Bond Enthalpy problems

1) Using only the information given in the thermochemical equation below, make a comparison between the sum of the bond enthalpies of the reactants and the sum of the bond enthalpies of the products. Explain why one value is greater than the other.

$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g) \quad \Delta H_{rxn} = -802.3$ kJ/mol

2) The following questions pertain to the bonds between the carbon atoms in C_2H_6 and C_2H_4.
   a. Draw visual representations that show the relative differences in bond lengths between the carbon atoms in C_2H_6 and C_2H_4.
   b. Which carbon-carbon bond contains the least amount of potential energy? Justify your answer.
   c. Which carbon-carbon bond requires the greatest input of energy in order to be broken? Justify your answer.

3) Determine the enthalpy change, ΔH_{rxn}, that occurs when two gaseous oxygen atoms combine to form a gaseous oxygen molecule ($2\ O(g) \rightarrow O_2(g)$) using the table of average bond energies.

4) Use the chemical equation below and the table of average bond energies to answer the following questions.

$N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

   a. Draw Lewis structures for all three species represented in the reaction above.
   b. Calculate the enthalpy change, ΔH_{rxn}, that occurs in the reaction.
   c. Draw a symbolic representation that demonstrated the flow of energy between the system and the surroundings.
   d. Is the process endothermic or exothermic?

5) Use the thermochemical equation for the combustion of methane and the table of average bond energies to find the average bond energy in a C – H bond.

$CH_4(g) + 2\ O_2(g) \rightarrow CO_2(g) + 2\ H_2O(g) \quad \Delta H_{rxn} = -802.3$ kJ

6) Use the chemical equation and the table of average bond energies to answer the following questions.

$C_3H_4 + 4\ O_2 \rightarrow 3\ CO_2 + 2\ H_2O$

   a. Draw Lewis structures for all four species represented in the reaction above.
   b. Calculate the enthalpy change, ΔH_{rxn}, that occurs in this reaction.

7) Use the chemical equation and the table of average bond energies to answer the following questions.

$$2\ C_2H_2 + 5\ O_2 \rightarrow 4\ CO_2 + 2\ H_2O$$

a. Draw Lewis structures for all four species represented in the reaction above.

b. Calculate the enthalpy change, ΔH_{rxn}, that occurs in this reaction.

Bond	Average Bond Enthalpies
O – C	351 kJ/mol
O = C	799 kJ/mol
O – O	142 kJ/mol
O = O	499 kJ/mol
C – C	348 kJ/mol
C = C	612 kJ/mol
C ≡ C	960 kJ.mol
H – H	436 kJ/mol
H – C	412 kJ/mol
H – O	467 kJ/mol
N – N	193 kJ/mol
N = N	418 kJ/mol
N ≡ N	941 kJ.mol
N – H	393 kJ/mol