

(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.

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

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

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$$\rho_{j233} := 47.7 \cdot 10^{-28} \cdot \text{m}^2$$

$$\rho_{j234} := 97 \cdot 10^{-28} \cdot \text{m}^2$$

$$\rho_{j235} := 89.6 \cdot 10^{-28} \cdot \text{m}^2$$

$$\phi t := 10^{25} \cdot \text{m}^{-2}$$

$$m_{233} := 1000 \cdot \text{kg}$$

$$\rho_{f235} := 582.2 \cdot 10^{-28} \cdot \text{m}^2$$

$$\text{coarse guess } \phi = 10^{17} \text{ m}^{-2} \text{ s}^{-2} > t = 10^8 \text{ s}$$

$$(a) \quad t_{irr} := 10^8 \cdot \text{sec}$$

$$\phi := \frac{\phi t}{t_{irr}}$$

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

$$N_{234} := \phi t \cdot \rho_{j233} \cdot N_{233}$$

$$N_{235} := \phi t^2 \cdot \rho_{j233} \cdot \rho_{j234} \cdot N_{233} \cdot 0.5$$

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

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

$$m_{235} = 2.333 \cdot \text{kg}$$

$$(b) \quad N_{235} := \phi t^2 \cdot \rho_{j233} \cdot \rho_{j234} \cdot N_{233} \cdot 0.5 \cdot \left[1 - \exp\left[-t_{irr} \cdot (\rho_{j235} + \rho_{f235}) \cdot \phi\right] \right]$$

$$N_{235} = 2.925 \cdot 10^{24}$$

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

$$m_{235} = 1.141 \cdot \text{kg}$$