Shree H.N.Shukla group of colleges

PHYSICS

T.Y.B.Sc. (Sem. VI) (CBCS)

Preliminary Examination

PAPER- 603

NULCEAR AND PARTICLE PHYSICS

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 indicates full marks.

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

(1) Protons and neutrons are jointly called _____.

(2) $\frac{nuclear\ mass}{nuclear\ volume}$ = _____.

(3) The nuclei, having even number of protons and even number of neutrons are called _____ nuclei.

(4) In semi empirical mass formula, the surface term, Es = _____.

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

(1) Calculate the binding energy of ${}_{32}Br^{80}$. Atomic masses of Br^{80}, proton and neutron are 79.91 amu, 1.007825 amu and 1.008665 amu respectively.

(2) What is the binding energy per nucleon of ${}_{28}Ni^{64}$ Mass of proton = 1.007275 amu, mass of neutron = 1.008665 amu. and mass of ${}_{28}\mathrm{Ni}^{64}$ nucleus = 63.8126 amu.

(C) Answer any **one** : **3**

(1) Determine the binding energy of ${}_{26}Fe^{56}$ using semi-empirical mass formula. The constants of the formula are $a = 15.7$, $b = 17.8$, $c = 0.711$, $d = 23.7$ and $\delta = 11.18$.

(2) Discuss binding energy.

(D) Answer any **one** : **5**

(1) Describe Rutherford's α – scattering experiment.

(2) Describe classification of nuclei.

2 (A) Fill up the blank : **4**

(1) The ionization power of α particle is _____ times greater than β rays.

(2) The _____ particles are identical with electrons.

(3) The unit of radioactivity is _____

(4) ${}_zX^A \rightarrow {}_{z-1}Y^A +$ _____.

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

(1) A radioactive substance has a half-life period is 30 days. Calculate the radioactive disintegration constant.

(2) The radioactive substance has decay constant 0.0231 per day. Calculate the time taken for $\frac{1}{8}$ of the original number of atoms to remain unchanged.

(C) Answer any **one** : **3**

(1) A radioactive substance initially contains 5 mg of U^{234}. How much parent substance will remain after 4.96×10^4 year? Half-life period is 2.48×10^4 years.

(2) Explain the radioactive thorium series.

(D) Answer any **one** : **5**

(1) Explain half-life and mean life.

(2) Describe the theory of α – decay.

3 (A) Fill up the blank : **4**

(1) In pair production _____ disappear and electron hole pair produced.

(2) The G M Counter must be utilized in the _____ region.

(3) The reaction ${}_{14}Si^{28} + {}_2He^4 \rightarrow {}_{15}P^{31} + {}_1H^1$ is known as _____ reaction.

(4) (n, α) reaction is belong to the class transmutation by _____

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

(1) Write in expanded form : $F^{19}(p, \alpha)O^{16}$.

(2) Write in abbreviated form : ${}_5B^{11} + {}_1H^1 \rightarrow {}_4Be^8 + {}_2He^4$.

(C) Answer any **one** : **3**

(1) Find the threshold energy for the reaction; ${}_7N^{14}(n, \alpha)\ {}_5B^{11}$ Q = – 0.15646 MeV. Masses of N^{14}, B^{11}, n^1 and α are 14.003074 amu, 11.009305 amu, 1.008665 amu and 4.002603 amu respectively.

(2) Explain working of solid state detector.

(D) Answer any **one** : **5**

(1) Describe the interaction between energetic particle and matter.

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

4 (A) Fill up the blank : **4**

(1) The length of n^{th} cylinder of a linear accelerator in terms of that of first cylinder is given by the formula; L_n = _____.

(2) An accelerator consists of one DEE is the modified form of _____.

(3) Uncontrolled chain reaction is take place in _____

(4) The chain reaction is super critical then k _____

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

(1) Fill up the blanks in the following breeding reactions :

(i) ${}_{90}Th^{232} + {}_0\,n^1 \rightarrow {}_{90}\,Th^{233} +$ _____

(ii) ${}_{90}Th^{233} \rightarrow {}_{91}\,Pa^{233} +$ _____

(iii) ${}_{91}Pa^{233} \rightarrow {}_{92}\,U^{233} +$ _____ + _____

(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 is 3.34×10^{-27} kg and $q = 1.6 \times 10^{-19} C$.

(C) Answer any **one** : **3**

(1) Calculate the amount of energy released in the process of fission by 1 mg of ${}_{92}U^{239}$ assuming that 200 MeV of energy is released per fission, Avogadro's number $= 6.025 \times 10^{26}$.

(2) Draw the schematic diagrams of synchrocyclotron, electron synchrotron and proton synchrotron.

(D) Answer any **one** : **5**

(1) Describe construction and working of linear accelerator.

(2) Describe main components of nuclear reactor.

5 (A) Fill up the blank : **4**

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

(2) Nuclear fusion as an energy source will be a boon to humanity because _____ is available everywhere on this planet.

(3) Positron is anti-particle of _____

(4) Lambda, sigma, xi and omega particles are known as _____

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

(1) What is the net result of the following reactions;

$${}_1H^1 + {}_1H^1 \rightarrow {}_1H^2 + {}_1e^0 + \gamma + 0.42\ MeV$$

$${}_1H^2 + {}_1H^1 \rightarrow {}_2He^3 + \gamma + 5.5\ MeV$$

$${}_2He^3 + {}_2He^3 \rightarrow {}_2He^4 + 2{}_1H^1 + 12.8\ MeV$$

(2) Calculate the energy liberated when a single helium nucleus is formed by the fusion of two deuterium nuclei. Given: mass of ${}_1H^2 = 2.07478$ amu, mass of ${}_2He^4 = 4.00388$ amu.

(C) Answer any **one** : **3**

(1) Calculate the mass of the ${}_2He^3$ in the following fusion reaction :

$${}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1 + 3.26\ MeV$$

Given: mass of ${}_1H^2 = 2.01471$ amu, mass of ${}_0n^1 = 1.00898$ amu.

(2) Discuss tokamak for plasma confinement.

(D) Answer any **one** : **5**

(1) Describe source of stellar energy.

(2) Give the classification of elementary particles.
