

Time: 3 hrs.

M. M.: 100

N.B.:

1. All questions are **compulsory**.
2. **Figures** to the **right** indicate **full** marks.
3. Draw **neat** diagrams wherever **necessary**.
4. Symbols have usual meaning unless otherwise stated.
5. Use of **non-programmable** calculator is allowed.

Constants: Planck's constant (h) = 6.64×10^{-34} J-s;

Mass of an electron (m_e) = 9.10×10^{-31} Kg = 0.00055 amu

Charge on electron (e) = 1.60×10^{-19} C

Speed of light (c) = 3×10^8 m/s

1 eV = 1.60×10^{-19} J

Q1.

Attempt any two

- (i) (a) Explain how a magnetic spectrograph can be used to determine the velocity of alpha particles? **10**
b) Write a short note on Geiger Nuttal law and discuss its significance.
- (ii) Explain the origin of short range α -particles using the decay scheme. **10**
- (iii) What is Pauli's neutrino hypothesis? Also explain continuous β - particle spectrum. **10**
- (iv) Derive the energy conditions under which different types of beta decay can take place. **10**

Q2

Attempt any two

- (i) What is gamma decay? Explain the selection rules for gamma decay. Also discuss Gamma ray spectra. **10**
- (ii) Discuss Mossbauer effect with experimental setup. State the applications of Mossbauer effect. **10**
- (iii) From the Bohr-Wheeler theory obtain the stability limit against spontaneous fission. **10**
- (iv) Obtain Weizsacker's Semi-Empirical mass formula. Draw a neat diagram indicating the variation of contribution of different energy terms to the binding energy per nucleon with respect to mass number A. **10**

Q3

Attempt any two

- (i) Explain Nuclear Chain Reaction. What are the various factors on which it depends? **10**
- (ii) What is Nuclear Reactor? Explain its various features. **10**
- (iii) Describe the construction and working of Betatron. **10**
- (iv) Discuss in detail the principle, construction and working of Cyclotron. **10**

- Q4** Attempt any two
- (i) Summarize the important experimental properties of the deuteron. **10**
- (ii) State conservation laws for the various properties of elementary particles. **10**
- Which of the following reactions can occur by conservation laws of elementary particles? If not, state the conservation principles violated by them.
- a) $\Lambda^0 \rightarrow p + \pi^-$
- b) $\pi^+ + p \rightarrow \pi^+ + p + \pi^- + \pi^0$
- c) $\gamma + n \rightarrow p + \pi^-$
- (iii) (a) Write note on electrons, positrons and their anti particles. **10**
(b) Explain Yukawa potential.
- (iv) Explain qualitatively the Quark model. **10**
- Q5.** Attempt any four
- (i) Ra^{226} decays by α – emission to Rn^{222} . The alpha disintegration energy is 4.863 MeV. Calculate the kinetic energy of the alpha particle. **05**
- (ii) What is meant by electron capture? **05**
- (iii) Explain the phenomenon of internal conversion. **05**
- (iv) Write short note on shell model of nucleus. **05**
- (v) Calculate the amount of energy available if 10gm of ${}_{92}\text{U}^{235}$ is completely fissioned. Given: Energy per fission = 200 MeV, and Avogadro's number = 6.022×10^{23} per gm-mole. **05**
- (vi) Protons are accelerated in a 100cm cyclotron. The oscillator frequency is 10 Megacycle. Calculate the magnetic field needed for the protons. Also calculate the energy required for acceleration of ions. **05**
- Given: $e = 1.6 \times 10^{-19}$ C, Mass of proton $m = 1.67 \times 10^{-27}$ kg.
- (vii) On the basis of the meson theory, estimate the mass of the exchanged particle if the 'range' of the potential is 10^{-15} m? **05**
- (viii) Show that lepton number and baryon number is conserved in case of neutron to (β^-) decay. **05**
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