WKS 5-5 – Chem H
Mass Defect and E = mc^2

Name_____
Period_____ Date_____

Read pp. 701-702 in your text

Practice Problems: Use data on Chart B when needed!!!! 1 MeV = 9.6483×10^{10} J/mol

1) Suppose $^{7}_{3}Li$ is made from its separate p, n and e.
   a) Write out the balanced equation for the reaction.

   b) Calculate the initial mass of the separate p, n and e, in amu. (Use masses on Chart B.)

   c) Calculate the mass defect for the formation of one atom of $^{7}_{3}Li$. Given: mass of $^{7}_{3}Li$ = 7.001600amu

   d) Calculate the energy released, in J/atom, when one atom of $^{7}_{3}Li$ is formed. *(First, find mass in kg.)*

   e) Calculate the energy released, in J/mol, when a mole of $^{7}_{3}Li$ is formed.

   f) Calculate the mass defect of $^{7}_{3}Li$ in MeV/nucleon (use the conversion factor above).

2) Suppose this fusion reaction takes place to form one atom of $^{4}_{2}He$. **Rxn:** $^{2}_{1}H + {}^{3}_{1}H \rightarrow {}^{4}_{2}He + {}^{1}_{0}n$
   a) Calculate the initial mass (reactants) for the reaction above, in amu.
   Givens: mass of $^{2}_{1}H$ = 2.01410 amu , mass of $^{3}_{1}H$ = 3.01605 amu,

   b) Calculate the final mass for the reaction above. *mass of $^{4}_{2}He$ = 4.00260 amu ($^{1}_{0}n$ mass is on Chart B)*

   c) Calculate the mass defect for the reaction above, in amu.

d) Calculate the amount of energy produced by this reaction, in J/atom of ${}^{4}_{2}He$. (*Remember- you need mass defect in kg.)*

e) Calculate the energy produced, in MJ/mol of ${}^{4}_{2}He$.

3) Given the fission of one atom of ${}^{235}_{92}U$ takes place as shown here:

$$ {}^{235}_{92}U + {}^{1}_{0}n \rightarrow {}^{90}_{38}Sr + {}^{143}_{54}Xe + 3{}^{1}_{0}n $$

Givens: mass of ${}^{235}_{92}U$ *= 235.0439 amu mass of* ${}^{90}_{38}Sr$ *= 89.8869 amu mass of* ${}^{143}_{54}Xe$ *= 142.9351amu*

a) Calculate the mass defect for the above reaction, in amu and kg

b) Calculate the energy released for one mol of ${}^{235}_{92}U$, in J/mol.

c) Calculate the energy released for one kg of ${}^{235}_{92}U$. (In comparison, 1 kg of TNT releases 4.184×10^{6} J)

4) Fe-56 is one of the most stable nuclei known. The mass of one atom of ${}^{56}_{26}Fe$ is 55.934939 amu.

a) Determine the mass defect for the formation of one atom of ${}^{56}_{26}Fe$, in amu.

b) Determine the energy released by the formation of one mol of ${}^{56}_{26}Fe$, in J/mol

c) Determine the energy released (mass defect) by formation of ${}^{56}_{26}Fe$, in MeV/nucleon

Answers: 1b) 7.0581338 amu; 1c) 0.0565338 amu 1d) 8.45×10^{-12} J/atom; 1e) 5.09×10^{12} J/mol; 1f) 7.53 MeV/nucleon; 2a) 5.03015 amu; 2b) 5.011265 amu; 1c) 0.018885 amu; 1d) 2.82×10^{-12} J/atom; 1e) 1.70×10^{12} J/mol; 3a) 0.20457 amu, 3.3969×10^{-28} kg; 3b) 1.84×10^{13} J/mol; 3c) 7.83×10^{13} J/kg; 4a) 0.528451 amu; 4b) 4.76×10^{13} J/mol; 4c) 8.80 MeV/nucleon