(17.5) A sample containing 50 g ethyl iodide was irradiated with neutrons from a RaBe source of $1*10^9$ n $m^{-2}$ $s^{-1}$ for 2 h. If there is a 20% retention and separation occurs 5 min after end of irradiation, what will be the activity of the AgI sample 10 min after separation? The detector has an 8% efficiency for the emitted $\gamma$-radiation. Assume the reaction cross-section for $^{127}I(n,\gamma)^{128}I$ ($\beta^-$, 25.0 min) to be 6.2 b.

First some definitions:

$barn := 10^{-28} \cdot m^2$ $N_A := 6.022137 \cdot 10^{23} \cdot mole^{-1}$ $Bq := sec^{-1}$

Then the data given in the text and elsewhere:

$\phi := 1 \cdot 10^9 \cdot m^{-2} \cdot sec^{-1}$ $\sigma_{I127} := 6.2 \cdot barn$ $t_{half} := 25.0 \cdot min$ $\psi := \frac{8}{100}$

$t_{irr} := 2 \cdot hr$ $t_{cool1} := 5 \cdot min$ $t_{cool2} := 10 \cdot min$

$\lambda := \frac{ln(2)}{t_{half}}$ $m_{ethyliodide} := 50 \cdot gm$

$M_H := 1.008 \cdot gm \cdot mole^{-1}$ $M_C := 12.01 \cdot gm \cdot mole^{-1}$ $M_I := 126.90 \cdot gm \cdot mole^{-1}$

$M_{CH3I} := 2 \cdot M_C + 5 \cdot M_H + 1 \cdot M_I$

Calculations:

$N_{0I} := \frac{m_{ethyliodide}}{M_{CH3I}} \cdot N_A$

$A_{I128} := \phi \cdot \sigma_{I127} N_{0I} \left(1 - exp\left(-\lambda \cdot t_{irr}\right)\right) \cdot exp\left[-\lambda \cdot \left(t_{cool1} + t_{cool2}\right)\right]$ Eqn. (17.14)

$\eta := \frac{100 - 20}{100}$ $R_{I128} := \eta \cdot A_{I128} \cdot \psi$ $R_{I128} = 4872.867 \cdot Bq$ (counts/second)