Name: _____
Hour: ____ Date: _____

Chemistry: *Nuclear Energy Transformations*

Directions: *Solve each of the following problems. Where necessary, show your work and include proper units.*

1. A. Calculate the total mass (in amu) of the nucleons that make up a fissionable U-235 nuclide.

B. In the atomic bomb (named "Little Boy") dropped on Hiroshima, 600 mg of the total of 64 kg of uranium in the bomb are estimated to have been converted from mass into energy. To two significant figures, find the energy released in this conversion.

2. The nuclear mass of a tin-120 nuclide is 119.8786 amu.

A. Find the mass defect, in amu.

B. Convert the mass defect into kg.

C. Calculate the nuclear binding energy (in J) of an Sn-120 nucleus.

D. Calculate the binding energy per nucleon (in J/nucleon).

E. Convert the binding energy per nucleon into eV/nucleon (1 eV = 1.60×10^{-19} J).

F. Convert the binding energy per nucleon into MeV/nucleon.

ANSWERS:
1A. 236. 90814 amu
1B. 5.4×10^{13} J
2A. 1.0916 amu
2B. 1.8133×10^{-27} kg
2C. 1.6320×10^{-10} J
2D. 1.3600×10^{-12} J/n
2E. 8.50×10^{6} eV/nucleon
2F. 8.50 MeV/n

3. The mass of an Al-26 nuclide is 25.9804 amu. Find the binding energy per nucleon, in MeV per nucleon.

4. The combustion of hydrogen is given by: $2\ H_2\ +\ O_2\ \rightarrow\ 2\ H_2O\ +\ 572\ kJ$

A. Calculate the energy released, in J, when two **molecules** of H_2 react with one **molecule** of O_2.

B. Write a balanced nuclear equation for the reaction that powers the Sun: the fusion of four atoms of hydrogen into one atom of helium. Two positrons are also emitted.

C. If a helium nuclide has a mass of 4.00160 amu, find its mass defect in amu.

D. Calculate the energy released, in J, when one helium nucleus is created in the equation from Q4B.

E. How many times more energy is released when four hydrogen atoms are fused into helium than when they are combusted with oxygen?

ANSWERS: 3. 8.15 MeV 4A. 9.50×10^{-19} J 4C. 0.03028 amu 4D. 4.53×10^{-12} J 4E. 4.77 million times