Mr. Dehne AMSAT Chem 1H

Name: ____

Date: __________________

Per#:___

Atom Topic #4
The Nuclear atom

WS#6: The Nucleus

1. Based on the information about elementary particles in your notes, which has the greatest mass?
   a. the proton
   b. the neutron
   c. the electron
   d. they all have the same mass
2. The force that keeps the nucleus together is
   a. a strong nuclear force
   b. a weak nuclear force
   c. an electromagnetic force
   d. a gravitational force
3. The stability of a nucleus is most affected by the
   a. number of neutrons
   b. number of protons
   c. number of electrons
   d. ratio of neutrons to protons
4. The number of neutrons in an atom of magnesium-25 is _____________.
5. Nuclides of the same element have the same ______________.
6. Identify the missing term in each of the following nuclear equations. Write the element's symbol, its atomic number, and its mass number.
   a. ${}^{14}_{6}C \rightarrow {}^{0}_{-1}e +$ _____
   b. ${}^{63}_{29}Cu + {}^{1}_{1}H \rightarrow$ _____ $+ {}^{4}_{2}He$
7. Write the equation that shows the equivalency of mass and energy.
8. Consider the two nuclides ${}^{56}_{26}Fe$ and ${}^{14}_{6}C$.
   a. Determine the number of protons in each nucleus.
   b. Determine the number of neutrons in each nucleus.
   c. Determine whether the ${}^{56}_{26}Fe$ nuclide is likely to be stable or unstable, based on its position in the band of stability shown in the notes.

WS#7: Radioactive Decay

1. The nuclear equation ${}^{210}_{84}Pb \rightarrow {}^{206}_{82}Pb + {}^{4}_{2}He$ is an example of an equation that represents
   a. alpha emission
   b. beta emission
   c. positron emission
   d. electron capture
2. Which of the following best represents the fraction of a radioactive sample that remains after four half-lives have occurred?
   a. $(½)^4$
   b. (½) x 4
   c. (¼)
   d. $(¼)^2$ x 4
3. Match the nuclear symbol on the right to the name of the corresponding particle on the left.

a. beta particle	(1) ${}^{1}_{1}p$
b. proton	(2) ${}^{4}_{2}He$
c. positron	(3) ${}^{0}_{-1}\beta$
d. alpha particle	(4) ${}^{0}_{+1}\beta$

4. Label each of the following statements as True or False. Consider the U-238 decay series in the notes. For the series of decays from U-234 to Po-218, each nuclide
   a. shares the same atomic number.
   b. differs in mass number from others by multiples of 4.
   c. has a unique atomic number.
   d. differs in atomic number from others by multiples of 4.
5. Identify the missing term in the following nuclear equation. Write the element's symbol, its atomic number, and its mass number. _?_ $\rightarrow {}^{231}_{90}Th + {}^{4}_{2}He$
6. Einsteinium is a transuranium element. Eisteinium-247 can be prepared by bombarding uranium-238 with nitrogen-14 nuclei, releasing several neutrons, as shown by the following equation

$${}^{238}_{92}U + {}^{14}_{7}N \rightarrow {}^{247}_{99}Es + x\,{}^{1}_{0}n$$

   What must be the value of *x* in the above equation? Explain your reasoning.

WS#8: Radioactivity Problems

Part 1: Balancing Nuclear Equations

For the following, write a balanced nuclear equation or fill in the blank with the missing particle or atom.

1. alpha decay of $^{231}_{91}Pa$.
2. beta decay of $^{152}_{54}Xe$
3. alpha decay of $^{146}_{62}Sm$
4. beta decay of cesium – 120
5. alpha decay of $^{222}_{86}Rn$
6. beta decay of $^{198}_{85}At$
7. $^{226}_{88}Ra \rightarrow ^{222}_{86}Rn$ + ____
8. $^{14}_{6}C \rightarrow ^{14}_{7}N$ + ____
9. $^{238}_{92}U \rightarrow ^{234}_{90}Th$ + ____
10. $^{219}_{84}Po \rightarrow$ ____ + $^{215}_{82}Pb$

Part 2: Half-Life

1. How much of a 100.0g sample of ^{198}Au is left after 8.10 days if its half-life is 2.70 days? (Ans: 12.5g)
2. A 50.0g sample of ^{16}N decays to 12.5g in 14.4 seconds. What is its half-life? (Ans: 7.2 sec)
3. The half-life of ^{42}K is 12.4 hours. How much of a 750.g sample is left after 62.0 hours? (Ans: 23.4g)
4. What is the half-life of ^{99}Tc if a 500.g sample decays to 62.5g in 639,000 years? (Ans: 213,000 yrs)
5. The half-life of ^{232}Th is 1.4×10^{10} years. If 25.0 grams of the sample remains after 2.8×10^{10} years, how many grams were in the original sample? (Ans: 100. grams)
6. There are 5.0 grams of ^{131}I remaining after 40.35 days. How many grams were in the original sample if its half-life is 8.07 days? (Ans: 160 grams)

WS#9: Review

1. The ancient alchemists dreamed of a being able to turn lead into gold. By using lead-206 as the target atom of a powerful accelerator, modern chemists can attain that dream in principle. Write the nuclear equation for a one-step process that will convert $^{206}_{82}Pb$ into a nuclide of gold-202. You may use alpha particle, beta particles, positrons, or protons.
2. Write the nuclear equations for the following reactions:
    a. Carbon-12 combines with hydrogen-1 to form nitrogen-13.
    b. Curium-246 combines with carbon-12 to form nobelium-254 and four neutrons.
    c. Hydrogen-2 combines with hydrogen-3 to form helium-4 and a neutron.
3. Write the complete nuclear equations for the following reactions:
    a. $^{91}_{42}Mo$ undergoes positron emission.
    b. $^{6}_{2}He$ undergoes beta decay.
    c. $^{194}_{84}Po$ undergoes alpha decay.
    d. $^{129}_{55}Cs$ undergoes electron capture.
4. Iodine-131 has a half-life of 8.0 days; it is used in medical treatments for thyroid conditions. Determine how many days must elapse for a 0.80mg sample of iodine-131 in the thyroid to decay to 0.10mg. (Ans: 24 days)
5. Following is an incomplete nuclear fission equation:

$$^{235}_{92}U + ^{1}_{0}n \rightarrow ^{90}_{38}Sr + ^{141}_{38}Xe + x\,^{1}_{0}n + \text{energy}$$

    a. Determine the value of x in the above equation.
    b. The strontium-90 produced in the above reaction has a half-life of 28 years. What fraction of strontium-90 still remains in the environment 84 years after it was produced in the reactor?