Read pp. 705-707 in your text

Part I. Overview
1. Define nuclear radiation. What is radioactive decay? What is a radioactive nuclide?
   Nuclear radiation is the particle or energy emitted by a nucleus during radioactive decay.
   Radioactive decay is the emission of nuclear radiation from an unstable nucleus as it becomes more stable.
   A radioactive nuclide is any radioactive isotope that is unstable and can undergo radioactive decay.

2. List the 5 main kinds of nuclear decay and their properties:
   Alpha particle: He-4 nucleus; mass = 4.003 amu; 2+ charge; stopped by paper/cloth; deflected in mag field
   Beta particle: electron; mass = $\frac{1}{1823}$ amu; 1– charge; stopped by metal plate; deflected in mag. field
   Positron: positive electron; mass = $\frac{1}{1823}$ amu; 1+ charge; stopped by metal plate; deflected in mag. field
   Electron capture: electron as reactant particle
   Gamma radiation: EM radiation; no mass or charge; penetrates thick lead; not deflected.
3. When will a nucleus stop undergoing decay processes?
   When it reaches a stable product nucleus.

Part II. Complete the following nuclear decay (spontaneous transmutation) equations then identify each as its specific type of decay (α, β, β^+, e^- capture, or γ)
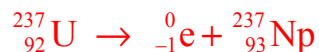
Equation	Type	Equation	Type

4. $^{214}_{84}\text{Po} \longrightarrow \, ^{210}_{82}\text{Pb} + \underline{\, ^{4}_{2}\text{He}\,} \Rightarrow \alpha$ decay

11. $^{59}_{28}\text{Ni} + \, ^{0}_{-1}\text{e} \longrightarrow \underline{\, ^{59}_{27}\text{Co}\,} \Rightarrow e^-$ capture

5. $^{222}_{86}\text{Rn} \longrightarrow \underline{\, ^{218}_{84}\text{Po}\,} + \, ^{4}_{2}\text{He} \Rightarrow \alpha$ decay

12. $^{60}_{27}\text{Co*} \longrightarrow \, ^{60}_{27}\text{Co} + \underline{\, ^{0}_{0}\gamma\,} \Rightarrow \gamma$ decay

6. $^{214}_{82}\text{Pb} \longrightarrow \, ^{214}_{83}\text{Bi} + \underline{\, ^{0}_{-1}\text{e}\,} \Rightarrow \beta$ decay

13. $\underline{\, ^{238}_{92}\text{U}\,} \longrightarrow \, ^{234}_{90}\text{Th} + \, ^{4}_{2}\text{He} \Rightarrow \alpha$ decay

7. $^{239}_{93}\text{Np} \longrightarrow \underline{\, ^{239}_{94}\text{Pu}\,} + \, ^{0}_{-1}\text{e} \Rightarrow \beta$ decay

14. $\underline{\, ^{45}_{22}\text{Ti}\,} \longrightarrow \, ^{45}_{21}\text{Sc} + \, ^{0}_{+1}\text{e} \Rightarrow \beta^+$ emission

8. $^{37}_{19}\text{K} \longrightarrow \underline{\, ^{37}_{18}\text{Ar}\,} + \, ^{0}_{+1}\text{e} \Rightarrow \beta^+$ emission

15. $\underline{\, ^{168}_{69}\text{Tm}\,} + \, ^{0}_{-1}\text{e} \longrightarrow \, ^{168}_{68}\text{Er} \Rightarrow e^-$ capture

9. $^{37}_{20}\text{Ca} \longrightarrow \, ^{37}_{19}\text{K} + \underline{\, ^{0}_{+1}\text{e}\,} \Rightarrow \beta^+$ emission

16. $\underline{\, ^{214}_{83}\text{Bi}\,} \longrightarrow \, ^{214}_{84}\text{Po} + \, ^{0}_{-1}\text{e} \Rightarrow \beta$ decay

10. $^{26}_{13}\text{Al} + \underline{\, ^{0}_{-1}\text{e}\,} \longrightarrow \, ^{26}_{12}\text{Mg} \Rightarrow e^-$ capture

17. $^{50}_{26}\text{Fe} \longrightarrow \, ^{50}_{27}\text{Co} + \underline{\, ^{0}_{-1}\text{e}\,} \Rightarrow \beta$ decay

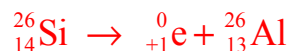**Part III.** For the following processes write the complete nuclear decay equation.

18. Write the equation for the alpha decay of americium-241

$$^{241}_{95}\text{Am} \rightarrow {}^{4}_{2}\text{He} + {}^{237}_{93}\text{Np}$$

19. Write the equation for the beta decay of uranium-237

$$^{237}_{92}\text{U} \rightarrow {}^{0}_{-1}\text{e} + {}^{237}_{93}\text{Np}$$

20. Write the equation for the positron emission from silicon-26

$$^{26}_{14}\text{Si} \rightarrow {}^{0}_{+1}\text{e} + {}^{26}_{13}\text{Al}$$

21. Write the equation for the electron capture of sodium-22

$$^{22}_{11}\text{Na} + {}^{0}_{-1}\text{e} \rightarrow {}^{22}_{10}\text{Ne}$$

Part IV. For the following processes, write the complete nuclear decay equation and *indicate the decay type*.

22. Write out the equation for the transformation of uranium-238 into thorium-234.

$$^{238}_{92}\text{U} \longrightarrow {}^{234}_{90}\text{Th} + {}^{4}_{2}\text{He} \Rightarrow \alpha \text{ decay}$$
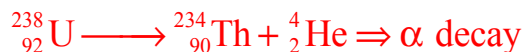
23. What decay process can transform cobalt-60 into nickel-60? Write out the equation.

$$^{60}_{27}\text{Co} \longrightarrow {}^{60}_{28}\text{Ni} + {}^{0}_{-1}\text{e} \Rightarrow \beta \text{ decay}$$

24. Write the *two* processes can transform oxygen-15 into nitrogen-15.

$$^{15}_{8}\text{O} \longrightarrow {}^{15}_{7}\text{N} + {}^{0}_{+1}\text{e} \Rightarrow \beta^{+} \text{ decay}$$

$$^{15}_{8}\text{O} + {}^{0}_{-1}\text{e} \longrightarrow {}^{15}_{7}\text{N} \Rightarrow e^{-} \text{ capture}$$

For more practice, go to http://www.chemteam.info/ChemTeamIndex.html and click on Radioactivity.