Problem Set 1
Due SES #4

[EL] = Lewis, Elmer L. *Fundamentals of Nuclear Reactor Physics*. Burlington, MA: Academic Press, 2008. ISBN: 9780123706317.

Suggested Problems: [EL] Chapter 1, Problems 1.4, 1.5, 1.6, 1.7, 1.11

Question 1: Why is the binding energy per nucleon relatively stable for heavy atoms?

Question 2: What are the advantages of a thorium fuel cycle?

Question 3: Calculate the Q values for the following reactions and determine whether or not the nuclear reactions are endothermic or exothermic.

$$^{9}_{4}Be + ^{4}_{2}\alpha \rightarrow ^{12}_{6}C + ^{1}_{0}n$$

$$^{1}_{0}n + ^{235}_{92}U \rightarrow ^{140}_{54}Xe + ^{94}_{38}Sr + 2^{1}_{0}n + \gamma(6MeV)$$

$$2^{4}_{2}He \rightarrow ^{6}_{3}Li + ^{2}_{1}H$$

$$^{12}_{6}C + ^{2}_{1}H \rightarrow ^{13}_{6}C + ^{1}_{1}p$$

Question 4: Calculate the total binding energy of Pu-239 and Xe-135.

Question 5: Assuming that promethium and samarium concentrations can be represented with the equations:

$$\frac{dp}{dt} = \gamma_P \Sigma_r \phi - \lambda_P \Gamma(t)$$

$$\frac{dS}{dt} = \lambda_P P(t) - \sigma_\alpha^3 \Phi S(t)$$

What are the equilibrium concentrations of each isotope?

After reaching equilibrium, the reactor is shut down so that $\phi = 0$ after $t=0$. What are the equations that represent the concentrations of each isotope?

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