1H^2 \rightarrow _2He^3 + _0n^1 + Q$$

Given: Masses of $_1H^2 = 2.014$ a.m.u., $_2He^3 = 3.01603$ a.m.u., $_0n^1 = 1.008986$ a.m.u.

Or

   (b) Discuss the compound nucleus hypothesis to explain nuclear reaction.

3. (a) Discuss the Bohr-Wheeler theory of nuclear fission.

Or

(b) Explain the collective model of nucleus.

4. (a) Explain the selection rules for gamma transitions between two nuclear states.

Or

(b) What do you mean by nuclear isomers? Give examples with nuclear energy diagram.

5. (a) State the conservation laws of hadrons and leptons. Explain with examples.

Or

(b) Explain SU(2) and SU(3) multiplets.

SECTION B — ($3 \times 15 = 45$ marks)

Answer any THREE questions.

6. Derive an expression for electric quadrupole moment of a nucleus. How is electric quadrupole moment determined experimentally?

7. What is meant by nuclear resonance? Derive Breit-wigner formula for nuclear reactions.

8. Write the experimental facts in support of shell model of nuclei. Explain how the shell model can be used to predict the angular moments and magnetic moments of odd A nuclei in the ground state.

9. Describe the salient features of the β-decay of nuclei. Explain the violation of parity conservation laws in β-decay.

10. Discuss the classification of elementary particles. Why do we need such classification?

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