(9.5) In order to determine the amount of gallium in meteorite iron, 373.5 mg meteorite iron (A) and 10.32 mg gallium oxinate (B) were irradiated in a reactor under similar conditions in 30 min. After a short cooling, A was dissolved in concentrated HCl and 4.53 mg inactive Ga^{3+} was added. After a number of chemical separation steps, which were not quantitative, a precipitate of 25.13 mg pure gallium oxinate was isolated (C). Sample B was also dissolved and diluted to 50 ml; 0.50 ml was removed, 4 mg inactive Ga^{3+} added, and gallium oxinate precipitated (D). The radioactive decay curve gave two straight lines: $\log R_C = 3.401 - 0.0213 * t$, and $\log R_D = 3.445 - 0.0213 * t$. What was the gallium content in sample A?

Sample A: 373.5 mg of Fe+Ga
Sample B: 10.32 mg Ga-oxinate
Oxine: C_9H_7NO = HOx
Ga-oxinate: $Ga(Ox)_3$

$M_{wH} := 1.008 \cdot \frac{gm}{mole}$ $M_{wC} := 12.01 \cdot \frac{gm}{mole}$

$M_{wO} := 16.00 \cdot \frac{gm}{mole}$ $M_{wN} := 14.01 \cdot \frac{gm}{mole}$

$M_{wGa} := 69.72 \cdot \frac{gm}{mole}$

$M_{wGaOx3} := M_{wGa} + 3 \cdot \left(9 \cdot M_{wC} + 6 \cdot M_{wH} + M_{wN} + M_{wO}\right)$

$M_{wGaOx3} = 0.502 \cdot \text{kg}$

$m_{tot} := 0.3735 \cdot gm$ $m_{GaOx} := 10.32 \cdot 10^{-3} \cdot gm$

At t=0 we have: $R_C := 10^{3.401} \cdot sec^{-1}$ $R_C = 2.518 \cdot 10^{3} \cdot \text{sec}^{-1}$

$R_D := 10^{3.445} \cdot sec^{-1}$ $R_D = 2.786 \cdot 10^{3} \cdot \text{sec}^{-1}$

$m_B := \frac{m_{GaOx}}{M_{wGaOx3}} \cdot M_{wGa}$ $m_B = 1.433 \cdot 10^{-6} \cdot \text{kg}$

$S_B := \frac{50}{0.50} \cdot \frac{R_D}{m_B}$ $S_B = 1.945 \cdot 10^{11} \cdot \text{kg}^{-1} \cdot \text{sec}^{-1}$

$m_{pureGaOx} := 25.13 \cdot 10^{-3} \cdot gm$

$m_C := \frac{m_{pureGaOx}}{M_{wGaOx3}} \cdot M_{wGa}$ $m_C = 3.489 \cdot 10^{-6} \cdot \text{kg}$ $S_C := \frac{R_C}{m_C}$

$S_C = 7.216 \cdot 10^{8} \cdot \text{kg}^{-1} \cdot \text{sec}^{-1}$

The specific activities are connected by the eqn. $S_C = m_A * S_B / (m_A + 4.53 * 10^{-3})$ which gives:

$m_{Ga.added} := 4.53 \cdot 10^{-3} \cdot gm$ $m_A := \frac{m_{Ga.added} \cdot S_C}{S_B - S_C}$

$m_A = 1.687 \cdot 10^{-8} \cdot \text{kg}$

$m_A = 1.687 \cdot 10^{-5} \cdot gm$ Ga in sample

$Ga_{conc} := \frac{m_A}{m_{tot}}$ $Ga_{conc} = 4.5 \cdot 10^{-3} \cdot \%$