α-decay $\left({}^{A}X \longrightarrow {}^{A-4}Y + \alpha + Q\right)$

→ Q value (disintegration energy) is due to the difference between rest mass energy at entrance & exit channel. It is shared betⁿ product nuclei.

→ Energy shared between daughter nucleus $\left({}^{A-4}Y\right)$ & α-particle can be calculated using conservation law of linear momentum.

If original nucleus $\left({}^{A}X\right)$ was at rest, the linear momentum is zero. So, the final momentum of two parts should be equal to zero.

magnitude wise they are constants.	considering direction $p_{daughter} = -p_{\alpha}$

K.E.

$$\frac{p_d^2}{2m_d} + \frac{p_\alpha^2}{2m_\alpha} = Q$$

$$\frac{p^2}{2}\left(\frac{m_\alpha + m_d}{m_\alpha m_d}\right) = Q$$

$$\boxed{\frac{p^2}{2} = \frac{Q\, m_\alpha m_d}{m_\alpha m_d}} \quad \text{—— (1)}$$

K.E. of α-Particle

$$K_\alpha = \frac{p^2}{2m_\alpha} = Q\,\frac{m_d}{m_\alpha + m_d}$$

$$K_d = \frac{p^2}{2m_d} = Q\,\frac{m_\alpha}{m_\alpha + m_d}$$

$$\rightarrow K_\alpha = Q\,\frac{(A-4)}{A}$$

$\because m_d \rightarrow (A-4)$

$m_\alpha \rightarrow 4$

$$\boxed{K_\alpha = Q\left(1 - \frac{4}{A}\right)}$$

or

$$\boxed{Q = \frac{A}{A-4}\,K.E_\alpha}$$