Chapter 19 Study Questions

1. Balance each of the following nuclear equations and indicate the type of nuclear reaction (α-decay, β-decay, γ-decay, fission or fusion).

   a) $^{239}_{94}Pu + ^{1}_{0}n \rightarrow ^{130}_{50}Sn + ? + 3^{1}_{0}n$

   b) $? + ^{6}_{3}Li \rightarrow 2^{4}_{2}He$

   c) $^{210}_{84}Po \rightarrow ^{4}_{2}He + ?$

   d) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{72}_{30}? + ? + 4^{1}_{0}n$

   e) $^{125}_{53}I \rightarrow ^{125}_{53}I + ?$

   f) $^{238}_{92}U \rightarrow ? + ^{234}_{?}Th$

   g) $^{235}_{92}U + ^{1}_{0}n \rightarrow ^{86}_{?}Br + ^{147}_{?}? + ?^{1}_{0}n$

   h) $^{234}_{90}Th \rightarrow ? + ^{234}_{91}?$

2. The isotope $^{137}_{55}Cs$ undergoes beta emission with a half-life of 30 years.
   a) Write a balanced nuclear equation for this reaction.
   b) What fraction of Cs-137 remains in a sample of the isotope after 60 years?
   c) What mass of Cs will be left in a 24.0 g sample of $^{137}_{55}Cs$ after 90 years?
   d) What fraction of Cs-137 has <u>decayed</u> after 120 years?

3. What is the half-life of an isotope that is 75% decayed after 16 days?

4. Explain what makes an isotope radioactive. Why do radioactive isotopes undergo radioactive decay? How does the energy released by nuclear reactions compare to that released by ordinary chemical reactions? Why?

5. Write balanced nuclear equations for:
   a) the fusion of two C-12 nuclei to give another nucleus and a neutron.
   b) the fission of U-235 to give Ba-140, another nucleus and three neutrons.

6. What new element is formed when I-131 decays by β-emission? Is the new element formed likely to be stable? Why or why not?

7. Why is nuclear fission considered a "chain reaction"? What is "critical" about critical mass? Why does nuclear fission produce radioactive waste? In a fission reaction, what is the source of the great amount of energy that is released?

Summary of Chapter 19: Radioactivity and Nuclear Energy

what makes elements radioactive
alpha emission
beta emission
gamma emission
nuclear equations
band of stability
half-life (rate of decay)
nuclear fission
  nuclear equation
  production of radioactive waste
  chain reaction
nuclear fusion