Nuclear Fission and Fusion   Name ________________________

Part A: Nuclear Fission and Fusion Reactions

Nuclear Fission One very large nucleus is broken into two smaller nuclei, releasing enormous amounts of energy. Releases enormous amounts of energy.
Nuclear Fusion Two very small nuclei (or even protons) are combined to form a lesson. Releases *even more* enormous amounts of energy than nuclear fission.

Nuclear Fission Examples - Nuclear power plants use nuclear fission to produce electricity - Most nuclear bombs, including those dropped on Hiroshima and Nagasaki, use a nuclear fission chain reaction to produce a massive burst of energy. - Submarines in the US Navy run on nuclear fission reactors.
Nuclear Fusion Examples - Nuclear fusion occurs in the center of the sun, producing all the energy that makes life on earth possible. _ Nuclear fusion inside of a supernova (exploding star) produces almost all of the elements that make up our daily life, such as carbon and iron. - In the 1950s, the US government developed nuclear fusion bombs (called Hydrogen-Bombs) that are even more powerful than fission bombs. None has ever been used in wartime, only in developmental tests. - Many scientists are attempting to harness nuclear fusion to create electrical power. This is one of the "holy grails" of science. If someone solves it, they would become unbelievable rich and famous and solve many of the world's problems in one piece, but thus far no one has come close.

A.1 Two small nuclei combine to make a large nuclei.

A.2 A large Uranium nucleus breaks into two smaller nuclei.

A.3 Which type of reaction releases more energy?

A.4 Used by nuclear power plants.

A.5 Used by the nuclear bomb that was dropped on Nagasaki during World War II.

A.6 Two protons merge to make a nucleus.

A.7 Type of reaction that occurs in the center of the sun.

Part C: Nuclear Reactions

For each nuclide, the number on the top is the *mass*,
and the number on the bottom is the *charge*. For nuclei, it is the atomic number of the nucleus.

The masses on each side of the arrow must balance out. The changes on each side of the equation must balance out as well.

C.1 For the reaction below, fill in the empty spaces:

$$^{235}_{[\ \ ]}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{[\ \ ]}_{[\ \ ]}\mathrm{Ba} + {}^{94}_{[\ \ ]}[\quad] + 3\,{}^{1}_{0}\mathrm{n}$$

Is this a *fission reaction* or a *fusion reaction*?

C.2 For the reaction below, fill in the empty spaces:

$$^{235}_{[\ \ ]}\mathrm{U} + {}^{1}_{0}\mathrm{n} \rightarrow {}^{139}_{[\ \ ]}[\quad] + {}^{[\ \ ]}_{[\ \ ]}\mathrm{Cs} + 3\,{}^{1}_{0}\mathrm{n}$$

Is this a *fission reaction* or a *fusion reaction*?

C.3 Fill in the empty spaces:

$$ {}^{1}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{[\quad]}_{1}[\quad] + {}^{0}_{[\quad]}\mathrm{e} + {}^{0}_{0}\nu $$

Is the “e” particle an electron or a positron?

Is this a *fission reaction* or a *fusion reaction*?

C.4 Fill in the empty spaces:

$$ 4\,{}^{1}_{[\quad]}\mathrm{H} \rightarrow {}^{[\quad]}_{[\quad]}[\quad] + 2\,{}^{0}_{1}\mathrm{e} $$

What is the name of the particle that you figured out:

Is this a *fission reaction* or a *fusion reaction*?

C.5 Fill in the empty spaces:

$$ {}^{2}_{1}\mathrm{H} + {}^{1}_{1}\mathrm{H} \rightarrow {}^{[\quad]}_{[\quad]}[\quad] + \gamma $$

Is this a *fission reaction* or a *fusion reaction*?

C.6 Fill in the empty spaces:

$$ {}^{2}_{[\quad]}\mathrm{H} + {}^{[\quad]}_{[\quad]}\mathrm{H} \rightarrow {}^{4}_{[\quad]}\mathrm{He} + {}^{[\quad]}_{[\quad]}\mathrm{n} $$

Is this a *fission reaction* or a *fusion reaction*?