$\Delta H = BER + (-BEP)$

$\Delta H = BER - BEP$

9 • Bonding & Molecular Structure

BOND ENERGIES

Table 9.9 • Some Average Single- and Multiple-Bond Energies (kJ/mol)

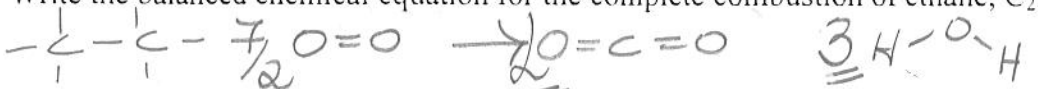
	H	C	N	O	F	Si	P	S	Cl	Br	I
H	**436**	**413**	**391**	**463**	**565**	**318**	**322**	**347**	**432**	**366**	**299**
C		346	305	358	485			272	339	285	213
N			**163**	**201**	**283**				**192**		
O				146		452	335		218	201	201
F					**155**	**565**	**490**	**284**	**253**	**249**	**278**
Si						222		293	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
N≡N	945	C≡C	835
C=N	615	C=O	732
C≡N	887	C≡O	1072
O=O (in O_2)	498		

Table 6.2 • Standard Enthalpies of Formation (kJ/mol)		
$C_2H_6(g)$	ethane	-84.7
$H_2O(g)$	water vapor	-241.8
$CO_2(g)$	carbon dioxide	-393.5

1. Write the balanced chemical equation for the complete combustion of ethane, $C_2H_6(g)$.



2. Draw structural formulas (shortcut Lewis structures) for each of the species.

$C_2H_6 + 7/2\ O_2 \rightarrow 2\ CO_2 + 3H_2O$ fractions in grade 11 !!

3. Calculate the energy needed to break the bonds in the reactants. 4567 kJ = BER
   Calculate the energy released as the bonds in the products are formed. 5706 kJ = BEP

BER
C-C = 346
C-H = 6(413) = 2478
+ 7/2 O=O = $\frac{7}{2}$(498) = 1743

BEP
C=O = (732)2×2
+ (O-H)×2×3(463) = 2778
2928

What is the $\Delta H_{combustion}$ based on bond energies? −1103 kJ

$\Delta H = BER - BEP = 4567\ kJ - 5706\ kJ$

$= \boxed{-1103\ kJ / 1\ mol\ C_2H_6}$ exo