

Answer on Question #77417, Chemistry / Inorganic Chemistry

Question:

Cesium-139 is a radioactive isotope. 10.0 ug of pure Cs-139 (isotopic mass = 138.913364u) has an activity of 1460.2 Curies. What is the half-life of Cs-139 in minutes?

Solution:

Amount of Cs-139: $10.0 / 138.913364 = 0.072 \text{ umol} = 7.2 \cdot 10^{-8} \text{ mol}$

Quantity of atoms of Cs-139: $7.2 \cdot 10^{-8} \cdot 6.022 \cdot 10^{23} = 4.33584 \cdot 10^{16} \text{ atoms}$

1 Curie = $3.7 \cdot 10^{10}$ decays per second

Activity: $1460.2 \cdot 3.7 \cdot 10^{10} = 5.40274 \cdot 10^{13} \text{ decays per second}$

Decay constant: $\lambda = 5.40274 \cdot 10^{13} / 4.33584 \cdot 10^{16} = 1.246 \cdot 10^{-3} \text{ s}^{-1}$

Half-life: $t_{1/2} = \ln(2) / \lambda = 0.693 / 1.246 \cdot 10^{-3} = 556.18 \text{ s} = 9.27 \text{ min}$

Answer:

9.27 min

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