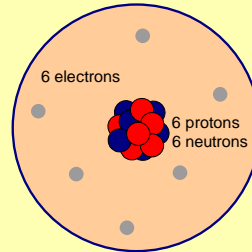


TAP 525-2: Finding binding energy

Binding energy of carbon-12 nucleus

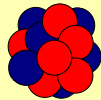
Mass of carbon-12 atom
 1 atomic mass unit u
 = 1/12 of mass of C-12 atom
 $1 u = 1.66056 \times 10^{-27} \text{ kg}$
 mass of C-12 atom = 12.0 u

Mass of 6 electrons
 mass of electron
 = $9.1095 \times 10^{-31} \text{ kg}$
 = 0.000549 u
 mass of 6 electrons = 0.0033 u



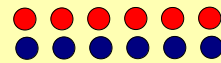
Calculate mass of carbon-12 nucleus

mass of carbon-12 nucleus
 = mass of carbon-12 atom
 – mass of 6 electrons



mass of carbon-12 nucleus
 = $(12.000 - 0.0033) u$
 = **11.9967 u**

Calculate mass of all the protons and neutrons



mass of proton
 = $1.67265 \times 10^{-27} \text{ kg}$
 = 1.00728 u

mass of neutron
 = $1.67495 \times 10^{-27} \text{ kg}$
 = 1.00866 u

mass of 6 protons and 6 neutrons
 = $6 (1.00728 + 1.00866) u$
 = **12.0956 u**

Difference in mass

= mass of carbon-12 nucleus – mass of protons and neutrons
 = $(11.9967 - 12.0956) u$
 = **-0.0989 u**

Binding energy

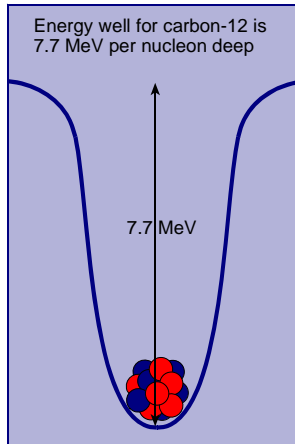
in mass units:
 = **-0.0989 u**
 = $-1.643 \times 10^{-28} \text{ kg}$

$$E_{\text{rest}} = mc^2$$

in energy units:
 = $-1.477 \times 10^{-11} \text{ J}$
 = **-92.16 MeV**

Binding energy per nucleon

-92.16 MeV for 12 nucleons
 = **-7.7 MeV per nucleon**



Binding energy of a nucleus is the difference between its mass and the sum of the masses of its neutrons and protons

Practical advice

This diagram is reproduced here so that you can use it for discussion with your class.

External reference

This activity is taken from Advancing Physics chapter 18, 60P