Chem 1311Ch9Ep3

00:00:01

Hello and welcome to the third episode of Chemical bonding.

00:00:08

Previously in chemical bonding.

00:00:13

We learned to calculate formal charges for Lewis dot structures.

00:00:19

And we learn to determine the most likely structure of a set of Lewis structures based on formal charges.

00:00:32

In this episode.

00:00:35

We will learn to calculate reaction enthalpy from the individual bond enthalpies.

00:00:46

We will determine whether our reaction is endothermic or exothermic, based on enthalpy calculations.

00:01:01

A bond enthalpy.

00:01:04

Is the enthalpy change required to break a particular bond in one mole of gaseous molecules.

00:01:21

The energy required to break a bond.

00:01:24

Can be used to determine whether a particular reaction will absorb or release energy.

00:01:37

A general rule is that the bond enthalpies of single bonds are smaller than those of double and triple bonds, as shown in this table.

00:02:00

Furthermore, for polyatomic molecules like water.

00:02:04

The average value is used to calculate reaction enthalpy.

00:02:21

The bond enthalpy of various bonds can be found in enthalpy tables such as this one.

00:02:37

To calculate the enthalpy change in a chemical reaction.

00:02:41

We must calculate the required energy needed to break the bonds between the atoms in the reactant side.

00:02:49

And the energy released by the formation of all the bonds on the product side.

00:02:59

This is delta H, the enthalpy change for the reaction.

00:03:11

The enthalpy change determines whether the reaction will produce heat or will absorb it.

00:03:26

This reaction enthalpy can be calculated by subtracting the sum of the bond enthalpies of the products from the sum of the bond enthalpies of the reactants.

00:03:44

Endothermic reactions are those which absorb heat and result from the reactants having higher bond energies than the products.

00:03:56

As a result, the reaction enthalpy will have a positive value.

00:04:07

Exothermic reactions are those which release heat and result from the reactants having lower bond enthalpies than the products.

00:04:18

As a result, the reaction enthalpy will have a negative value.

00:04:35

We will consider the reaction enthalpies of two reactions.

00:04:43

The combination reaction between hydrogen and chlorine gases is to form hydrogen chloride.

00:04:54

The combination reaction between hydrogen and oxygen gases is to form water.

00:05:11

For these reactions to proceed, the bonds of the reactants must all be broken.

00:05:18

So we will calculate the change in enthalpy required to break these bonds.

00:05:27

And the bonds of the products must be formed.

00:05:30

So we will also calculate and subtract the enthalpy released when these bonds are formed.

00:05:45

We will start with the first reaction.

00:05:48

Hydrogen and chlorine gas form.

00:05:53

Hydrogen chloride

00:05:59

Keep in mind that bond breaking is an endothermic process and bond making is an exothermic process.

00:06:16

First, we count the number of bonds broken and formed in the reaction.

00:06:25

Next we write down the value for their bond enthalpies.

00:06:31

Then by multiplying the number of bonds by the bond enthalpies, we can obtain the energy change.

00:06:45

And finally,

00:06:47

We subtract the energy released by bond formation from the energy input from bond breaking.

00:06:59

This gets us the reaction enthalpy of negative 184.7 kilojoules per mole.

00:07:09

This reaction is exothermic because the value.

00:07:14

For the reaction, enthalpy is negative.

00:07:27

The same calculation can be carried out for the second reaction between hydrogen and oxygen to form water.

00:07:42

We can organize the data in a table like the one we used just now.

00:07:51

We will record the number of bonds of each type.

00:07:55

Notice that there are four hydrogen oxygen bonds, because each of the two water molecules has two bonds.

00:08:10

We then record the bond enthalpies for each bond.

00:08:19

And we will record the energy changes by multiplying the number of bonds by the bond enthalpies.

00:08:36

Next, we will add the energy change due to bonds breaking and subtract the energy change due to bond formation.

00:08:49

To get a reaction enthalpy of negative 469Kilojoules per mole.

00:08:59

This reaction is also exothermic because the value of the reaction enthalpy is negative.

00:09:15

And that's all there is.

00:09:17

There isn't any more.