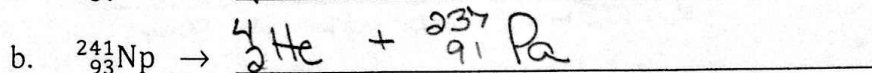
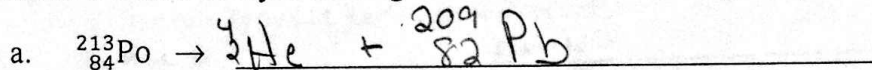


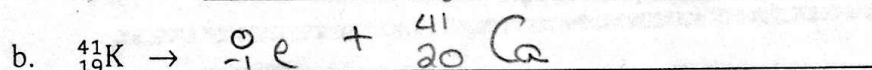
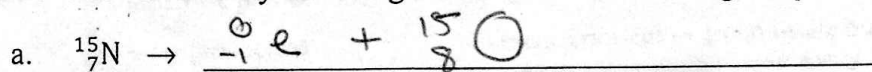
Nuclear Decay Reactions

Block: _____

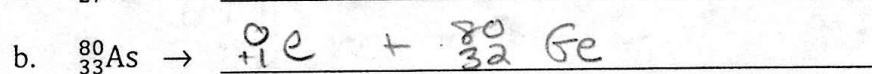
1. These two radioactive elements that are alpha particle (α) emitters. Write the nuclear reactions for each decay including the formation of the daughter products:



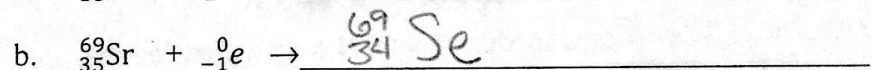
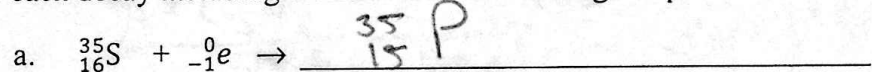
2. These two radioactive elements that are beta particle (β^-) emitters. Write the nuclear reactions for each decay including the formation of the daughter products:



3. These two radioactive elements that are positron (β^+) emitters. Write the nuclear reactions for each decay including the formation of the daughter products:



4. These two radioactive elements decay by electron capture (EC). Write the nuclear reactions for each decay including the formation of the daughter products:



5. Balance each nuclear decay equation by filling in the blanks. Classify each nuclear decay as alpha (α), beta (β^-), positron (β^+), or electron capture (EC):

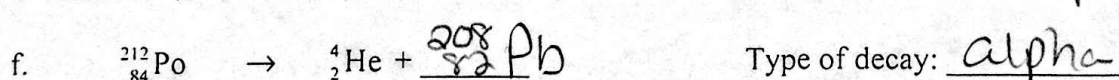
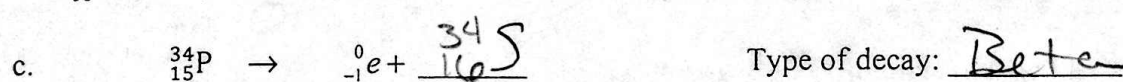
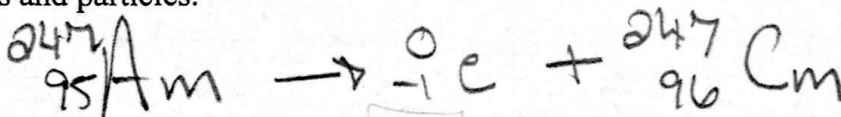


Table 19.1	
Various Types of Radioactive Processes	
Process	Example
β-particle (electron) production	$^{227}_{89}\text{Ac} \rightarrow ^{227}_{90}\text{Th} + ^{-1}_0\text{e}$
positron production	$^{13}_7\text{N} \rightarrow ^{13}_6\text{C} + ^{+1}_0\text{e}$
electron capture	$^{73}_{33}\text{As} + ^{-1}_0\text{e} \rightarrow ^{73}_{32}\text{Ge}$
α-particle production	$^{210}_{84}\text{Po} \rightarrow ^{206}_{82}\text{Pb} + ^4_2\text{He}$
γ-ray production	excited nucleus → ground-state nucleus + $^0_0\gamma$ excess energy lower energy

Show all work; observe all significant figures, and record units with all answers.

6. Americium-247 undergoes beta decay to curium-247 with a half-life of 23 minutes.
- a. Write the complete nuclear decay reaction for this process, using full symbols for all isotopes and particles.



- b. How many half-lives will it take for 75% of a 350 gram sample of americium-247 to decay to curium-247?

1st cycle → 50%
2nd cycle → 25% = 2 cycles

- c. If one starts with a 1000 g sample of americium-247, what mass of americium-247 will remain after 92 minutes?

1/2 life → $\frac{92 \text{ min}}{23 \text{ min}} = 4 \text{ cycles}$

$1000 \text{ g sample} \times \left(\frac{1}{2}\right)^4 = 62.5 \text{ g}$
 $\times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2} \times \frac{1}{2}$

7. The half life of cobalt-60 is 5.3 years. How much of a 1.000 mg sample of cobalt-60 is left after a 2.15 year period?

1/2 life → $\frac{2.15 \text{ yr}}{5.3 \text{ yr}} = 0.4 \text{ cycle}$

$1.000 \text{ mg} \left(\frac{1}{2}\right)^{0.4} = 0.75 \text{ mg}$

8. The half-life of tritium (hydrogen-3) is 12.3 years. If 48.0 mg of tritium is released from a nuclear power plant during the course of an accident, what mass of this nuclide will remain after 12.3 years? After 74.2 years?

$\frac{12.3 \text{ yr}}{12.3 \text{ yr}} = 1 \text{ cycle}$ $48.0 \text{ mg} \left(\frac{1}{2}\right)^1 = 24.0 \text{ mg}$

$\frac{74.2 \text{ yr}}{12.3 \text{ yr}} = 6 \text{ cycles}$ $48.0 \text{ mg} \times \left(\frac{1}{2}\right)^6 = 0.75 \text{ mg}$

9. The half life of Plutonium-239 is 24,000 years. What fraction of the Plutonium-239 present in nuclear wastes generated today will be present in the year 3000?

$\frac{3000 - 2014}{24,000} = \frac{986 \text{ yr}}{24,000} = 0.041 \text{ cycles}$

$100 \text{ g sample} \left(\frac{1}{2}\right)^{0.041} = 97.2 \text{ g}$
100 g sample
= 0.972