Problem Solutions for
W. D. Ehmann and D. E. Vance, Radiochemistry and Nuclear Methods of Analysis
(Rev 0)

Chapter 1

1. To determine the identity of the series, divide the mass number by 4:

\[
\frac{214}{4} = 53.5
\]

The end product of the 4n+2 series is $^{206}$Pb.

2. Number of alpha particles determined by mass difference between parent and daughter:

\[
A_{\text{parent}} - A_{\text{daughter}}
\]

\[
238 - 210 = 82 + 4 = 7 \text{ alpha particles}
\]

Number of beta particles determined by difference in protons removed and $Z$ of daughter:

protons removed by $\alpha$ decay: \[7 \times 2 = 14\]

difference in $Z$: \[Z_{\text{parent}} - Z_{\text{daughter}} = 92 - 82 = 10\]

number of beta particles: \[14 - 10 = 4 \text{ beta particles}\]

3. | Species  | No. protons | No. neutrons | No. electrons |
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>$^{235}$U</td>
<td>92</td>
<td>143</td>
<td>92</td>
</tr>
<tr>
<td>$^{14}$C</td>
<td>6</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td>$^{40}$K$^+$</td>
<td>19</td>
<td>21</td>
<td>18</td>
</tr>
<tr>
<td>$^{18}$O$^+$</td>
<td>8</td>
<td>10</td>
<td>10</td>
</tr>
</tbody>
</table>

4. The radius of curvature provided Anderson information on the mass of the positron. The radius was the same as that of the electron, or negatron, so the masses must be equivalent. The fact that the curvature was in a direction opposite to that of the negatron indicated that the charge must be opposite to that of the negatron.

5. Isotopes have the same $Z$, but different $A$. Thus, isotopes would be:

(a) $^{11}$C and $^{14}$C  
(b) $^{235}$U and $^{238}$U
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Chapter 1

6. Isotones have the same number of neutrons.
   (a) $^{59}\text{Cr}$, $^{48}\text{Ti}$ and $^{46}\text{Ca}$ all have 26 neutrons
   (b) $^{50}\text{V}$ and $^{48}\text{Sc}$ both have 27 neutrons

7. $^{235}\text{U}(\alpha,\text{n})^{238}\text{Pu}$

8. (a) stable (gray box)
    (b) secondary natural radionuclide
    (c) primary natural radionuclide
    (d) artificial radionuclide
    (e) induced natural radionuclide

9. Divide mass number by 4 to determine series:
   \[
   \frac{238}{4} = 4n + 2 \text{ series}
   \]

10. $^{238}\text{U}(^{12}\text{C},4\text{n})^{246}\text{Cf}$

11. (a) $\mu = 37$
    (b) $A = 36.9659026$
    (c) atomic mass = 35.453