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DCI-003-1016031

Seat No. _____

B. Sc. (Sem. VI) (CBCS) Examination

July - 2022

601 : Physics

Faculty Code : 003

Subject Code : 1016031

Time : **2:30** Hours] [Total Marks : **70**

Instructions: (1) All questions are compulsory.
(2) Symbols have their usual meanings.
(3) Figures to the right indicate marks.

1 (A) Answer the following in short. **4**

(1) The proton and neutron are jointly called as _____.

(2) Isobars are atoms of different elements having the same number of _____.

(3) According to the liquid drop model of nucleus, the density of nucleus is independent of _____.

(4) The magic numbers are given by the _____ model of the nucleus.

(B) Answer in Brief. (any one) **2**

(1) The binding energy of $_{21}Sc^{50}$ is 425 MeV. How much energy is required to remove a nucleon from it?

(2) Calculate the binding energy of $_{21}Sc^{50}$ using semi-empirical mass formula, if a = 14, b = 13, c = 0.583, d = 19.3 and δ = 33.5

(C) Answer in detail. (any one) **3**

(1) Write a note on nuclear density.

(2) Give evidences of shell model of nucleus.

(D) Write a note. (any one) **5**

(1) Explain Rutherford's alpha scattering experiment and discuss its results.

(2) Write the semi-empirical mass formula and explain the terms.

2 (A) Answer the following in short. **4**

(1) Define natural radioactivity.

(2) What is the charge of an α-particle?

(3) The penetrating power of β-particles is _____ (more/less) than that of α-particles.

(4) γ-rays are not affected by _____ and _____ fields.

(B) Answer in brief. (any one) **2**

(1) A radioactive substance has a half-life of 50 days. Calculate the radiocative disintegration constant and the average life period.

(2) A radioactive substance has a decay constant 0.0182 per day. Calculate the time taken for 20% of the original number of atoms to remain unchanged.

(C) Answer in detail. (any one) **3**

(1) Write six properties of γ-rays.

(2) Explain the theory of beta decay.

(D) Write a note. (any one) **5**

(1) Derive the law of radioactive decay.

(2) Explain the method of calculating the age of the earth.

3 (A) Answer the following in short. **4**

(1) Define stopping power for heavy charged particles.

(2) Write in expanded form ${}_4Be^9$ (α, n) ${}_6C^{12}$.

(3) Complete the reaction ${}_{29}Cu^{65}$+ _____ $\rightarrow$ ${}_{30}Zn^{65}$+${}_0n^1$.

(4) The characteristic curve of a GM counter is also called _____ curve.

(B) Answer in brief. (any one) **2**

(1) Determine the Q-value in the following reaction: ${}_7N^{14} + {}_2He^4 \rightarrow {}_8O^{17} + {}_1H^1 + Q$. The atomic masses are as follows: $m({}_7N^{14}) = 14.003074$ u, $m({}_2He^4) = 4.002604$ u, $m({}_8O^{17}) = 16.99913$ u, $m({}_1H^1) = 1.007825$ u. Comment on the result.

(2) The rest mass of ${}_{13}Al^{27}$ is 26.98154 u and that of neutron is 1.008665 u. Find the mass of the product nucleus for the reaction ${}_{13}Al^{27}$ (n, γ) ${}_{13}Al^{28}$, given Q = 7.722 MeV.

(C) Answer in detail. (any one) **3**

(1) Explain energy balance in nuclear reactions.

(2) Obtain equation for threshold energy in a nuclear reaction.

(D) Write a note. (any one) **5**

(1) Explain the construction and working of GM counter.

(2) Explain the construction and working of Scintillation counter.

4 (A) Answer the following in short. **4**

(1) Write the formula for the cyclotron frequency.

(2) Name the accelerator which contains only dee.

(3) Write the value of k when the reactor is critical.

(4) The _____ chain reaction takes place in atom bombs.

(B) Answer in brief. (any one) **2**

(1) A linear accelerator is used for accelerating protons. It is designed so that between any pair of accelerating gaps, the protons spend one complete radio frequency cycle inside a drift tube. The frequency applied is 240 MHz. The velocity of the proton in the last cylinder is 20×10^7 m/s. Find the length of the last drift tube.

(2) The energy released by fission of one nucleus of ${}_{92}U^{235}$ is 210 MeV. How much energy (in MeV) is released by 1 kg of uranium?

(C) Answer in detail. (any one) **3**

(1) Derive betatron condition.

(2) Describe Bohr and Wheeler's theory of nuclear fission.

(D) Write a note on. (any one) **5**

(1) Explain the construction and working of Cyclotron.

(2) Explain the construction and working of power reactor.

5 (A) Answer the following in short. **4**

(1) Define nuclear fusion.

(2) Name the method of plasma confinement in stars.

(3) What is the antiparticle of proton called? Give its symbol.

(4) Name the exchange quanta of gravitational interaction.

(B) Answer in brief. (any one) **2**

(1) Calculate the energy released when a single helium nucleus is formed by the fusion of two deuterium nuclei. Given: m(d) = 2.07478 amu, m (helium) = 4.00388 amu.

(2) Show whether the Baryon numbers are conserved in the following reactions:

(a) $n = p + e^{+} + \overline{\nu}_e$

(b) $p + p \rightarrow n + p + \pi^{+}$

(C) Answer in detail. (any one) **3**

(1) Explain the construction and working of hydrogen bomb.

(2) Explain classification of elementary particles.

(D) Write a note. (any one) **5**

(1) Explain source of stellar energy

(2) Describe elementary particle quantum numbers.

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