1. \[ \text{\( }^{218}_{84}\text{Po} \rightarrow ^{214}_{82}\text{Pb} + 4\alpha \) \]

\[ A = 218 - 4 = 214 \]
\[ Z = 84 - 2 = 82 \]

b) \[ ^{214}_{82}\text{Pb} \rightarrow ^{214}_{83}\text{Bi} + e^- + \bar{\nu}_e \]

Beta decay
\[ A = 214 \]

c) Alpha radiation has less penetrating power than the beta radiation. The alpha radiation would be safer to hold (low penetration of the skin) but more dangerous to swallow (once inside the body, the \( \alpha \)-particles cause tremendous ionization damage.)

2. \[ \vec{F} = \frac{q \vec{v} \times \vec{B}}{c} \]
\[ = -1.6 \times 10^{-19} \text{C} \times (10^4 \text{m/s}) \times 1.5 \times 10^{-5} \text{T} = 1.5 \times 10^{-5} \text{T} (10 \text{A})(1.5 \text{m}) \]
\[ = 2.25 \times 10^{-4} \text{N repulsive} \]

\[ b) \vec{F} = \frac{\mu_0 I_1 I_2 l}{2\pi r} = \vec{B}_1 \times \vec{I}_2 \begin{array}{c} \text{m} \\
7.5 \text{A} \\
10 \text{cm}
\end{array} \]
\[ = 1.5 \times 10^{-5} \text{T} \begin{array}{c} \text{m} \\
0.1 \text{m}
\end{array} \]
\[ a) \vec{B} = \frac{\mu_0 I}{2\pi r} = \begin{array}{c} \text{m} \\
2 \times 10^{-7} \text{T} \text{m} \text{A} \\
0.1 \text{m}
\end{array} \begin{array}{c} \text{m} \\
\text{A}
\end{array} \]
\[ = 1.5 \times 10^{-5} \text{T} \begin{array}{c} \text{m} \\
\text{A}
\end{array} \]
(From the right-hand rule)
3)

\[ \frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i} \]
\[ \frac{1}{200 \text{ cm}} = \frac{1}{200 \text{ cm}} + \frac{1}{d_i} \]
\[ d_i = 2.02 \text{ cm} \]

Image 1 is 202 cm from the first lens, 3 cm from the second lens.

b) \[ m_1 = -\frac{d_i}{d_0} = -\frac{-202 \text{ cm}}{20000 \text{ cm}} = -0.0101x \]
\[ m_2 = -\frac{d_i}{d_0} = -\frac{-12 \text{ cm}}{3.0 \text{ cm}} = 4.0x \]

c) The first image is inverted, the second is "upright", so it remains inverted. Overall, the image is inverted.

\[ m_{\text{total}} = m_1 m_2 = -0.0101(4.0) = -0.0404x \]

The negative sign also indicates inverted.

d) \[ \Delta \theta = \frac{m_{\text{total}} \cdot \Delta \theta_{\text{source}}}{D} \]
\[ = \frac{1.22 \times 10^{-8} \text{ rad} \cdot 1.22 (600 \times 10^{-3} \text{ m})}{0.1 \text{ m}} = 7.32 \times 10^{-6} \text{ radians} \]