p 861   36, 37, 38, 39, 40, 43, 45, 47, 50, 54, 56

36) $A_0 = 1280$ decays min^{-1}
$A = 370$ decays min^{-1}
$t = 4.6\,h = 276$ min

$A = A_0 e^{-\lambda t}$

$$\lambda = \frac{-\ln\left(\frac{A}{A_0}\right)}{t} = \frac{-\ln\left(\frac{370}{1280}\right)}{276\text{ min}} = 0.005$$

$$T_{1/2} = \frac{\ln(2)}{\lambda} = \frac{\ln(2)}{0.005} = 138\text{ min} = \underline{140\text{ min}}$$

37) (a) $\lambda = \frac{\ln(2)}{T_{1/2}} = \frac{\ln(2)}{4.5 \times 10^{9}\text{ yr}} = \underline{1.5 \times 10^{-10}\text{ yr}^{-1}}$

(b) $T_{1/2} = \frac{\ln(2)}{\lambda} = \frac{\ln(2)}{8.2 \times 10^{-5}\text{ s}^{-1}} = \underline{8500\text{ s}}$

38) ^{14}C $T_{1/2} = 5730$ yr $\lambda = \frac{\ln(2)}{T_{1/2}} = \frac{\ln(2)}{5730\text{ yr}} = 1.2097 \times 10^{-4}\text{ yr}^{-1}$

$$A = \lambda N = (1.2097 \times 10^{-4}\text{ yr}^{-1})(3.1 \times 10^{20}) = 3.75 \times 10^{16}\text{ decays yr}^{-1}$$
$$= \underline{1.19 \times 10^{9}\text{ Bq}}$$

39) $\lambda = \frac{\ln(2)}{T_{1/2}} = \frac{\ln(2)}{(9/12)\text{ yr}} = 0.924\text{ yr}^{-1}$

$$\frac{A}{A_0} = e^{-\lambda t} = e^{-(.924)(3)} = \underline{0.06}$$

(40) $$\frac{A}{A_0} = e^{-\lambda t} = e^{-\frac{\ln 2}{T_{1/2}}(6T_{1/2})} = \underline{0.02}$$

(43) ^{131}I $\quad T_{1/2} = 8.0207$ days $\qquad \lambda = \frac{\ln 2}{T_{1/2}} = 1.0 \times 10^{-6}\ s^{-1}$

(a) $$\frac{130.906124\ g}{682 \times 10^{-6}\ g} = \frac{6.02 \times 10^{23}}{x}$$

$$N_0 = 3.136 \times 10^{18}$$

$$A_0 = \lambda N = (1.0 \times 10^{-6}\ s^{-1})(3.136 \times 10^{18}) = \underline{3.14 \times 10^{12}\ Bq}$$

(b) $$A = A_0 e^{-\lambda t}$$
$$= (3.14 \times 10^{12}\ Bq)\, e^{-(1.0 \times 10^{-6}\ s^{-1})(3600\ s)} = \underline{3.13 \times 10^{12}\ Bq}$$

(c) $$A = A_0 e^{-\lambda t}$$
$$= (3.14 \times 10^{12}\ Bq)\, e^{-(1.0 \times 10^{-6}\ s^{-1})(1.578 \times 10^{7}\ s)} = \underline{4.40 \times 10^{5}\ Bq}$$

(45) $$\lambda = \frac{\ln 2}{T_{1/2}} = \frac{\ln 2}{(1.28 \times 10^{9}\ yr)(3.156 \times 10^{7}\ s\ yr^{-1})} = 1.7153 \times 10^{-17}\ s^{-1}$$

$$A = \lambda N$$
$$N = \frac{A}{\lambda} = \frac{2.0 \times 10^{5}\ s^{-1}}{1.7153 \times 10^{-17}\ s^{-1}} = 1.166 \times 10^{22} \text{ nuclei}$$

$$\frac{1.166 \times 10^{22}}{6.02 \times 10^{23}} = 0.019\ mol\ (40\ g\ mol^{-1}) = \underline{0.77\ g}$$

(47) $\lambda = \frac{\ln 2}{T_{1/2}} = \frac{\ln 2}{7.55 \times 10^{6} s} = 9.181 \times 10^{-8} s^{-1}$

$A = \lambda N$

$N = \frac{A}{\lambda} = \frac{2.65 \times 10^{5} s^{-1}}{9.181 \times 10^{-8} s^{-1}} = 2.886 \times 10^{12}$ nuclei

$\frac{2.886 \times 10^{12}}{6.02 \times 10^{23}} = 4.795 \times 10^{-12} mol \left(35 g mol^{-1}\right) = \underline{1.68 \times 10^{-10} g}$

(50) $\frac{12.0107 g}{285 g} = \frac{6.02 \times 10^{23}}{x}$

1.428×10^{25} atoms $(1.3 \times 10^{-12}) = 1.857 \times 10^{13}$ ^{14}C atoms

$T_{1/2} = 5730 yr (3.156 \times 10^{7} s yr^{-1}) = 1.808 \times 10^{11} s$

$\lambda = \frac{\ln(2)}{T_{1/2}} = \frac{\ln(2)}{1.808 \times 10^{11}} = 3.834 \times 10^{-12} s^{-1}$

$A = \lambda N = (3.834 \times 10^{-12})(1.857 \times 10^{13}) = \underline{71.2 Bq}$

(54) $T_{1/2} = 53 d = 4.579 \times 10^{6} s$

$\lambda = \frac{\ln 2}{T_{1/2}} = 1.514 \times 10^{-7} s^{-1}$

(a) $A = A_0 e^{-\lambda t}$

$t = \frac{-\ln\left(\frac{A}{A_0}\right)}{\lambda} = \frac{-\ln\left(\frac{15}{450}\right)}{1.514 \times 10^{-7}} = \underline{2.3 \times 10^{7} s} = \underline{4.3 \text{ days}}$

54 (b) $A = \lambda N$

$N = \frac{A}{\lambda} = \frac{450\ s^{-1}}{1.514 \times 10^{-7} s^{-1}} = 2.97 \times 10^{9}$ atoms

$\frac{2.97 \times 10^{9}}{6.02 \times 10^{23}} = 4.937 \times 10^{-15}$ mol $(7g) = \underline{3.5 \times 10^{-14} g}$

56 $\frac{12.0107g}{290g} = \frac{6.02 \times 10^{23}}{x}$

1.4535×10^{25} atoms $(1.3 \times 10^{-12}) = 1.89 \times 10^{13}$ ^{14}C atoms

$T_{1/2} = 5730\ yr = 1.808 \times 10^{11} s$

$\lambda = \frac{\ln 2}{T_{1/2}} = 3.834 \times 10^{-12}\ s^{-1}$

$A_0 = \lambda N_0 = (3.834 \times 10^{-12}\ s^{-1})(1.89 \times 10^{13}) = 72.46\ s^{-1}$

$A = A_0 e^{-\lambda t}$

$t = \frac{-\ln\left(\frac{A}{A_0}\right)}{\lambda} = \frac{-\ln\left(\frac{8}{72.46}\right)}{3.834 \times 10^{-12}} = 5.748 \times 10^{11} s$

$= \underline{18\ 000\ yrs}$