

Enthalpy of Reaction from Bond Energies

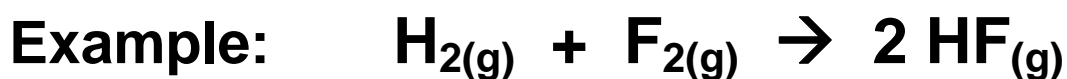
Table 8.4 Average Bond Energies (kJ/mol)

Single Bonds				Multiple Bonds			
H—H	432	N—H	391	I—I	149	C=C	614
H—F	565	N—N	160	I—Cl	208	C≡C	839
H—Cl	427	N—F	272	I—Br	175	O=O	495
H—Br	363	N—Cl	200	S—H	347	C=O*	745
H—I	295	N—Br	243	S—F	327	C≡O	1072
		N—O	201	S—Cl	253	N=O	607
C—H	413	O—H	467	S—Br	218	N=N	418
C—C	347	O—O	146	S—S	266	N≡N	941
C—N	305	O—F	190	Si—Si	340	C≡N	891
C—O	358	O—Cl	203	Si—H	393	C=N	615
C—F	485	O—I	234	Si—C	360		
C—Cl	339	F—F	154	Si—O	452		
C—Br	276	F—Cl	253				
C—I	240	F—Br	237				
C—S	259	Cl—Cl	239				
		Cl—Br	218				
		Br—Br	193				

*C=O(CO₂) = 799

$$\Delta H = \underbrace{\sum D(\text{bonds broken})}_{\text{Energy required}} - \underbrace{\sum D(\text{bonds formed})}_{\text{Energy released}}$$

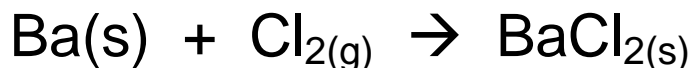
D represents the bond energy per mole of bonds and D always has a positive sign.



$$\begin{aligned} \Delta H &= [D_{\text{H-H}} + D_{\text{F-F}}] - 2D_{\text{H-F}} \\ &= \left[1 \text{ mol} \times \frac{432 \text{ kJ}}{\text{mol}} + 1 \text{ mol} \times \frac{154 \text{ kJ}}{\text{mol}} \right] - 2 \text{ mol} \times \frac{565 \text{ kJ}}{\text{mol}} \\ &= -544 \text{ kJ} \end{aligned}$$

Enthalpy of Reaction Involving Salts

Calculate the enthalpy of the following reaction:



Energy Data	
Lattice Energy	-2056 kJ/mol
1 st Ionization Energy of Ba	+503 kJ/mol
2 nd Ionization Energy of Ba	+965 kJ/mol
Electron Affinity of Cl	-349 kJ/mol
Bond Energy of Cl ₂	+239 kJ/mol
Enthalpy of Sublimation of Ba	+178 kJ/mol

Solve using a Hess's Law approach:

