

A note on the use on units for expressing enthalpy changes for chemical reactions.

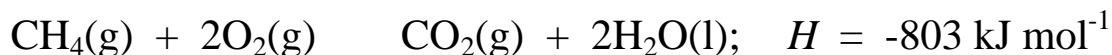
Let us take as an example the reaction:



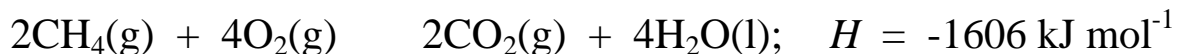
When expressing the enthalpy change for this reaction, the enthalpy of reaction (often loosely called the 'heat of reaction') is correctly described as -803 kJ mol^{-1} .

The use of 'per mole' following the kJ is a frequent source of confusion, since it appears to beg the question 'per mole of what?'

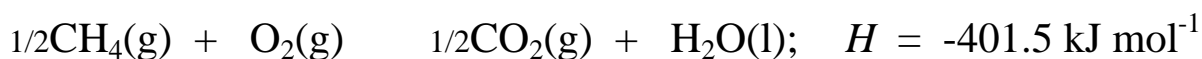
A complete statement of the enthalpy change of the reaction is:



Multiplying the reaction by 2 gives:



or by one-half:



Saying ' mol^{-1} ' in this context means '*per mole of reaction as written*'. Thus, for the first of these reactions, the equation and the accompanying H mean:

"When one mole of methane plus two mole of oxygen react to produce one mole of carbon dioxide plus two mole of water, the reaction products (1 mol of $\text{CO}_2(\text{g})$ + 2 mol of $\text{H}_2\text{O}(\text{l})$) will be 803 kJ lower than the reactants".

For the second reaction, the equation and the accompanying H mean:

"When two mole of methane plus four mole of oxygen react to produce two mole of carbon dioxide plus four mole of water, the reaction products (2 mol of $\text{CO}_2(\text{g})$ + 4 mol of $\text{H}_2\text{O}(\text{l})$) will be 1606 kJ lower than the reactants".

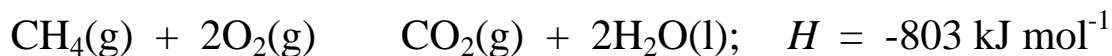
Thus, the use of ' mol^{-1} ' after the kJ is telling us that the chemical reaction as written refers to *molar* amounts, not molecules.

Another way of looking at this is to write the first reaction as:



Now it is quite correct to write the enthalpy change as simply 'kJ'.

Dividing by 'mol' on both sides of this equation, we then have:



To repeat, the 'per mole' after the enthalpy change of a chemical equation written in symbols, tells us that the enthalpy change is 'per mole of the reaction as written....'