Potential step :

$E < U$

$x < 0$

$$\psi(x) = \underset{\substack{\text{Right} \\ \text{incident}}}{A e^{ikx}} + \underset{\substack{\text{left} \\ \text{Reflected}}}{B e^{-ikx}}$$

$x > 0$

$$\psi(x) = C e^{-\alpha x}$$

$$\alpha^2 = \frac{2m}{\hbar^2}(U-E)$$

$$R = \frac{B}{A} \cdot \frac{B^*}{A^*} = 1$$

$$T = \frac{4k^2}{\alpha^2 + k^2}$$

$$k = \sqrt{\frac{2mE}{\hbar^2}}$$

$$T = \frac{C}{A} \cdot \frac{C^*}{A^*} > 0$$

$x < 0$

$x > 0$

$E > U$

$$\psi = C e^{ik'x}$$

$$k' = \frac{\sqrt{2mc^2 KE_1}}{\hbar c}$$

$$R = \frac{(k-k')^2}{(k+k')^2} > 0$$

$$k' = \sqrt{\frac{2m}{\hbar^2}(E-U)}$$

$$k = \frac{\sqrt{2mc^2 KE_2}}{\hbar c}$$

$$T = \frac{4kk'}{(k+k')^2}$$

$E >> U$

$E << U$

$$k_2 = \frac{k_1}{\sqrt{2}}$$

$T = 0, R = 1$

$T = 1, R = 0$

$$k_1 = k_1$$

the barrier has a width

$$\alpha = \frac{\sqrt{2m\,(U-E)}}{\hbar}$$

$E < U$

$$\frac{1}{T} = 1 + \frac{1}{4}\left[\frac{U^2}{E(U-E)}\right] \sinh^2 \alpha L$$

$$k' = \sqrt{\frac{2m\,(E-U)}{\hbar^2}}$$

$E > U$

$$\frac{1}{T} = 1 + \frac{1}{4}\left[\frac{U^2}{E(U-E)}\right] \sin^2 k' L$$

α decay

$R = 1.3(A)^{1/3}\ 10^{-15}\ m$

mass

nucler radius

0.0993 Mev

the dauster

$$T = e^{\left[-4\pi Z\sqrt{\frac{E_0}{E}} + 8\sqrt{\frac{ZR}{r_0}}\right]}$$

the dauster

7.25×10^{-15}

$$\lambda = 10^{21}\, T$$

$$t_{1/2} = \frac{\ln 2}{\lambda}$$

$$E = U - \frac{1}{2m}\left(\frac{\ln T}{2L}\hbar\right)^2$$

$${}^{232}_{90}Th \xrightarrow{\alpha} {}^{228}_{88}Ra \xrightarrow{\alpha} {}^{224}_{86}Rn \xrightarrow{\alpha} {}^{220}_{84}Po \longrightarrow {}^{116}_{82}Pb$$

$\Big| \alpha$

$\Big| \beta$

Stable Pb