RAMAKRISHNA MISSION VIDYAMANDIRA

(Residential Autonomous College under University of Calcutta)

B.A./B.SC. SIXTH SEMESTER EXAMINATION, MAY-JUNE 2013

THIRD YEAR

Date : 28/05/2013 **Physics (Honours)**

Time : 11am – 1pm Paper : VII Gr. A Full Marks : 40

Group – A

(*Answer **any four** questions*)

1. a) How is straggling of the range of α-particles explained? [2]
   b) What is Geiger-Nuttal Law for the α-particles? [2]
   c) In positron emission, the proton inside the nucleus is transformed into neutron, but the mass of the proton is less than that of a neutron. Explain the anomaly. [2]
   d) Explain spin, magnetic moment and binding energy of the nucleus. [4]

2. a) What is Q-value of a nuclear reaction? What are endoergic and exoergic reactions? [2+2]
   b) In an experimental study of the reaction ^{7}Li(p,α)α, the incident proton of energy 0·25 MeV led to the emission of two alpha particles each of energy 8·6 MeV. What is the Q-value of the reaction? Is the reaction exoergic or endoergic? Calculate the momentum of each α-particles. [Given μ_α = 3724 Mev; $\mu(^{7}\text{Li}) = 7{\cdot}016005\mu$; where $\mu = 931{\cdot}502$ Mev] [1+1+4]

3. a) Explain magic numbers. How does the shell model account for the magic numbers? What is the role of the spin-orbit coupling in this connection? [1+3+3]
   b) Give experimental evidences in support of the shell structure of nucleous in nuclei. [3]

4. a) State and explain Bohr's hypothesis of the formation of compound nucleus and its subsequent decay. Describe an experiment verifying this hypothesis. [2+3]
   b) Explain why fission of heavy nuclei and the fusion of light nuclei lead to release of energy. Calculate the energy released in the fusion of two $^{12}_{6}C$ nuclei. Use the mass formula. [Given (in MeV unit) : a_v = 15.75, a_s = 17.92, a_A = 23.51 and a_p = 33.5] [2+3]

5. a) What were the difficulties felt in explaining the features of β-decay? How did Pauli solve the problem?
   b) "Free neutrons show β-decay but free proton cannot" —Explain. [8+2]

6. a) Describe the construction and working of a semi-conductor detector. What are the advantages of the detector over others? Mention its limitations. [6+2+2]

7. a) Explain strangeness and iso spin quantum numbers giving examples. [4]
   b) Explain from the conservation principles which of the following reactions occur. [6]
   (i) $\pi^- + \text{p} \rightarrow \text{n} + \pi^\text{o}$
   (ii) $\pi^+ + \text{p} \rightarrow \pi^+ + \text{p} + \pi^- + \pi^\text{o}$
   (iii) $\gamma + \pi \rightarrow \pi^- + p$
   (iv) $p + p \rightarrow n + p + \pi^+$

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