

NUCLEAR CHEMISTRY

PRACTICE EXERCISES

1. Given : Iodine-131
 $t_{1/2} = 8 \text{ days}$
 $N_0 = 12.0 \text{ g}$
 $t = 32.0 \text{ days}$

Req'd: N_t

Solution: First, solve for k - radioactive decay constant

$$t_{1/2} = \frac{0.693}{k}$$

$$k = \frac{0.693}{t_{1/2}} = \frac{0.693}{8 \text{ days}}$$

$$k = 0.0866 \text{ day}^{-1}$$

or
0.0866 /day

Then, solve for N_t :

$$\ln \frac{N_t}{N_0} = -kt$$

* use natural log or ln Properties

$$e^{\ln(x)} = x$$

$$e^{\ln \frac{N_t}{N_0}} = e^{-kt}$$

$$\frac{N_t}{N_0} = e^{-kt}$$

$$N_t = N_0(e^{-kt})$$

$$= 12.0 \text{ g} [e^{-(0.0866/\text{day})(32.0 \text{ days})}]$$

$$N_t = 0.7510 \text{ g} \text{ will remain after 32 days}$$

2. Given : Strontium-90

$$\left. \begin{array}{l} N_0 = 1.00 \text{ g} \\ N_t = 0.953 \text{ g} \\ t = 2.0 \text{ years} \end{array} \right\}$$

Req'd: a) $t_{1/2}$, half-life

b) N_t after $t = 5.0 \text{ yr}$

Solution:

a) First, solve for k

$$\ln \frac{N_t}{N_0} = -kt$$

$$\ln \frac{0.953 \text{ g}}{1.0 \text{ g}} = -k(2 \text{ yr})$$

$$k = 0.0241 \text{ yr}^{-1}$$

or
0.0241 /yr

Then, solve for $t_{1/2}$

$$t_{1/2} = \frac{0.693}{k} = \frac{0.693}{0.0241 \text{ yr}^{-1}}$$

$$t_{1/2} = 28.7552 \text{ yr} \text{ half-life}$$

$$b) \ln \frac{N_t}{N_0} = -kt$$

↓

$$e^{\ln \frac{N_t}{N_0}} = e^{-kt}$$

$$\frac{N_t}{N_0} = e^{-kt}$$

$$N_t = N_0 e^{-kt}$$

$$= (1.00 \text{ g})(e^{-(0.0241/\text{yr})(5 \text{ yr})})$$

$$N_t = 0.8869 \text{ g} \text{ will remain after 5 yrs.}$$

Notes On Nuclear Chemistry Solved Problems

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