What does enthalpy changes mean

The equation showing the standard enthalpy change of formation for water is: When you are writing one of these equations for enthalpy change of formation, you must end up with 1 mole of the compound. If that needs you to write fractions on the left-hand side of the equation, that is OK. (In fact, it is not just OK, it is essential, because otherwise you will end up with more than 1 mole of compound, or else the equation won't balance!) The equation shows that 286 kJ of heat energy is given out when 1 mole of liquid water is formed from its elements under standard conditions. Standard enthalpy changes of formation can be written for any compound, even if you can't make it directly from the elements. For example, the standard enthalpy change of formation for liquid benzene is +49 kJ mol^{-1}. The equation is: If carbon won't react with hydrogen to make benzene, what is the point of this, and how does anybody know what the enthalpy change is? What the figure of +49 shows is the relative positions of benzene and its elements on an energy diagram: How do we know this if the reaction doesn't happen? It is actually very simple to calculate it from other values which we can measure - for example, from enthalpy changes of combustion (coming up next). We will come back to this again when we look at calculations on another page. Knowing the enthalpy changes of formation of compounds enables you to calculate the enthalpy changes in a whole host of reactions and, again, we will explore that in a bit more detail on another page. And one final comment about enthalpy changes of formation: The standard enthalpy change of formation of an element in its standard state is zero. That's an important fact. The reason is obvious . . . For example, if you "make" one mole of hydrogen gas starting from one mole of hydrogen gas you aren't changing it in any way, so you wouldn't expect any enthalpy change. That is equally true of any other element. The enthalpy change of formation of any element has to be zero because of the way enthalpy change of formation is defined. An enthalpy change is approximately equal to the difference between the energy used to break bonds in a chemical reaction and the energy gained by the formation of new chemical bonds in the reaction. It describes the energy change of a system at constant pressure. Enthalpy change is denoted by ΔH. At constant pressure, ΔH equals the internal energy of the system added to the pressure-volume work done by the system on its surroundings. For an endothermic reaction, ΔH is a positive value. For an exothermic reaction, ΔH has a negative value. This is because heat (thermal energy) is absorbed by the endothermic reaction, while it is released by the exothermic reaction. Enthalpy change and entropy are related concepts. Entropy is a measure of the disorder or randomness of a system. In an exothermic reaction, the entropy of the surroundings increases. As heat is evolved, the energy imparted to the system increases disorder. In an endothermic reaction, the external entropy decreases. As heat is absorbed by a process or reaction, the kinetic energy of molecules in the surroundings decreases, which tends to reduce reduce disorder. Enthalpy change is the heat change accompanying a chemical reaction at constant volume or constant pressure. The enthalpy change tells the amount of heat absorbed or evolved during the reaction. It is denoted by ΔH. Types of Enthalpy Change Enthalpy change of a reaction expressed in different ways depending on the nature of the reaction. Some are discussed below: Heat of formation The enthalpy change that takes place when one mole of compound is formed from its elements. It is denoted by ΔH_f. As for example, the heat of formation of ferrous sulphide from its elements is given below: Fe(s) + S(s) → FeS(s) ΔH_f = -24.0 kcal Heat of combustion The enthalpy change that takes place when one mole of compound is completely burnt in excess of air or oxygen. It is denoted by ΔH_c. As for example, the heat of combustion of methane is given below: $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$ ΔH_c = -21.0 kcal Heat of neutralization The enthalpy change that takes place when one gram equivalent of an acid is completely neutralized with one gram equivalent of base in dilute solution. As for example, the heat of neutralization of nitric acid and sodium hydroxide is given below: $HNO_3(aq) + NaOH(aq) \rightarrow NaNO_3(aq) + H_2O(l)$ ΔH = -13.69 kcal Heat of solution The enthalpy change that takes place when one mole of substance is dissolved in specified quantity of solvent in given temperature. As for example, the heat of solution of magnesium sulphate is given below: $MgSO_4(s) + H_2O(l) \rightarrow MgSO_4(aq)$ ΔH = -20.28 kcal Calculating enthalpy change The enthalpy of a system is measured by the sum of the internal energy and the product at constant pressure and volume. H = E + PV .... (i) Here E = internal energy, P = Pressure and V = volume of the system. It is also called heat content. Thus the enthalpy change is $\Delta H = H_{products} - H_{reactants}$ $\Delta H = H_p - H_r$ ....(ii) If ΔV = the change in volume at constant temperature and pressure, ΔE = the sum of the change in internal energy at constant volume and ΔH = the change in enthalpy at constant pressure. Then from the equation (i) we can write, ΔH = ΔE + PΔV ....