



Date: 01st October 2017

Time: 01.00 pm – 02.00 pm

Answer all the questions.

Part A: Write down the best choice in the answer book quoting the respective question number

(15 minutes; 4 marks x 10 = 40 marks)

- (01) Which one of the following is an example for a pair of mirror nuclei?
(a) $^{108}_{47}\text{Ag}$ and $^{70}_{31}\text{Ga}$ (b) *Ni* and *In* (c) $^{23}_{11}\text{Na}$ and $^{23}_{12}\text{Ga}$ (d) ^1_1H and ^2_2He
- (02) The observed variation of binding energy of a nucleus with increasing number of its nucleons does **not** depend on,
(a) Asymmetry energy. (b) Ionization energy. (c) Pairing energy. (d) Surface energy.
- (03) Rate of radioactive disintegration is proportional to,
(a) Number of neutrons. (b) Number of electrons.
(c) Number of stable nuclei. (d) Number of unstable nuclei.
- (04) If the nuclear disintegration process $A \rightarrow B + C$ happens spontaneously, which one of the following equations about their masses is true?
(a) $M_A > M_B + M_C$ (b) $M_A < M_B + M_C$
(c) $M_A > M_C - M_B$ (d) $M_A = M_B + M_C$
- (05) If a nucleus $^{241}_{94}\text{Pu}$ decays through a series of α , β , α , β , α , β , α decays, the resulting nucleus would have a mass number of,
(a) 222 (b) 225 (c) 228 (d) 260
- (06) Electron capture involves an electron,
(a) Combining with a neutron. (b) Being captured by ground.
(c) Being ejected from the nucleus. (d) Combining with a proton.
- (07) An uncontrolled chain reaction will occur when,
(a) Just one neutron from a fission causes one more nucleus to fission.
(b) A few neutrons from a fission cause one more nucleus to fission.
(c) A few neutrons from a fission cause a few more nuclei to fission.
(d) Just one neutron from a fission possess the critical energy.
- (08) Production of energy in the sun is primarily due to,
(a) Burning of gases. (b) Greenhouse effect. (c) Nuclear fission. (d) Nuclear fusion.

- (09) In fission reaction, mass of products is,
 (a) Less than the mass of original nucleus (b) Equal to the mass of original nucleus
 (c) More than the mass of original nucleus (d) Double the mass of original nucleus
- (10) Which of the following is **not** a radiation detector?
 (a) Bubble chamber (b) Synchrocyclotron
 (c) Geiger counter (d) Photographic emulsion

Part B:*(45 minutes; 20 marks x 3 = 60 marks)*

- (I) (a) What is an alpha particle?
 (b) Compare the important properties of the alpha, beta and gamma particles.
 (c) What is the Q-value for the radioactive disintegration of ${}^{226}_{88}\text{Ra} \rightarrow {}^{222}_{86}\text{Rn} + {}^4_2\text{He}$
- (II) (a) Define the terms, 'half-life' and 'mean-life' of radioactive elements.
 (b) Distinguish between the nuclear decay processes and the nuclear reactions.
 (c) Briefly explain the conservation laws applicable to all nuclear reactions.
- (III) Bombarding ${}^7_3\text{Li}$ with 0.5 MeV protons leads to formation of beryllium compound nucleus, which decays to ground state by emission of a gamma ray.
 (a) Write down the nuclear reaction.
 (b) Calculate the excitation energy of the compound nucleus.

Useful Physical Data

Atomic mass of ${}^1_1\text{H}$	=	1.007825 u
Atomic mass of ${}^4_2\text{He}$	=	4.002603 u
Atomic mass of ${}^7_3\text{Li}$	=	7.016004 u
Atomic mass of ${}^8_4\text{Be}$	=	8.005305 u
Atomic mass of ${}^{222}_{86}\text{Rn}$	=	222.017578 u
Atomic mass of ${}^{226}_{88}\text{Ra}$	=	226.025409 u
1 u	=	931.5 MeV/c ²
