Answers to Exercise 8.7
Bond Length and Bond Energy

1. Complete the table below given the available information.

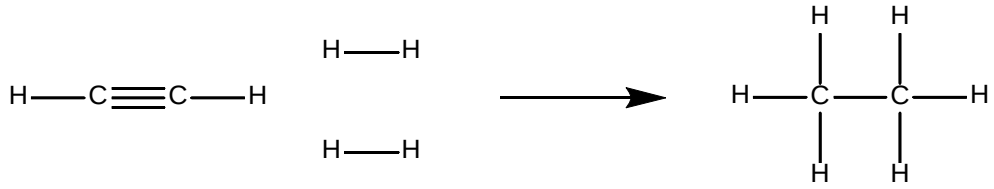
Bond	Bond Length	Enthalpy of Bond Dissociation
H-F	92 pm	565 kJ/mol
H-Cl	127 pm	427 kJ/mol
Cl-Cl	199 pm	243 kJ/mol
Cl-Br	214 pm	215 kJ/mol
Br-Br	228 pm	193 kJ/mol
Br-I	248 pm	175 kJ/mol
I-I	266 pm	151 kJ/mol

Bond length increases as the atoms become larger. (It also increases as bond order decreases; however, atom size is a more important factor.)

The energy required to break a bond (approximated here as "enthalpy of bond dissociation") tends to decrease as bond length increases. As a general rule, shorter bonds tend to be stronger.

2. The enthalpy change for a reaction can be estimated by subtracting the heat released by forming bonds from the heat consumed by breaking bonds

Step 1: Draw Lewis diagrams for all molecules in the balanced reaction equation



Step 2: Identify which bonds will be formed and which bonds will be broken

Bonds formed: four C-H and one C-C

Bonds broken: two H-H and one C≡C

There is no way to directly calculate the difference between the C-C and C≡C bonds. You have to imagine completely breaking the triple bond then forming a new single bond.

Step 3: Calculate the enthalpy change from forming and breaking bonds

$\Delta H \approx \sum \Delta_{bd} H(bonds\ broken) - \sum \Delta_{bd} H(bonds\ formed)$

$\Delta H \approx [2\Delta_{bd} H(H-H) + \Delta_{bd} H(C \equiv C)] - [4\Delta_{bd} H(C-H) + \Delta_{bd} H(C-C)]$

$\Delta H \approx \left[2\left(432\frac{kJ}{mol}\right) + \left(839\frac{kJ}{mol}\right)\right] - \left[4\left(413\frac{kJ}{mol}\right) + \left(347\frac{kJ}{mol}\right)\right]$

$\Delta H \approx -296\frac{kJ}{mol}$

Step 4: Check your work

Does your answer seem reasonable? Are sig. fig. correct?