(b) Most Stable Nuclei Among Members of Isobaric Family

For a given A, we have to find the value of Z for which the binding energy B is a maximum, which corresponds to maximum stability, we must show $\left(\frac{dB}{dZ}\right)_{Z=Z_0}=0$

Since, $B=a_vA-a_sA^{2/3}-a_c\frac{Z(Z-1)}{A^{1/3}}-a_a\frac{(A-2Z)^2}{A}(\pm,0)\frac{a_p}{A^{3/4}}$

$$\Rightarrow\left(\frac{dB}{dZ}\right)_{Z=Z_0}=-\frac{a_c}{A^{1/3}}(2Z_0-1)-\frac{a_a}{A}2(A-2Z_0)(-2)=0$$

$$\Rightarrow-\frac{a_c}{A^{1/3}}(2Z_0-1)+\frac{4a_a}{A}(A-2Z_0)=0\Rightarrow-2Z_0\left(\frac{a_c}{A^{1/3}}+\frac{4a_a}{A}\right)=-\frac{a_c}{A^{1/3}}-4a_a$$

$$\Rightarrow Z_0=\frac{\left(4a_a+\frac{a_c}{A^{1/3}}\right)}{2\left(\frac{a_c}{A^{1/3}}+\frac{4a_a}{A}\right)}\Rightarrow Z_0=\frac{4a_a+a_cA^{-1/3}}{2a_cA^{-1/3}+8a_aA^{-1}}$$

Example: For $A=25$, we get $Z_0=\frac{4\times19+4\times0.595(25)^{-1/3}}{2\times(0.595)\times(25)^{-1/3}+8\times19\times25^{-1}}=\frac{76.81}{6.48}\approx12$ should be the atomic number of the most stable isobar of $A=25$. This nuclide is ${}^{25}_{12}Mg$, which is in fact the only stable $A=25$ isobar. The other isobars ${}^{25}_{11}Na$ and ${}^{25}_{13}Al$, are both radioactive.