(iii) Let us consider a reaction aA + bB → cC + dD Here, Change in number of moles = no.of moles of products – no. of moles of reactants. = (c + d) – (a + b) = Δn If V = the volume occupied by one mole of gas, the change in volume, ΔV = change in no. of moles X volume occupied by one mole of gas. ΔV = Δn X V PΔV = P(Δn X V) PΔV = PV X Δn ....(iv) But for one mole of gas PV = RT. By placing this value in equation (iv) we get PΔV = RT X Δn Substituting the value of PΔV in equation (iii) we get ΔH = ΔE + Δn RT Here it should be noted that to calculate Δn, the no. of moles of reactants and products in only gaseous state are considered. The value of gas constant R = 8.314 J/mol.K or 1.987 cal/mol.K. Exothermic and endothermic reactions Let us consider a reaction at constant pressure, A + B → C+ D Rewritting equation (ii) we get $\Delta H = H_p - H_r$ ΔH = (HC + HD) – (HA + HB) The value of ΔH can be positive, negative or zero. If ΔH is zero that means there is no heat change during the reaction, neither heat is absorbed or evolved. Sign of ΔH Energy Reaction type + Absorbed Endothermic – Evolved Exothermic In case ΔH is positive that means Hp is greater than Hr, then heat is absorbed or the reaction is endothermic. And when ΔH is negative means Hp is less than Hr then heat is evolved or the reaction is exothermic. 4.63/5 (176) Enthalpy is important because it tells us how much heat (energy) is in a system. Heat is important because we can extract useful work from it. In terms of a chemical reaction, an enthalpy change tells us how much enthalpy was lost or gained, enthalpy meaning the heat energy of the system.Beside this, what is enthalpy and what does it tell us?This means that the change in enthalpy under such conditions is the heat absorbed or released by the system through a chemical reaction or by external heat transfer. Enthalpies for chemical substances at constant pressure usually refer to standard state: most commonly 1 bar pressure.What exactly is enthalpy?Enthalpy is the change in energy of a chemical compound or reaction. However, enthalpy is unique because it is not just the internal energy change (q.) It also accounts for the energy required to combat atmospheric pressure. Enthalpy is zero for elements because they are in their natural, ground state.What is enthalpy in thermodynamics?Enthalpy /'?nθ?lpi/ (listen) is a property of a thermodynamic system. The enthalpy of a system is equal to the system's internal energy plus the product of its pressure and volume. The total enthalpy, H, of a system cannot be measured directly. Standard definition: Enthalpy is a measurement of energy in a thermodynamic system. It is the thermodynamic quantity equivalent to the internal energy of the system plus the product of pressure and volume. $H=U+PV$ In a nutshell, The U term can be interpreted as the energy required to create the system, and the PV term as the energy that would be required to "make room" for the system if the pressure of the environment remained constant. When a system, for example, n moles of a gas of volume V at pressure P and temperature T, is created or brought to its present state from absolute zero, energy must be supplied equal to its internal energy U plus PV, where PV is the work done in pushing against the ambient (atmospheric) pressure. More on Enthalpy : 1) The total enthalpy, H, of a system cannot be measured directly. Enthalpy itself is a thermodynamic potential, so in order to measure the enthalpy of a system, we must refer to a defined reference point; therefore what we measure is the change in enthalpy, ΔH. 2) In basic physics and statistical mechanics it may be more interesting to study the internal properties of the system and therefore the internal energy is used. But In basic chemistry, experiments are often conducted at constant atmospheric pressure, and the pressure-volume work represents an energy exchange with the atmosphere that cannot be accessed or controlled, so that ΔH is the expression chosen for the heat of reaction. 3) Energy must be supplied to remove particles from the surroundings to make space for the creation of the system, assuming that the pressure P remains constant; this is the PV term. The supplied energy must also provide the change in internal energy, U, which includes activation energies, ionization energies, mixing energies, vaporization energies, chemical bond energies, and so forth. Together, these constitute the change in the enthalpy $U + PV$. For systems at constant pressure, with no external work done other than the PV work, the change in enthalpy is the heat received by the system. For a simple system, with a constant number of particles, the difference in enthalpy is the maximum amount of thermal energy derivable from a thermodynamic process in which the pressure is held constant. (Source :) OP's question- What does "make room" mean ? - For instance, you are sitting on a chair. Then you stand up and stretch your arms. Doing this, you displace some air to make room for yourself. Similarly a gas does some work to displace other gases or any other constraint to make room for itself. To make it more understandable, imagine yourself contained in a box just big enough to contain you. Now, trying stretching your arms. You will certainly have to do a lot of work to completely stretch you arms completely. Air is just like this box except in case of air you have to do negligible work to make room for yourself.