Dr. Krueger (CHEM 121-01)  
April 20, 2007  
(10 pts)  
(name)  

\[ \begin{align*} 
\text{Masses:} \\
\text{Proton} &= 1.672622 \times 10^{-24} \text{ kg} = 1.007276 \text{ g/mol} \\
\text{Neutron} &= 1.674927 \times 10^{-24} \text{ kg} = 1.008665 \text{ g/mol} \\
\text{Electron} &= 9.1094 \times 10^{-31} \text{ kg} = 5.486 \times 10^{-4} \text{ g/mol} 
\end{align*} \]

1. (3 pts) Write the balanced nuclear reaction for \(^{202}\text{Pb}\) decaying by \(\alpha\) emission.

\[ \begin{align*} 
\text{202}^{81}\text{Pb} & \rightarrow 4\alpha + 198^{79}\text{Au} 
\end{align*} \]

2. (4 pts) How much energy is released when one mole of platinum decays through the following reaction?

\[ \text{197}^{78}\text{Pt} \rightarrow \text{197}^{79}\text{Au} + 0^{-1}\beta^- \]

The isotopic mass of \(^{78}\text{Pt}\) is 196.967323 g/mol and the isotopic mass of \(^{79}\text{Au}\) is 196.966587 g/mol

\[ \Delta \text{mass} = -196.967323 + (196.966587 + 5.486 \times 10^{-4}) \text{ g/mol} \]

\[ = -2.057 \times 10^{-4} \text{ g/mol} \]

\[ \Delta E = mc^2 = \left(-2.057 \times 10^{-4} \text{ g/mol}\right) \left(\frac{1 \text{ kg}}{1000 \text{ g}}\right) \left(2.9979 \times 10^8 \text{ m/s}\right)^2 \]

\[ = -1.847 \times 10^7 \text{ J/mol} \]

3. (3 pts) Write a general balanced equation for a nuclide decaying by electron capture. For example, the general balanced equation for beta decay (as seen in #2) is:

\[ \begin{align*} 
\text{z}\text{X} & \rightarrow \text{z+1}\text{Y} + 0^{-1}\beta^- \\
\text{z}\text{X} + 0^{-1}\text{e} & \rightarrow \text{z-1}\text{Y} + \text{z-RA}\text{Y} 
\end{align*} \]

4. (2 pt bonus) Does electron capture happen to nuclides that lie above or below the belt of stability?

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