Chemistry I Name___________________________

Worksheet 8: Nuclear Chemistry

Directions: Skim through pages 700 - 721 of your textbook. Then go back and read more carefully, answering the following questions as you do.

I. The Nucleus

1. In the language of nuclear chemistry, what do you call

a. protons and neutrons? _________________

b. atoms? ________________

2. Review: What are isotopes? ____

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Two atoms of carbon could be isotopes if they have the same number of

________________ but different numbers of _______________ in their nuclei.

What are the two ways you could represent an atom of carbon that has an atomic number of 6 (# of protons) and a mass number of 14 (#protons + # neutrons)?

_____________ and ___________________

3. An amu is defined as one twelfth the mass of carbon-12, and is used to measure the masses of very small things. When amu's are used to measure the masses of a helium-4 atom and the parts that make up a helium-4 atom, they don't add up the same!

a. Which has the greater mass? ____

b. What is this difference called? ____

c. What causes the difference? ____

____

d. What famous equation says that mass can be converted to energy and vice versa?

____

e. What is the name of this energy that is released when protons and neutrons come together to form a nucleus? ________________________________. This energy is also a measure of the _______________________

4. Flip back to page 74. What are nuclear forces? _____________________________________

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a. Nuclear forces only work when the nucleons are very __________ ________________

b. Now go back to page 703 and consider figure 22-3. Protons A and B are attracted to each other because of the ________________ __________________ but are repelled by each other because they both have a __________________ charge. The ___________ _____________ doesn't attract proton A to proton C because they are too ___________ _____________. All they do is repel each other.

c. So having more _______________ in a nucleus makes it more stable, because you increase the nuclear force without increasing the electrostatic (pos - pos) repulsion.

5. Define these two terms:

a. Nuclear reaction ____

____

b. Transmutation ____

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II. Radioactive Decay

1. Define the following:

a. Radioactive decay ____

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b. Nuclear radiation ____

____

2. Complete the following chart:

Type of nuclear radiation:	Symbol	Charge	What is necessary to stop it? (Figure 22-11 on pg 713)
Alpha particle			
		-1	
		+1	(not given)
Gamma ray			

Which of these: (give the symbol)

Is the biggest? ________ Is the smallest? ________ Are equal in mass? _______ and _______

3. The emissions:

a. An alpha particle is basically a __________ nucleus and has a charge of ________

b. A beta particle is just a fast moving ________________ and has a charge of ______

c. A positron is essentially a positive _______________, and has a charge of _______

d. Gamma rays are high energy _______________________ that come out of a nucleus as it changes from an _____________ state to a ______________ energy state. They generally accompany other types of __________when the other types leave the nucleus in an _______________ ______________.

4. Half-life

a. Define half-life: ____

____

b. Look at table 22-2.

i. Which element has the longest half-life? __________ What is it? __________

ii. Which element has the shortest half-life? _________ What is it? __________

III. Fission and Fusion (finally!)

1. Go to page 717 to define nuclear fission: _______________________________________

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a. This process releases __________________ amounts of ______________. When uranium-235 is bombarded with slow _________________, a uranium nucleus may ________________ one of the _______________, making it very _______________. The nucleus splits into medium-mass parts (smaller atoms) with the emission of more _______________ (which can go on to bombard other U-235's.) The mass of the products is less than the mass of the _______________. The missing mass is converted to _________________ (gulp!). Figure 22-14 shows the type of chain reaction that can occur if there is enough U-235 around (critical mass).

i. Define critical mass: ____

____

b. Nuclear reactors use _______________________chain reactions to produce ________________ or _______________ nuclides (for research).

c. **Atomic bombs**, like those used in Hiroshima and Nagasaki in 1945, contain separated chunks of fissionable material such as U-235. When the bomb is detonated the chunks are pushed together to form a critical mass, which causes a fission chain reaction and a tremendous release of energy.

2. Go to page 719 to define nuclear fusion ____

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a. Amazingly, nuclear fusion releases _________ ____________ ____________ per gram than nuclear ____________. In our sun and in other stars, four _____________ nuclei combine at extremely high ____________________ and __________________ to form a _______________ nucleus with a _________ of mass and ______________ of ________________,

b. **Hydrogen bombs** get their energy from uncontrolled _______________ reactions of _________________.

i. What kind of reaction is used to provide the heat and pressure to trigger the fusion reaction? _____________________

ii. What temperature (in degrees Kelvin) is required to induce a fusion reaction? _______________

3. Nucleosynthesis Consider this article from NASA's web site: http://helios.gsfc.nasa.gov/nucleo.html

A star's energy comes from the combining of light elements into heavier elements in a process known as fusion, or "nuclear burning". It is generally believed that most of the elements in the universe heavier than helium are created, or synthesized, in stars when lighter nuclei fuse to make heavier nuclei. The process is called nucleosynthesis. Nucleosynthesis requires a high-speed collision, which can only be achieved with very high temperatures. The minimum temperature required for the fusion of hydrogen is 5 million degrees F. Elements with more protons in their nuclei require still higher temperatures. For instance, fusing carbon requires a temperature of about one billion degrees! Most of the heavy elements, from oxygen up through iron, are thought to be produced in stars that contain at least ten times as much matter as our Sun. Our Sun is currently burning, or fusing, hydrogen to helium. This is the process that occurs during most of a star's lifetime. After the hydrogen in the star's core is exhausted, the star can burn helium to form progressively heavier elements, carbon and oxygen and so on, until iron and nickel are formed. Up to this point the process releases energy. The formation of elements heavier than iron and nickel requires the input of energy. Supernova explosions result when the cores of massive stars have exhausted their fuel supplies and burned everything into iron and nickel. The nuclei with mass heavier than iron and nickel are thought to be formed during these explosions.

If this is true, all carbon-based life on Earth, including the body you live in, is literally composed of stardust.