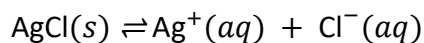


Nuclear Chemistry

Section 138 – Uses of Radioisotopes

138-1 How can a radioactive nuclide be used to show that the equilibrium:



is a dynamic equilibrium?

Solution

Introduction of either radioactive Ag^+ or radioactive Cl^- into the solution containing the stated reaction, with subsequent time given for equilibration, will produce a radioactive precipitate that was originally devoid of radiation.

138-2 Technetium-99m has a half-life of 6.01 hours. If a patient injected with technetium-99m is safe to leave the hospital once 75% of the dose has decayed, when is the patient allowed to leave?

Solution

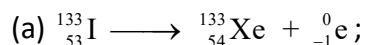
75% decayed is equivalent to 25% remaining. This represents two half-lives $\left(\frac{1}{2}\right)^2 = 0.25$, so the patient would be free to go after 12.02 hours

138-3 Iodine that enters the body is stored in the thyroid gland from which it is released to control growth and metabolism. The thyroid can be imaged if iodine-131 is injected into the body. In larger doses, I-131 is also used as a means of treating cancer of the thyroid. I-131 has a half-life of 8.70 days and decays by β^- emission.

(a) Write an equation for the decay.

(b) How long will it take for 95.0% of a dose of I-131 to decay?

Solution



(b) First, find the value of λ :

$$\lambda = \frac{0.6931}{8.70 \text{ day}} = 0.07967 \text{ day}^{-1}$$

$$\frac{\ln c_0}{c} = \lambda t; \ln\left(\frac{1.000}{0.050}\right) = 0.07967 \text{ day}^{-1} t$$

$$t = \frac{2.996}{0.07967 \text{ day}^{-1}} = 37.6 \text{ days}$$