# Nuclei

**Q.No.1:**
(a) In a nuclear reaction
$_2^3He + _2^3He \rightarrow _2^4He + _1^1H + _1^1H + 12.86\,MeV$, though the number of nucleons is conserved on both sides of the reaction, yet the energy is released. How? Explain.
(b) Draw a plot of potential energy between a pair of nucleons as a function of their separation. Mark the regions where potential energy is (i) positive and (ii) negative.

**CBSE Board Paper 2013**

**Q.No.2:** In the study of Geiger-Marsdon experiment on scattering of α particles by a thin foil of gold, draw the trajectory of α-particles in the coulomb field of target nucleus. Explain briefly how one gets the information on the size of the nucleus from this study.
From the relation $R = R_0 A^{1/3}$, where $R_0$ is constant and $A$ is the mass number of the nucleus, show that nuclear matter density is independent of $A$.

**OR**

Distinguish between nuclear fission and fusion. Show how in both these processes energy is released.
Calculate the energy release in MeV in the deuterium-tritium fusion reaction :
$_1^2H + _1^3H \longrightarrow _2^4He + n$

Using the data :
$m\left(_1^2H\right) = 2.014102\ u$

$m\left(_1^3H\right) = 3.016049\ u$

$m\left(_2^4He\right) = 4.002603\ u$

$m_n = 1.008665\ u$
$1u = 931.5\ MeV/c^2$

**CBSE Board Paper 2015**

**Q.No.3:** In a fission event of $_{92}^{238}U$ by fast moving neutrons, no neutrons are

emitted and final products, after the beta decay of the primary fragments, are ${}^{140}_{58}\mathrm{Ce}$ and ${}^{99}_{44}\mathrm{Ru}$. Calculate Q for this process. Neglect the masses of electrons/positrons emitted during the intermediate steps.

Given : $\mathrm{m}\left({}^{238}_{92}\mathrm{U}\right) = 238.05079\mathrm{u};\ \mathrm{m}\left({}^{140}_{58}\mathrm{Ce}\right) = 139.90543\mathrm{u}$

$$\mathrm{m}\left({}^{99}_{44}\mathrm{Ru}\right) = 98.90594\mathrm{u};\ \mathrm{m}\left({}^{1}_{0}\mathrm{n}\right) = 1.008665\mathrm{u}$$

**CBSE Board Paper 2022**

**Q.No.4:** The ratio of the nuclear densities of two nuclei having mass numbers 64 and 125 is

(A) $\frac{64}{125}$

(B) $\frac{4}{5}$

(C) $\frac{5}{4}$

(D) 1 **CBSE Board Paper 2023**

**Q.No.5:** Draw a graph showing the variation of potential energy of a pair of nucleons as a function of their separation. Indicate the region in which the nuclear force is (a) attractive and (b) repulsive. **CBSE Board Paper 2023**

**Q.No.6:** (a) Calculate the binding energy of an alpha particle in MeV. Given

mass of a proton = 1.007825 u

mass of a neutron = 1.008665 u

mass of He nucleus = 4.002800 u

l*u* = 931 MeV/$c^2$ **CBSE Board Paper 2023**

**Q.No.7:** A heavy nucleus *P* of mass number 240 and binding energy 7.6 MeV per nucleon splits into two nuclei *Q* and *R* of mass number 110 and 130 and binding energy per nucleon 8.5 MeV and 8.4 MeV respectively. Calculate the energy released in the fission. **CBSE Board Paper 2023**