# Homework: Chapter 24

Wednesday, January 10, 2007
12:18 AM

Problems: 1, 3, 5, 9, 13, 16, 17, 31, 32, 41, 42, 43, 45, 46, 47, 45, 53, 55, 60, 80, 93, 97, For fun 131

1.
   a. Chemical reactions are accompanied by relatively small changes in energy while nuclear reactions have large changes in energy
   b. Chemical reaction rates are influence by temperature but nuclear reactions are not.
   c. Chemical reaction rates are affected by concentration but nuclear reactions are not.
   d. In both chemical and nuclear reactions, a higher reactant concentration will increase the total yield.

2.
   a. Marie Sklodoska Curie found that the intensity of the radiation is directly proportional to the concentration of the element in the mineral, not to the nature of the mineral or compound in which the element occurs.
   b. Radium

5. $_2{}^2He$ has no neutrons to balance out the positive protons in the nucleus. Since the positive protons repel each other, the element does not exist.

(9) (a) $^{26}_{11}Na \rightarrow {}^{26}_{12}Mg + {}^{0}_{-1}\beta$

(b) $^{223}_{87}Fr \rightarrow {}^{223}_{88}Ra + {}^{0}_{-1}\beta$

(c) $^{212}_{83}Bi \rightarrow {}^{4}_{2}He + {}^{208}_{81}Tl$

(13) (a) $^{241}_{95}Am$ $\beta$

$^{241}_{96}Cm \rightarrow {}^{241}_{97}Bk + {}^{0}_{-1}\beta$

(b) $^{228}_{89}Ac$ thru $\beta$

$^{228}_{88}Ra \rightarrow {}^{228}_{89}Ac + {}^{0}_{-1}\beta$

(c) $^{203}_{83}Bi$ thru $\alpha$

$^{207}_{85}At \rightarrow {}^{4}_{2}He + {}^{203}_{83}Bi$

(16) b- $^{59}_{27}Co$ because N/Z ratio is most stable

(17) b- $^{114}_{48}Cd$ because N/Z ratio is favorable

(31) The half life would be 1 minute even for larger amounts of molecules.

32. High-energy neutrons from cosmic ray collision reach Earth from outer space. When they enter the atmosphere the cause the slow formation of $^{14}C$ from $^{14}N$ atoms.

(41) $^{212}_{83}Bi$ half life 1.01yr

$1.01\text{yr} \times \frac{365.25\text{ days}}{1\text{ year}} \times \frac{24\text{hrs}}{1\text{ day}} = 8853.47\text{hrs}$

$\frac{3750\text{hrs}}{8853.47} = .4236$ half life

$2.00\text{mg} \times \frac{.4236}{2} =$

(42) $^{226}_{88}Ra$ $1.60\times10^{3}$ yr half life

$2.5\text{g Ra} \times \frac{1\text{mol}}{226\text{g}} = 0.011062\text{ mol}$

$1.85\text{g Ra} \times \frac{1\text{mol}}{226\text{g}} = .0081858$

$1.60\times10^{3} = \frac{\ln 2}{k}$

$k = 4.33\times10^{-4}$

$\ln\left(\frac{N_t}{N_0}\right) = -kt = \ln\left(\frac{2.5}{1.85}\right) = (4.33\times10^{-4})t$

$t = 695$

(43) $270\ \mu\text{mol}\ ^{238}U$ $t_{1/2} = 4.5\times10^{9}$ yr

$110\ \mu\text{mol}\ ^{206}Pb$

$4.5\times10^{9} = \frac{\ln 2}{k}$ $\quad k = 1.54\times10^{-10}$

$\ln\left(\frac{110}{270}\right) = -(1.54\times10^{-10})t$

$t = 5.8\times10^{9}$

(45) $^{40}K$ $\quad \frac{6\times10^{-11}\text{ mCi}}{1\text{ mL}} = \frac{3.70\times10^{10}\text{ d}}{1\text{s}\cdot1\text{C}} \times \frac{1\text{C}}{1.056688\text{ qt}} = 3.5\times10^{10}$

(47) $N_0 = 2.1\times10^{-15}\text{ mol} + \left(9.5\times10^{4}\text{ atoms} \times \frac{1\text{mol}}{6.022\times10^{23}}\right)$

$= 2.1001577\times10^{-15}$

$\ln\left(\frac{2.1100157\overset{549}{7}\times10^{-15}}{2.1\times10^{-15}}\right) = (4.95\times10^{-11})t$

$1.4\times10^{10} = \frac{\ln 2}{k}$ $\quad k = 4.95\times10^{-11}$

$t = 9.7\times10^{7}$

$t = 9.7 \times 10^7$

(46) $2.41 \times 10^4 \times 7 =$ 168703 yrs

(53) (a) $^{10}B(\alpha, n)\ \underline{N}$

(b) $^{28}Si(d, \underline{n})^{29}P$ (the d is $^2H$)

(c) $_{66}\underline{Dy}(\alpha, 2n)^{244}_{98}Cf$

(55) $^{249}_{98}Cf + ^{12}_{6}C \rightarrow ^{257}_{104}Rf + 4\,^1_0n$

$^{249}_{98}Cf + ^{14}_{7}N \rightarrow ^{259}_{105}Db + 4\,^1_0n$

$^{249}_{98}Cf + ^{14}_{7}N \rightarrow ^{261}_{106}Sg + 4\,^1_0n$

(60) (a) 135 lb person

$$\frac{3.3 \times 10^{-7}\ J}{135\ lb} \times \frac{kg}{.01\ J} \times \frac{2.2046\ lb}{1\ kg} = 5.4 \times 10^{-7}$$

(b) $5.4 \times 10^{-7}$

(80) (a) $205.974440\ amu \times \frac{931.5\ MeV}{1\ amu} = 191865.19086\ MeV$

(b) $\frac{191865}{204} = 931.38\ MeV$

(c) $931.38 \times 6.022 \times 10^{23} = 5.609 \times 10^{26}\ MeV$

(83) (a) $^{80}_{35}Br \rightarrow _{36}Kr + ^0_{-1}\beta$

$^{80}_{35}Br + ^0_{-1}e \rightarrow ^{80}_{34}Se$

oops, did an extra problem

(b) $E = mc^2$ $\beta$ releases more energy

(93) $^3_1H + ^2_1H \rightarrow ^4_2He + ^1_0n$

$^3_1H = 3.01605\ amu$, $^2_1H = 2.0140\ amu$, $^4_2He = 4.00260\ amu$, $^1_0n = 1.008665\ amu$

$1.7 \times 10^9\ kJ/mol$

(97) $4.38\ g\ CaCO_3 \times \frac{1\ mol}{} = 0.04376\ mol$

(97) $4.38\,g\ CaCO_3 \times \frac{1\,mol}{100.09\,g} = 0.04376\,mol$

$\frac{3.2\,d}{min} \times \frac{60\,min}{1\,hr} \times \frac{24\,hr}{1\,day} \times \frac{365.25\,day}{1\,yr} = \frac{1683072\,d}{1\,yr}$