(19.10) Our solar system is considered to be 4.5 billion years old. What was the ^{235}U percentage in natural uranium when the solar system was formed?

$N_A := 6.022137 \cdot 10^{23} \cdot mole^{-1}$ $M_{235} := 235 \cdot gm \cdot mole^{-1}$ $M_{238} := 238 \cdot gm \cdot mole^{-1}$

$t_{h235} := 7.038 \cdot 10^8 \cdot yr$ $\lambda_{235} := \frac{ln(2)}{t_{h235}}$

$t_{h238} := 4.468 \cdot 10^9 \cdot yr$ $\lambda_{238} := \frac{ln(2)}{t_{h238}}$

$x_{235} := 0.72 \cdot \%$ $x_{238} := 1 - x_{235}$

$M_U := x_{235} \cdot M_{235} + x_{238} \cdot M_{238}$

Assume 1 kg uranium for simplicity: $m_{tot} := 1 \cdot kg$

$N_{235} := \frac{m_{tot}}{M_U} \cdot N_A \cdot x_{235}$ $N_{238} := \frac{m_{tot}}{M_U} \cdot N_A \cdot x_{238}$ $t_{age} := 4.5 \cdot 10^9 \cdot yr$

$N_{0235} := N_{235} \cdot exp(\lambda_{235} \cdot t_{age})$ $m_{old235} := \frac{N_{0235}}{N_A} \cdot M_{235}$

$N_{0238} := N_{238} \cdot exp(\lambda_{238} \cdot t_{age})$ $m_{old238} := \frac{N_{0238}}{N_A} \cdot M_{238}$

$m_{old} := m_{old235} + m_{old238}$

$Fraction_{235} := \frac{m_{old235}}{m_{old}}$ $Fraction_{235} = 0.231$ or

$Fraction_{235} = 23.052 \cdot \%$