

Name _____

Period ____ Date ____/____/____

8 • Thermochemistry

BOND ENERGIES and ENTHALPY OF COMBUSTION

Table: Some Average Single- and Multiple-Bond Energies (kJ/mol)

	H	C	N	O	F	Si	P	S	Cl	Br	I
H	436	413	391	463	565	318	322	347	432	366	299
C		346	305	358	485			272	339	285	213
N			163	201	283				192		
O				146		452	335		218	201	201
F					155	565	490	284	253	249	278
Si						222		293	381	310	234
P							201		326		184
S								226	255		
Cl									242	216	208
Br										193	175
I											151

Multiple Bonds

N=N	418	C=C	602	C=O	732
N≡N	945	C≡C	835	C≡O	1072
O=O (in O ₂)	498	C=N	615	C≡N	887

Table: Standard Enthalpies of Formation (kJ/mol)

C ₂ H ₆ (g)	ethane	-84.7
H ₂ O(g)	water vapor	-241.8
CO ₂ (g)	carbon dioxide	-393.5

- Write the balanced chemical equation for the complete combustion of ethane, C₂H₆(g).
- Draw Lewis structures for each of the species.
- Calculate the energy needed to break the bonds in the reactants. _____
Calculate the energy released as the bonds in the products are formed. _____
- What is the $\Delta H_{\text{combustion}}$ based on bond energies? _____
- Calculate the $\Delta H_{\text{combustion}}$ using Hess's Law and the thermochemical data from your textbook.

6. (a) Write the balanced chemical equation for the combustion of butane, C_3H_8 .

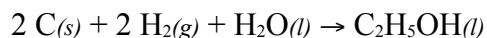
(b) Using your textbook, calculate the heat of combustion (ΔH_c) of butane.

7.

<u>Substance</u>	Enthalpy of Combustion, ΔH° (kiloJoules/mol)
$C_{(s)}$	-393.5
$H_{2(g)}$	-285.8
$C_2H_5OH_{(l)}$	-1366.7
$H_2O_{(l)}$	- -

(a) Write a separate, balanced chemical equation for the combustion of each of the following: $C_{(s)}$, $H_{2(g)}$, and $C_2H_5OH_{(l)}$. Consider the only products to be CO_2 and/or $H_2O_{(l)}$.

(b) In principle, ethanol can be prepared by the following reaction:



Calculate the standard enthalpy change, ΔH° , for the preparation of ethanol, as shown in the reaction above.