NE150 Homework 1

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1 Problem 1

Types of spontaneous nuclear decay:

1.1 Alpha Decay

Dominant decay for high Z nuclei, results in the ejection of a He-4 (Alpha Particle) from the nucleus.

$$ {}^{Z}_{A}\mathrm{X} \longrightarrow {}^{Z-4}_{A-2}\mathrm{X}^{+}{}^{4}_{2}\mathrm{He} $$

1.2 Beta Decay

There are three types of beta decay: β^-, β^+, and Election Capture. These exchange a proton for a neutron, or vice versa in the nucleus. A β particle is ejected as a neutreino or anti neutrino. Election capture involves the capture of an orbital election to convert a proton in the nucleus.

$$ \beta^- \text{ Decay: } {}^{Z}_{A}\mathrm{X} \longrightarrow {}^{Z-4}_{A-2}\mathrm{X}^{+}\mathrm{e}^{+} + \bar{\nu} $$
$$ \beta^+ \text{ Decay: } {}^{Z}_{A}\mathrm{X} \longrightarrow {}^{Z-4}_{A-2}\mathrm{X}^{+}\mathrm{e}^{+} + \bar{\nu} $$
$$ \text{Election Cepture: } {}^{Z}_{A}\mathrm{X} \longrightarrow {}^{Z-4}_{A-2}\mathrm{X}^{+}{}^{4}_{2}\mathrm{He} $$

1.3 Gamma decay

Gamma decay is caused by the deexcitation of the nucleus...

2 Problem 2

$$ A = A_0 e^{\lambda t} $$

Solve for t at $A = A_0 * .1$ and $\lambda = 1.33e^{-7}s^{-1}$

$$ t = 12341234 $$

First calculate the half life of the isotope:

$$ T_{1/2} = ln(2)/\lambda $$
$$ T_{1/2} = 1234 $$

The time to reach .1 initial activity is

3 Problem 3

4 Problem 4

a. ${}^{16}_{8}\mathrm{O} + n \longrightarrow {}^{16}_{7}\mathrm{N} + p$

b. ${}^{238}_{92}\mathrm{U} \longrightarrow {}^{234}_{90}\mathrm{Th} + \alpha$

c. ${}^{3}\mathrm{H} + n \longrightarrow {}^{4}_{2}\mathrm{He} + \mathrm{e}^{-} + \bar{\nu}$

d. ${}^{240}_{94}\mathrm{Pu} + n \longrightarrow {}^{241}_{94}\mathrm{Pu}^{+}\mathrm{XX}$

5 Problem 5

6 Problem 6

7 Problem 7

8 Problem 8

9 Problem 9

10 Problem 10