Name _____ Date _____ Class _____

25 NUCLEAR CHEMISTRY

Practice Problems

In your notebook, solve the following problems.

SECTION 25.1 NUCLEAR RADIATION

1. What happens to the mass number and atomic number of an atom that undergoes beta decay?
2. A radioisotope of an element undergoes alpha particle decay. How do the atomic number and mass number of the particle change?
3. Give the composition of the nucleus of the following isotopes.
   a. $^{64}_{28}\text{Ni}$ **b.** $^{136}_{53}\text{I}$ **c.** $^{195}_{79}\text{Au}$
4. Complete each of the following equations.
   a. $^{14}_{6}\text{C} \rightarrow {}^{0}_{-1}e + ?$
   b. $^{241}_{95}\text{Am} \rightarrow {}^{4}_{2}\text{He} + ?$
   c. $^{16}_{7}\text{N} \rightarrow {}^{16}_{8}\text{O} + ?$

SECTION 25.2 NUCLEAR TRANSFORMATIONS

1. Write a nuclear equation for the following radioactive processes.
   a. alpha decay of francium-208
   b. electron capture by beryllium-7
   c. beta emission by argon-37
   d. positron emission by fluorine-17
2. Complete the equations for these transmutation reactions.
   a. $^{6}_{3}\text{Li} + {}^{1}_{0}n \rightarrow {}^{4}_{2}\text{He} + ?$
   b. $^{235}_{92}\text{U} + {}^{1}_{0}n \rightarrow ? + {}^{141}_{56}\text{Ba} + 3{}^{1}_{0}n$
   c. $^{27}_{13}\text{Al} + {}^{4}_{2}\text{He} \rightarrow ? + {}^{1}_{0}n$
   d. $^{235}_{92}\text{U} \rightarrow {}^{90}_{38}\text{Sr} + ? + {}^{1}_{0}n + 4{}^{0}_{-1}e$
   e. $^{1}_{0}n + ? \rightarrow {}^{144}_{58}\text{Ce} + {}^{90}_{38}\text{Sr} + 6{}^{1}_{0}n + 2{}^{0}_{-1}e$
3. Polonium-214 has a relatively short half-life of 164 s. How many seconds would it take for 8.0 g of this isotope to decay to 0.25 g?
4. How many days does it take for 16 g of palladium-103 to decay to 1.0 g? The half-life of palladium-103 is 17 days.
5. By approximately what factor would the mass of a sample of copper-66 decrease in 51 minutes? The half-life of copper-66 is 5.10 min.
6. In 5.49 seconds, 1.20 g of argon-35 decay to leave only 0.15 g. What is the half-life of argon-35?

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SECTION 25.3 FISSION AND FUSION OF ATOMIC NUCLEI

1. How many free neutrons are produced in each of the following uranium-235 fission reactions?

   a. ${}^{1}_{0}n + {}^{235}_{92}\mathrm{U} \rightarrow {}^{90}_{37}\mathrm{Rb} + {}^{144}_{55}\mathrm{Cs} + ? \, {}^{1}_{0}n$

   b. ${}^{1}_{0}n + {}^{235}_{92}\mathrm{U} \rightarrow {}^{87}_{35}\mathrm{Br} + {}^{146}_{57}\mathrm{La} + ? \, {}^{1}_{0}n$

   c. ${}^{1}_{0}n + {}^{235}_{92}\mathrm{U} \rightarrow {}^{72}_{30}\mathrm{Zn} + {}^{160}_{62}\mathrm{Sm} + ? \, {}^{1}_{0}n$

2. The fission energy of uranium-235 is 2.0×10^7 kcal/g. The heat of combustion of coal is about 8.0 kcal/g. Approximately what mass of coal must be burned to produce the energy released by the fission of 1.0 gram of uranium-235?

3. What is the product of the following fusion reaction?

$$4 \, {}^{1}_{1}\mathrm{H} + 2 \, {}^{0}_{-1}e \rightarrow ?$$

SECTION 25.4 RADIATION IN YOUR LIFE

1. How are radioisotopes used to study chemical reactions?

2. What is teletherapy?

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