chem580 exam 1

Binding Energy

$$B = 15.56A - 17.23A^{2/3} - 0.72Z^2 A^{-1/3} - 23.285 (A - 2Z)^2 A^{-1} + 11A^{-1/2}$$

$$B = 931 (1.00783Z + 1.00867N - M)$$

Nuclear Radius

$$R(\text{cm}) = 1.4 \times 10^{-13} A^{1/3}$$

Magic Numbers

2, 8, 20, 28, 50, 82, 126 (also 118 for p^+)

AMU

$1\,\text{u} = 931\,\text{MeV}$

Coulomb Barrier

$$E_C = 1.11 \frac{(A + A')}{A} \frac{ZZ'}{\left(A^{1/3} + A'^{1/3}\right)}$$

Specific Activity

A is mass number, T is half-life in days

$\frac{\text{mCi}}{\text{mg}}$

$\frac{1.3 \times 10^8}{AT}$

$\frac{\text{MBq}}{\text{mg}}$

$\frac{4.8 \times 10^6}{AT}$

Equilibrium

Secular

$$\lambda_d N_d = \lambda_p N_p \left(1 - e^{-\lambda dt}\right)$$

Beta Recoil

$$E_{Max} = E_m \frac{m_e}{m_e + M_D}$$

Alpha Range

$$R_{air} = 0.31 E_\alpha^{1.5}$$

$$R_? = R_{air} * \rho_{Air}/\rho_?$$

$$E_\alpha = E_{decay} \frac{m_{Daughter}}{m_\alpha + m_{Daughter}}$$

α produces $30\,000$ ion pairs per cm in air

Beta Ranges

$$E_{avg} \approx E_{max}/3$$

$$E_{max}^{daughter} = E_\beta \frac{m_\beta}{m_\beta + M_{daughter}}$$

$$R(mg/cm^2) = \begin{cases} 543 E_m - 133 & E_m \geq 0.8\,\text{MeV} \\ 407 E_m^{1.38} & E_m < 0.8\,\text{MeV} \end{cases}$$

Scattering increases with Z and surface density up to about 1/5 of the range

Compton

$$E_s = \frac{E_{tot}}{1 + \frac{E_{tot}}{m_e} (1 - \cos\theta_\gamma)}$$