Radioactivity Worksheet

1. State the number of neutrons and protons in each of the following nuclei:
   a. $^3_1H$ : __Neutrons__ = 1  __Protons__ = 1
   b. $^{12}_{6}C$ : __Neutrons__ = 6  __Protons__ = 6
   c. $^{56}_{26}Fe$ : __Neutrons__ = 30  __Protons__ = 26
   d. $^{197}_{79}Au$ : __Neutrons__ = 118  __Protons__ = 79

2. The three types of radioactive emissions are called alpha ($\alpha$), beta ($\beta$) and gamma ($\gamma$) radiation. Complete the table below with the correct information about each type.

<table>
<thead>
<tr>
<th></th>
<th>Charge</th>
<th>Atomic Symbol</th>
<th>Can Be Stopped By</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alpha</td>
<td>+2</td>
<td>$^4_2He$</td>
<td>paper</td>
</tr>
<tr>
<td>Beta</td>
<td>-1</td>
<td>$^0_e$</td>
<td>aluminum</td>
</tr>
<tr>
<td>Gamma</td>
<td>0</td>
<td>$^0_0\gamma$</td>
<td>lead</td>
</tr>
</tbody>
</table>

3. Which of the three radioactive emissions ($\alpha$, $\beta$, $\gamma$) best fit the following statements? Write the correct symbol/s on the lines.
   a) These emissions are charged. $\alpha$, $\beta$
   b) This emission is the most massive (heaviest). $\alpha$
   c) This emission is the most charged. $\alpha$
   d) This emission is most dangerous outside of the body. $\gamma$
   e) This emission is stopped by thin paper or a few centimeters of air. $\alpha$
   f) This emission can travel through paper, but is stopped by aluminum. $\beta$
   g) This emission can travel through fairly thick lead. $\gamma$

4. Which type of radiation – alpha, beta, or gamma:
   a. Results in the greatest change in atomic number? Why?
      Alpha - changes by 2

   b. Results in the least change in atomic number? Why?
      Gamma - no change in atomic number
c. Produces the greatest change in mass number? Why?

\[ \text{alpha} - \text{changes mass number by 4} \]

d. Produces the least change in mass number? Why?

\[ \text{Beta} \:\text{gamma} \: - \text{no change in mass number} \]

5. Complete the following nuclear reactions:

a. \[ ^{226}_{88}\text{Ra} \rightarrow ^{8}X + _{0}^{0}\text{e} \]
\[ ^{226}_{88}\text{Ra} \rightarrow ^{206}_{82}\text{Ac} + _{-1}^{0}\text{e} \]

b. \[ ^{209}_{84}\text{Po} \rightarrow ^{205}_{82}\text{Pb} + _{2}^{4}\text{He} \]
\[ ^{209}_{84}\text{Po} \rightarrow ^{205}_{82}\text{Pb} + _{2}^{4}\text{He} \]

c. \[ ^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} + _{2}^{4}\text{He} \]
\[ ^{238}_{92}\text{U} \rightarrow ^{234}_{90}\text{Th} + _{2}^{4}\text{He} \]

d. \[ ^{234}_{91}\text{Th} \rightarrow ^{234}_{91}\text{Pa} + _{2}^{4}\text{He} \]
\[ ^{234}_{91}\text{Th} \rightarrow ^{234}_{91}\text{Pa} + _{2}^{4}\text{He} \]

e. \[ _{2}^{4}\text{He} + _{7}^{14}\text{N} \rightarrow _{8}^{17}\text{O} + _{1}^{1}\text{H} \]
\[ _{2}^{4}\text{He} + _{7}^{14}\text{N} \rightarrow _{8}^{17}\text{O} + _{1}^{1}\text{H} \]

6. When isotope bismuth-213 emits an alpha particle:

a. Write out the nuclear equation:
\[ ^{213}_{83}\text{Bi} \rightarrow ^{4}_{2}\text{He} + ^{209}_{83}\text{Th} \]

b. What new element results if the isotope, instead, emits a beta particle?

\[ \text{Polonium} \]