Bond Energy Calculations

(a) Shows the central concept of bond energy calculations – that energy must be ***used*** to break a chemical bond. And, if energy must be used to break chemical bonds, the opposite must also be true – energy is ***released*** when chemical bonds are formed.

(b) This shows the overall balanced equation and the bonding in each substance (reactants on the left, products on the right, separated by a squiggly line. You don't have to use a line, but it helps to keep the two sides of the reaction separate from each other.

(c) In this part, the number of each type of bond (C – H, C – C, C = O, etc.) in each reactant and product is determined, and these numbers are then multiplied by the corresponding coefficient in the equation. For instance, in ethane, there are six **C – H** bonds and one **C – C** bond. But since ethane has a coefficient of **2** in the balanced equation, both of those numbers are multiplied by two, for a total of twelve **C – H** bonds and two **C – C** bonds. For the **C – H** bonds, that number (12) is then multiplied by the bond energy of a **C – H** bond, which is 413 kJ per mole.* This process is then repeated for each type of bond in each molecule on the reactant side, and then all the bond energies are added up for the reactants (9134 kJ). The same process is then followed for the product side of the equation, and we get 11,516 kJ for that side. Then, going back to step (a), we put a positive sign in front of the reactant value (+9134 kJ) since we have to put energy in when breaking bonds, and we put a negative sign in front of the product side (– 11,516 kJ), since energy is released when bonds are formed. All that is left to do is to add the two numbers, and we then get a total of – 2382 kJ. The negative sign tells us that the reaction is exothermic.

* These bond energy values are taken from a table of bond energies.