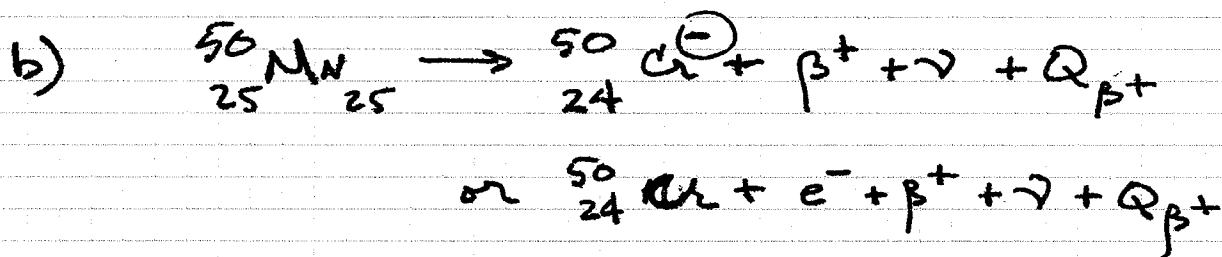
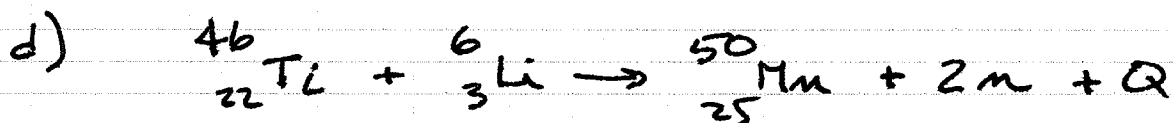


$$1 a) \quad Z(A) = \frac{A}{2} \frac{81}{80 + 0.6A^{2/3}} = \frac{100 \times 81}{2 * (80 + 0.6(100)^{2/3})} = 43.98 \sim 44$$



$$c) \quad \frac{A}{A_0} = e^{-\lambda t} = e^{-\frac{\ln 2}{0.28 \text{ h}} \times 1 \text{ h}} = e^{-2.476} = 8.41 \times 10^{-2}$$



$$e) \quad \sigma_{\text{geo}} \sim \pi R^2 = \pi \left(1.2(46)^{1/3} + 1.2(6)^{1/3} \right)^2 \text{ fm}^2$$

$$= \pi (4.30 + 2.18)^2 = 132. \text{ fm}^2$$

$$= 1.32 \text{ barns}$$

$$f) \quad V_{\text{coul}}^{\text{CNS}} = \frac{1.439 \text{ MeV} \cdot \text{fm} \cdot Z_1 Z_2}{R} = \frac{1.439 \text{ MeV} \cdot \text{fm} \times 3 \times 22}{(4.30 + 2.18) \text{ fm}}$$

$$= 14.7 \text{ MeV}$$

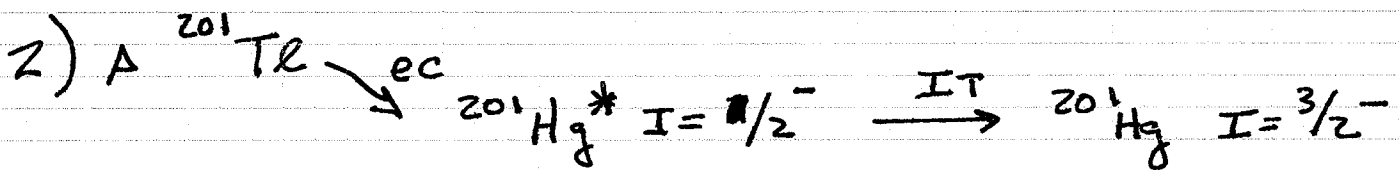
g) The cross section for slow neutrons increases w/ $\frac{1}{\text{velocity}}$ due to the deBroglie wavelength increase of slow moving particles



which is a doubly-magic or doubly closed shell
 \rightarrow like noble gases in atoms \rightarrow increased stability

i) $A_{\text{fission}} \sim \frac{236}{92} \times Z_{\text{fission}} \rightarrow \frac{236}{92} \times 36 = 92.3$
 so "92"

- j) • all fissile nuclei are even-odd and capture of neutron gives more excitation energy when E-E product is formed
- ${}^{238}\text{U}$ is E-E and produces E-O ${}^{239}\text{U}$ with less excitation energy than fissile nuclei



δ_{IT} has $\Delta l = \frac{3}{2} - \frac{1}{2} = 1 \hbar$ $\Delta \pi = \ominus \rightarrow \ominus = \text{No}$
 therefore M1

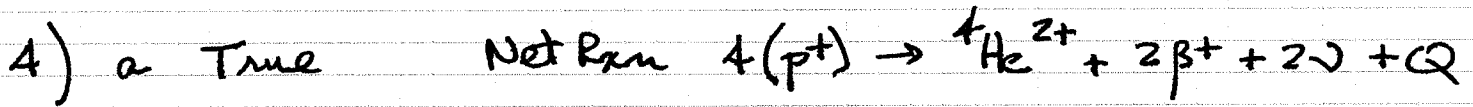
B $\lambda_{sp}(s^{-1}) = 3.15 \times 10^{13} \underbrace{(0.167)^3}_{4.66 \times 10^{-3}} = 1.47 \times 10^{11} / s$

3) A $\text{fission Rate} = \frac{MWe}{\epsilon_{\text{fic}}} \frac{1}{\Delta E / \text{fission}} = \frac{1100 \times 10^6 \text{ W}}{0.30} \left(\frac{1 \text{ J}/2}{\text{W}} \right) \frac{1}{\Delta E / \text{fission}}$

f. Rate = $\frac{3.66 \times 10^9 \text{ J}}{\frac{195 \text{ MeV}}{\text{fission}} \times 10^6 \frac{\text{eV}}{\text{MeV}} \times 1.602 \times 10^{-19} \frac{\text{J}}{\text{eV}}} = 1.17 \times 10^{20} \frac{\text{fission}}{\text{sec}}$
 $\frac{3.124 \times 10^{11} \text{ J/f}}{}$

$$3) B \quad \frac{\text{Mass}}{\text{yr}} = 1.17 \times 10^{20} \frac{\text{fission}}{\text{sec}} \times 3.15 \times 10^7 \frac{\text{s}}{\text{yr}} \times \frac{235 \text{ g}}{\text{mol}} \times \frac{1}{N_A \text{ /mol}}$$

$$= 1.44 \times 10^6 \text{ g/yr} = 1.44 \times 10^3 \frac{\text{kg}}{\text{yr}} = 1.44 \text{ metric ton/yr}$$



b False, sun only makes He

c False, several very different processes must

d True, ${}^{209}\text{Bi} + n \rightarrow {}^{210}\text{Bi} \rightarrow {}^{210}\text{Po} \rightarrow {}^{206}\text{Pb} + \alpha \dots$ have taken place

e True, can't go above $A=210$
several examples given in lecture & homework