DP-003-1016031   Seat No. _____

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

April - 2022

Physics : 601

(Nuclear & Particle Physics) (Old Course)

Faculty Code : 003

Subject Code : 1016031

Time : $2\frac{1}{2}$ Hours]   [Total Marks : **70**

Instructions : (1) Attempt any five questions.
(2) Symbols have their usual meaning.
(3) Figures on right hand sides indicates full marks.

1 (A) Fill up the blank.   **4**

(1) The nuclei having odd number of proton and even number of neutron are call _____nuclei.

(2) In semi-empirical mass formula, the volume term, EV =_____.

(3) Nuclear density = _____.

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

(B) Solve any one :   **2**

(1) Calculate the binding energy of $_{23}V^{50}$ using semi-empirical mass formula :

$$14A - 13A^{\frac{2}{3}} - 0.583Z^2 - 19.5(A-2Z)^2 A^{-1} \pm 33.5A^{-\frac{1}{2}}$$

(2) Calculate the binding energy of $_{35}Br^{80}$ Atomic masses of Br^{80}, proton and neutron are 79.91 amu, 1.007825 amu, and 1.008665 amu respectively.

(C) Answer any one : **3**
   (1) Discuss nuclear density.
   (2) Discuss classification of nuclei.

(D) Answer any one in detail : **5**
   (1) Explain variation of binding energy with mass number.
   (2) Describe Rutherford's α scattering experiment.

2 (A) Fill up the blank : **4**
   (1) γ rays travel with the velocity of _____.
   (2) The α particle carries _____ unit of positive charge.
   (3) The half life time of a radioactive substance is given as $T_{\frac{1}{2}} =$ _____.
   (4) 3.7 curie = _____ disintegration/sec.

(B) Solve any one : **2**
   (1) What is the mass of one curie of U^{234}? 1 Curie = 3.7×10^{10} disintegration/sec.
   (2) What is the mass of one Rutherford of U^{234}? 1 Rutherford = 3.7×10^6 disintegration/sec.

(C) Answer any one : **3**
   (1) Explain neutrino hypothesis.
   (2) Describe general rules of α and β decay.

(D) Answer any one in detail : **5**
   (1) Describe natural radioactive series.
   (2) Explain half life time of a radioactive substance.

3 (A) Fill up the blank : **4**
   (1) In pair production_____disappear and electron hole pair appear.
   (2) The flat region of the characteristic curve of G M Counter is known as _____of the counter.
   (3) An ionization chamber is much less sensitive to _____particle.
   (4) The reaction, ${}_1H^2 + \gamma \rightarrow {}_1H^1 + {}_0n^1$ is known as _____ reaction.

(B) Answer any one : 2
  (1) State any two (d, α) reactions.
  (2) State any two (p, n) reactions.
(C) Answer any one : 3
  (1) Expand the following reactions;
    (i) $B^{10}(\alpha, p)C^{13}$
    (ii) $F^{19}(p, \alpha)O^{16}$
    (iii) $Ne^{20}(d, \alpha)F^{18}$
  (2) Obtain equation of threshold energy.
(D) Answer any one in detail : 5
  (1) Explain principle, construction and working of ionization chamber.
  (2) Derive Q-value equation of a nuclear reaction.

4 (A) Do as directed : 4
  (1) In linear accelerator, the length of the cylinders can be given by $L_n = \underline{\hspace{1cm}}$. (Fill up the blank).
  (2) On which base of the method a synchrotron is worked ?
  (3) In _____ frequency of radio frequency oscillator is varied where as it was kept constant in cyclotron. (Fill up the blank).
  (4) The equation $\phi = 2\pi r^2 B$ is known as _____. (Fill up the blank).

(B) Solve any one : 2
  (1) A reactor is developing energy at the rate of 32×10^{-6} Watt. How many atoms of U^{235} undergo fission per second ? Assume that on the average, an energy of 200 MeV is released per fission.
  (2) Deuterons are accelerated in the cyclotron which has magnetic field of 15000 gauss. Calculate maximum frequency of the dee voltage. Given : q = 1.6023×10^{-19} C Mass of deuteron is 2.014102 amu and m_p = 1.66×10^{-27} kg.

(C) Answer any one :　　　　　　　　　　　　　　　　　　　　　3

　(1) Describe construction of cyclotron.

　(2) Explain self-Sustained chain reaction.

(D) Answer any one in detail :　　　　　　　　　　　　　　　　5

　(1) Explain principle of phase stability.

　(2) Describe construction and working of proton synchrotron.

5 (A) Fill up the blank :　　　　　　　　　　　　　　　　　　4

　(1) Small nuclei are fused together to form a single heavy nucleus is called _____.

　(2) The sun radiates _____ joule energy per second.

　(3) $4_1H^1 \rightarrow _2He^4 + 2_1e^0 + 2v + 2\gamma = 24.64\,MeV$ is the net result of the _____ cycle.

　(4) Two type of magnetic confinement for plasma are under study, magnetic bottle and _____.

(B) Solve any one :　　　　　　　　　　　　　　　　　　　　2

　(1) How much energy released in the following fusion reaction : $_1H^2 + _1H^2 \rightarrow _1H^3 + _1H^1 + Q$ Masses of $_1H^2, _1H^3$ and $_1H^1$ are 2.07478 amu, 3.017633 and 1.00759 amu.

　(2) Complete the following reactions :

　　(i) $_1H^1 + _1H^1 \rightarrow$ _____ + _____ + _____ + _____ .

　　(ii) $_1H^2 + _1H^1 \rightarrow$ _____ + _____ + _____ .

(C) Answer any one :　　　　　　　　　　　　　　　　　　　3

　(1) Describe nuclear fusion with example.

　(2) Explain hydrogen bomb.

(D) Answer any one in detail :　　　　　　　　　　　　　　　5

　(1) Describe source of stellar energy.

　(2) Explain the classification of elementary particles.

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