



P-003-1016031 Seat No. _____

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

March / April - 2020

Physics : Paper - 601

(Nuclear & Particle Physics)

(New Course)

Faculty Code : 003

Subject Code : 1016031

Time : $2\frac{1}{2}$ Hours]

[Total Marks : 70]

Instructions : (1) All questions are compulsory.
(2) Symbols have their usual meaning.
(3) Figures on right hand sides indicate full marks.

1 (A) Fill up the blank. 4

- (1) Two nuclides are _____ if they have same number of neutrons but different number of protons.
- (2) The nuclear shell model is also known as _____ model.
- (3) The nuclei having even number of protons and even number of neutrons are called _____ nuclei.
- (4) The volume term of semi-empirical mass formula is $E_v = \dots$.

(B) Solve Any One : 2

- (1) Find binding energy of $^{26}Fe^{56}$. Atomic mass of Fe^{56} is 55.939395 amu, mass of proton is 1.007825 amu and mass of neutron is 1.008665 amu.
- (2) Calculate the binding energy of $^{29}Cu^{64}$, using semi-empirical mass formula :

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

(C) Answer Any One : 3

- (1) Find binding energy of $^{24}Cr^{50}$ using Weizsacker's formula. The constants of the formula are : $a = 14.0, b = -13.0, c = 0.583, d = 19.3$ and $\delta = 33.5$.
- (2) Discuss binding energy.

(D) Answer Any One : 5

- (1) Explain intrinsic properties of nucleus.
- (2) Explain classification of nuclei.

2 (A) Fill up the blanks : 4

- (1) The α -particles carries _____ unit of positive charge.
- (2) $Z X^A \rightarrow \text{_____} + \alpha$.
- (3) 1 Curie = _____ disintegration / second.
- (4) $Z X^A + \text{_____} \rightarrow_{z-1} Y^A$.

(B) Solve Any One : 2

- (1) A radioactive substance has a half-life period 300 days. Calculate radioactive disintegration constant and the mean life time.
- (2) If a radioactive element disintegrates for a period of time equal to its mean life, what fraction of the original amount remains and what fraction will have disintegrated ?

(C) Answer Any One : 3

- (1) Identify the nuclei that result from the positive β -decay of $^{48}Cd^{107}$, $^{19}K^{38}$ and $^{51}Sb^{120}$.
- (2) Write properties of γ -rays.

(D) Answer any one : 5

- (1) Explain the law of radioactive decay.
- (2) Explain three natural radioactive series.

3 (A) Fill up the blank : 4

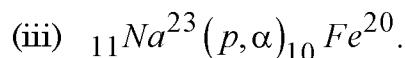
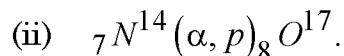
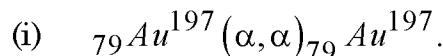
- (1) In pair production _____ disappear and electron hole pair appears.
- (2) The flat region of characteristic curve of G. M. counter is _____ of the counter.
- (3) In nuclear reaction, if Q is negative, the reaction is _____
- (4) A reaction, $^{14}Si^{28} +_2 He^4 \rightarrow_{15} P^{31} +_1 H^1$ known as _____ reaction.

(B) Solve Any One : 2

- (1) Is the following reaction exoergic or endoergic ?
Calculate. $^{7}N^{14} +_2 He^4 \rightarrow_8 O^{17} +_1 H^1 + Q$.
The atomic masses of N^{14} , He^4 , O^{17} and H^1 are 14.003074 amu, 4.002604 amu, 16.99913 amu and 1.007825 amu respectively Take amu = 931.3 MeV
- (2) Write in abbreviated form :
(i) $^{7}N^{14} +_0 n^1 \rightarrow_5 B^{11} +_2 He^4$.
(ii) $^{12}Mg^{24} +_0 n^1 \rightarrow_{11} Na^{24} +_1 H^1$.

(C) Answer Any One : 3

(1) Write in expanded form :



(2) Explain construction of ionization chamber.

(D) Answer Any One : 3

(1) Describe characteristic of G. M. counter.

(2) Obtain Q-value equation for a nuclear reaction.

4 (A) Fill up the blank : 4

(1) The time taken by an ion to travel a semi-circle in cyclotron depends only on the _____.

(2) The _____ consist magnets of four segments connected by four equal straight sectors.



(4) The chain reaction is steady when multiplication factor K = _____

(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, 200 MeV energy is released per fission.

(2) Calculate the frequency of oscillating potential that must be applied to a cyclotron in which deuterons are accelerated in a constant field of intensity 25000 gauss. Mass of deuteron = 3.34×10^{-27} kg and $q = 1.6 \times 10^{-19} C$.

(C) Answer Any One : 3

(1) Energy released by fission of one nucleus of ${}_{92}^{235}U$ is 200 MeV. How much energy released by 1 kg of uranium ?

(2) Describe self-sustaining chain reaction.

(D) Answer Any One : 5

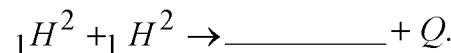
(1) Explain construction and working of linear accelerator.

(2) Explain principle of phase stability.

5 (A) Fill up the blank : 4

(1) The Sun radiates _____ joule energy per second.

(2) In nuclear fusion reaction

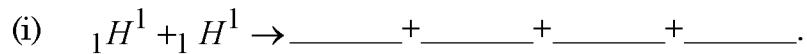


(3) Nucleons and hyperons are jointly called _____.

(4) The multiplet number for pions is M = _____

(B) Solve Any One : 2

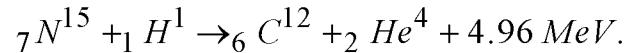
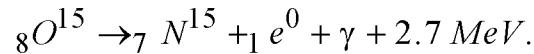
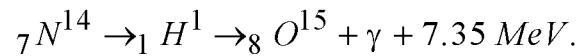
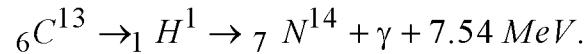
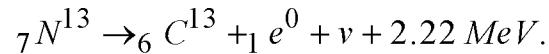
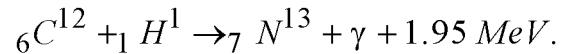
(1) Complete the reactions :



(2) Give the quark model of antineutron and antiproton.

(C) Answer Any One : 3

(1) Write the net result of the following reactions :



(2) Explain three generations of quarks and leptons.

(D) Answer Any One : 5

(1) Explain the classification of elementary particles.

(2) Explain elementary particle quantum numbers.