Half-Lives and Spent Nuclear Fuel

1. The half-lives of some significant radionuclides are listed below. The radionuclides listed are fission products, naturally occurring radionuclides, and transuranics. All are present in spent fuel. Fill in the chart below. The first problem has been done as an example. (y=year; d=day; h=hour.)

Radioisotopes	Type of Decay	Half-Life	How long will it take to lose 1/2 of its radioactivity?	How long will it take to lose 3/4 of its radioactivity?	How long will it take to lose 7/8 of its radioactivity?	Specific Activity (curies/ gram)
Fission Products						
Gases						
krypton-85	Beta	10.72 y	10.72 y	21.44 y	32.16 y	392
xenon-133	Beta	5.27 d				186,000
Solids						
strontium-90	Beta	28.1 y				141
molybdenum-99	Beta	66.7 h				474,000
iodine-131	Beta	8.07 d				123,500
cesium-137	Beta	30.2 y				86.4
cerium-144	Beta	285 d				3,182
Natural Elements						
uranium-235	Alpha	710,000,000 y				0.00000241
uranium-238	Alpha	4,500,000,000 y				0.000000334
Transuranics						
plutonium-238	Alpha	86 y				17.47
plutonium-239	Alpha	24,400 y				0.0613
plutonium-240	Alpha	6,580 y				0.226
plutonium-241	Beta	13.2 y				112
americium-241	Alpha	458 y				3.24
americium-243	Alpha	7,370 y				0.200

The higher the specific activity of the radionuclide, the more intense the radioactivity and the more particles or rays emitted in a given time period.

2. Which three radionuclides in the table above have the highest specific activity (curies per gram)?

3. Which three radionuclides in the table have the lowest specific activity?

4. What is generally the relationship between specific activity and half-life? Circle the correct word: The more intense the radioactivity, the (longer? shorter?) the half-life.

5. In your own words, explain the significance of all of the above information as it relates to permanently disposing of radioactive waste.