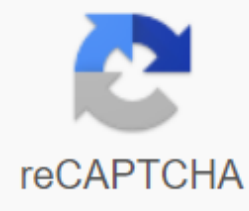




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The Enthalpy chemical system refers to the heat-content system. Enthalpy is given the H Enthalpy symbol a change that refers to the amount of heat released or absorbed in a chemical reaction, and it is given the xG symbol an exothermic reaction when it releases energy, and H - negative. The reaction is determined by endothermia when it absorbs energy, so zG and positive. The amount of heat developed or absorbed in the reaction is carried out under constant pressure called enthalpy changes. It is given a symbol of zH, read as delta H. It is important to remember that the term enthalpy change applies only to reactions rendered under constant pressure. Standard enthalpy changes apply when the reaction works under standard conditions that are: 298 K (25 degrees Celsius) pressure 1 bar (100 kP). where solutions are involved, concentration 1 mole dm-3 In addition, the compounds must be present in their standard state. It is a physical and chemical condition that you expect to find it in standard conditions. This means that the standard condition for water, for example, is liquid water, not steam or water vapor or ice. The standard state of oxygen is gas, not liquid oxygen or oxygen atoms. Enthalpy changes are calculated using hesa law: If the process can be written as the sum of several steps, then the enthalpy process change equals the sum of enthalpy changes of individual steps. If we know enthalpy changes a number of reactions that add up to give a general reaction, we add these enthalpy changes to determine enthalpy changes in the overall reaction. If we know the standard enthalpies forming, zH, from reactionary and reaction products we can calculate the enthalpy change of reaction using the following abbreviated version of the Hesia Law: Where HG indicate the amount of changes enthalpies. Hess Law says that if you convert A reactants into B products, the overall enthalpy change is exactly the same whether you do it in one step or two steps or how many many steps. The reaction is exothermic when it releases energy, and HS is negative. On the other hand, the reaction is determined by endothermia when it absorbs energy, so zG and positive. Scheme 1. Graphic representation of enthalpy changes in reactions. In an exothermic reaction heat is a product of a reaction. The temperature of the reaction mixture rises. Hproducts zlt; Hreactants hh - Hproducts - Hreactants - Negative number In endothermic reaction heat reacts in response. The temperature of the reaction mixture decreases. Hproducts qH - Hproducts - Hreactants - Positive Number Let's Look Now at the following picture: Image Source: This shows the chemical reaction between the same reagents, producing the same products but going through two different ways. In one case, there is a direct on the other hand, there is a two-step process involving some intermediates. As you can see, in any case, the overall enthalpy change is the same because it is governed by the relative positions of reactionary and products on the enthalpy chart. If you go through intermediate, you should put in some extra thermal energy to start with, but you'll get it back in the second phase of the reaction sequence. This is true for any reaction. Let's look at the example and take a closer look at this topic: H2O2(l) → H2O (l) 1/2 O2 (g); -98.2 kJ The standard enthalpy reaction change is 1h'r. For enthalpy reaction changes, r (for reaction) is often overlooked - it's just assumed. kJ mol-1 (kilojoules per mole) refers to the number of substances given in the equation. In this case, 98.2 kJ heat is formed when 1 mole of hydrogen peroxide liquid reacts to the shape of 1 mole water liquid and 1 mole of oxygen gas. Whenever a standard enthalpy change is cited, standard conditions are assumed. If the reaction had to be made in different conditions, another enthalpy change would be recorded. But that's the problem another time. Let's use the same reaction in a common enthalpy problem: Hydrogen peroxide decomposes according to the following thermochemical reaction: H2O2 (l) → H2O(l) 1/2 O2(g); -98.2 kJ How do we calculate the change in enthalpy, qH when 1.00 g of hydrogen peroxide decomposes in this reaction? First of all, we need to know the value of the enthalpy change that is given here. If it is not given, there are tables pointing to them. The thermochemical equation tells us that for the decomposition of 1 mole H2O2 is -98.2 kJ. Now we need to know the number of moles of the appropriate compound to calculate the answer. We use a periodic table to add the masses of hydrogen and oxygen atoms into hydrogen peroxide: the molecular mass of H2O2 is 34.0 (2 x 1 for hydrogen and 2 x 16 for oxygen), which means that 1 ma H2O2 (l) 34.0 g H2O2 Using this data, We can calculate: 34.0 g H2O2 x -98.2 