(21.4) In a ^{233}U fueled reactor, some ^{233}U is converted into ^{235}U. Calculate the amount of ^{235}U formed in 1 t ^{233}U from neutron capture in ^{233}U and ^{234}U ($\sigma_{n,\gamma}$ 97 b) for a fluence of 10^{25} n m^{-2} (a) assuming no consumption of ^{235}U formed, (b) taking ^{235}U fission and capture into account.

$N_A := 6.022137 \cdot 10^{23} \cdot mole^{-1}$

$M_{233} := 233 \cdot gm \cdot mole^{-1}$ $M_{234} := 234 \cdot gm \cdot mole^{-1}$ $M_{235} := 235 \cdot gm \cdot mole^{-1}$

$\rho_{\gamma 233} := 47.7 \cdot 10^{-28} \cdot m^2$ $\rho_{\gamma 234} := 97 \cdot 10^{-28} \cdot m^2$ $\rho_{\gamma 235} := 89.6 \cdot 10^{-28} \cdot m^2$

$\phi t := 10^{25} \cdot m^{-2}$ $m_{233} := 1000 \cdot kg$

$\rho_{f235} := 582.2 \cdot 10^{-28} \cdot m^2$ coarse guess $\phi = 10^{17}$ m^{-2} s^{-2} > t=10^8 s

(a) $t_{irr} := 10^8 \cdot sec$ $\phi := \frac{\phi t}{t_{irr}}$

$N_{233} := \frac{m_{233}}{M_{233}} \cdot N_A$

$N_{234} := \phi t \cdot \rho_{\gamma 233} \cdot N_{233}$ $N_{235} := \phi t^2 \cdot \rho_{\gamma 233} \cdot \rho_{\gamma 234} \cdot N_{233} \cdot 0.5$

$m_{234} := \frac{N_{234}}{N_A} \cdot M_{234}$ $m_{235} := \frac{N_{235}}{N_A} \cdot M_{235}$ $m_{235} = 2.333 \cdot kg$

(b) $N_{235} := \phi t^2 \cdot \rho_{\gamma 233} \cdot \rho_{\gamma 234} \cdot N_{233} \cdot 0.5 \cdot \left[1 - exp\left[-t_{irr} \cdot \left(\rho_{\gamma 235} + \rho_{f235} \right) \cdot \phi \right] \right]$

$N_{235} = 2.925 \cdot 10^{24}$ $m_{235} := \frac{N_{235}}{N_A} \cdot M_{235}$ $m_{235} = 1.141 \cdot kg$