**Chapter 20 Nuclear Chemistry Math Summary**

Particles Involved in Nuclear Reactions, either as Nucleons, Emitted particles or Particles that React with a Nucleus and Induce a Decay

(Memorize these for Test)
- the first three, alpha, beta, and positrons are the crucial ones for balancing radioactive nuclear decay reactions

<table>
<thead>
<tr>
<th>Particle</th>
<th>Charge</th>
<th>Mass Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$^4_2$He</td>
<td>0</td>
<td>4</td>
<td>$\alpha$-particle (alpha)</td>
</tr>
<tr>
<td>$^0_0\gamma$</td>
<td>0</td>
<td>0</td>
<td>gamma</td>
</tr>
<tr>
<td>$^0_{-1}$e</td>
<td>1</td>
<td>0</td>
<td>$\beta$-particle (beta), electron</td>
</tr>
<tr>
<td>$^0_{+1}$e</td>
<td>0</td>
<td>1</td>
<td>positron</td>
</tr>
<tr>
<td>$^1_0$n</td>
<td>0</td>
<td>1</td>
<td>neutron</td>
</tr>
<tr>
<td>$^1_1$H</td>
<td>1</td>
<td>0</td>
<td>proton</td>
</tr>
</tbody>
</table>

Radioactive Decay Math

\[
t = \left(\frac{t_{1/2}}{0.693}\right) \ln \left(\frac{A_o}{A_t}\right)
\]

When solving for time, given half life and quantities of material

\[
\ln \left(\frac{A_o}{A_t}\right) = 0.693 \left(\frac{t}{t_{1/2}}\right)
\]

When solving for the amount of material left after a given time, given the half life

Handling “\(\ln y = x\)” on calculator, when you know “\(x\)” but want to solve for “\(y\)”: enter “\(x\)”, then hit your “\(e^x\)” button.

Mass Defect/Binding Energy Math

Proton mass: 1.00783

Neutron mass: 1.00867

\[E = \Delta mc^2\]

\[\Delta m = (\text{sum mass of protons plus neutrons}) - \text{actual mass}\]

- The binding energy will depend on the \(\Delta m\) difference between the summed weight of the protons and neutrons minus the actual mass of the nucleus.
- \(\Delta m\) in terms of kilograms (you’ll normally need to convert from grams to kg)
- The energy answer from the formula comes out in terms of Joules, not kJ; you’ll routinely need to convert from J to kJ to fit the answers.