NUCLEI DERIVATIONS

Derive an expression for the density of nucleus. Hence show that the density is independent of mass number.

Let A be the mass number and R be the radius of a nucleus. If m is the average mass of a nucleon, then

Mass of nucleus = mA

Volume of nucleus

$$= \frac{4}{3}\pi R^3$$

$$= \frac{4}{3}\pi\left(R_o A^{\frac{1}{3}}\right)^3 = \frac{4}{3}\pi R_o A$$

Therefore, nuclear density

$$\rho = \frac{\text{Mass of nuclues}}{\text{Volume of nucleus}}$$

$$\rho = \frac{mA}{\frac{4}{3}\pi R_o^3 A} = \frac{3m}{4\pi R_o^3}$$

Clearly, density of nucleus is independent of mass number A or the size of the nucleus.

Taking $m = 1.67 \times 10^{-27}\text{kg}$, $R_o = 1.2 \times 10^{-15}\text{m}$, we get

$\rho = 2.30 \times 10^{17}\text{kgm}^{-3}$ which is very large as compared to the density of ordinary matter.