β Beta Decay

Because electrons are very small and only a tiny fraction of an atom's mass, the loss of a single electron will have no effect on the mass number of the atom. The mass number on the periodic table will remain the same. However, because a neutron has been changed into a proton, the atomic number of the new atom or isotope is increased by one.

In the following example, the radioactive isotope thorium-234 undergoes a β^- decay to become a new radioactive isotope progeny isotope: protactinium-234.

$$^{234}_{90}\mathrm{Th} \rightarrow \beta - {}^{234}_{91}\mathrm{Pa}$$

Emits beta particle

Note the mass number did not change but the atomic number, the number of protons in the atom, changed from 90 to 91. In equation form, β^- decay would be written:

$$^{234}_{90}\mathrm{Th} \rightarrow {}^{234}_{91}\mathrm{Pa} + (e^-) + \overline{V_e}$$

Where the $e^- + V_e$ represent the electron emitted as a beta particle and the antineutrino.

In most cases, to find the progeny isotope of a radioactive isotope which gives off ß particles, look on the periodic table of elements for an element that has an atomic number which is one higher than the original or parent radioactive isotope. The mass number, however, will remain unchanged. Here is another example: The radioactive isotope cesium-137, will undergo $ß^-$ decay and become barium-137.

$$^{137}_{55}\mathrm{Cs} \rightarrow \beta - {}^{137}_{56}\mathrm{Ba}$$

Emits beta particle

Again the equation, and if you check your periodic table, barium is the next element to the right of cesium.

$$^{137}_{55}\mathrm{Cs} \rightarrow {}^{137}_{56}\mathrm{Ba} + (e-) + Ve$$

β Beta Decay

Name: ______________________________ Period: ____ Date: ________________

Read through the “Beta Decay” section in the *What is Radiation?* module on the **Nuclear Technology: Exploring Possibilities Website** then answer the following questions.

What happens when electron emission (beta minus decay) occurs?

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What effect does the loss of an electron have on the mass of an atom which has undergone a beta minus decay?

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Using the periodic table as a resource, complete the following beta decay equations by filling in the blank.

1. ${}^{14}_{6}\text{C} \rightarrow \_\_\_ + {}^{0}_{-1}\text{e}$
2. $\_\_\_ \rightarrow {}^{131}_{54}\text{Xe} + {}^{0}_{-1}\text{e}$
3. $\_\_\_ \rightarrow {}^{6}_{3}\text{Li} + {}^{0}_{-1}\text{e}$
4. ${}^{24}_{11}\text{Na} \rightarrow \_\_\_ + {}^{0}_{-1}\text{e}$
5. $\_\_\_ \rightarrow {}^{201}_{80}\text{Hg} + {}^{0}_{-1}\text{e}$
6. ${}^{52}_{26}\text{Fe} \rightarrow \_\_\_ + {}^{0}_{-1}\text{e}$
7. ${}^{42}_{19}\text{K} \rightarrow {}^{42}_{20}\text{Ca} + \_\_\_$
8. ${}^{90}_{38}\text{Sr} \rightarrow \_\_\_ + {}^{0}_{-1}\text{e}$
9. $\_\_\_ \rightarrow {}^{239}_{94}\text{Pu} + {}^{0}_{-1}\text{e}$
10. ${}^{234}_{90}\text{Th} \rightarrow \_\_\_ + {}^{0}_{-1}\text{e}$