kJ / 1 mole H2O2 x -2.89 kJ Let's look at another example and consider the following Reaction: CS2 (l) - 3 O2 (g) → CO2 (g) - 2 SO2(g) Given values: C (s) - O2 (g) → CO2 (g); -393.5 kJ/mole C (s) - O2 (g) → SO2 (g); -296.8 kJ/mole C (s) 2 C (s) → CS2(l); To solve this kind of problem, we can follow several rules: -The reaction can be reversed. This will change the sign of the zH. -The reaction can be multiplied by a constant. -The value of zH should be multiplied by the same constant. Any combination of the first two rules can be used. Let's start finding one of the reactionary or products where there is only one mole in the reaction. In our case, one CO2 and the first reaction has one CO2 on the product side. C (s) - O2 (g) → CO2 (g), kJ/mol This gives us the CO2 we need on the product side and one of the O2 moles we need on the reactionary side. To get two more O2 moles, use the second equation and multiply it by two. Don't forget to multiply the CC by two as well. 2 S (s) 2 O2(g) → 2 SO2 (g), NoH 2 (-326.8 kJ/mol) Now we have two additional S and one additional C molecule on the reaction side. The third reaction also has two S and one C on the reactionary side. Reverse this reaction to bring the molecules towards the product. Don't forget to change the sign on qHf. CS2 (l) → C (s) 2 S (s), zHf -87.9 kJ/mol When all three reactions are added, an additional two sulfur and one additional carbon atom are cancelled, leaving a targeted response. All that's left is to lower the XG values -393.5 kJ/mole 2 (-296.8 kJ/mole) .6 kJ/mol - 87.9 kJ/mol qH -1075.0 kJ/mol Equation, showing the standard enthalpy formation change for water: When you write one of these equations for enthalpy education changes, you should end up with one mole compound. If it needs you to write a fraction on the left side of the equation, that's fine. (Actually, it's not just OK, it's important because otherwise you'll end up with more than 1 mole compound, otherwise the equation won't balance!) The equation shows that 286 kJ thermal energy is produced when 1 mole of liquid water is formed from its elements under standard conditions. Standard enthalpy formation changes can be written for any connection, even if you can't make it directly from the items. For example, the standard change in formation for liquid benzene is 49 kJ ma-1. Equation: If carbon won't react with hydrogen to make benzene, what's the point of that, and how does anyone know what the enthalpy change is? What figure 49 shows is the relative position of benzene and its elements on the energy chart: How do we know this if the reaction doesn't occur? It's actually very easy to calculate it from other values that we can measure - for example, from enthalpy combustion changes (more). We'll get back to that again when we look at the calculations on the other page. Knowing the enthalpy changes in compound formation allows us to calculate enthalpy changes in a whole series of reactions and, again, we'll study that in a bit more detail on another page. And one more final comment on the changes in formation: the standard change in the formation of an element in its standard state is zero. This is an important fact. The reason is obvious... For example, if you make one mole of hydrogen gas starting with a single mole of hydrogen gas you don't change it anyway, so you don't expect any enthalpy changes. This applies equally to any other element. Enthalpy change in the formation of any element should be zero due to determines the way enthalpy changes the formation. Why do weak acids or weak alkaline give different values? In weak acid, such as ethanol, in normal concentrations, something like 99% acid is not actually ionized. This means that the enthalpy change of neutrality will include other terms of enthalpy involved in the ionization of acid as well as the reaction between hydrogen ions and hydroxide ions. And in a weak alkaline-like ammonia solution, ammonia is also present mainly as ammonia molecules in the solution. Again, there will be other enthalpy changes involved, besides the simple formation of water from hydrogen ions and hydroxide. For reactions associated with ethanol or ammonia, the measured change in the neutralization of tothylies by several kilojoules is less exothermic than in strong acids and bases. For example, one source that gives enthalpy a change in the neutralization of sodium hydroxide solution with HCl as -57.9 kJ mol-1, gives a value of -56.1 kJ mol-1 for a solution of sodium hydroxide neutralizing ethanol. For very weak acids such as hydrogen cyanide solution, enthalpy change of neutralization can be much smaller. Another source gives value for a hydrogen cyanide solution neutralized by a potassium hydroxide solution like -11.7 kJ mol-1, for example. © Jim Clark 2010 (changed July 2013) 2013)

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