

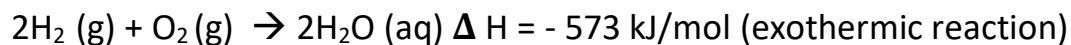
## HW4

Enthalpy change ( $\Delta H$ ) – amount of chemical heat energy taken in (giving out) in a reaction. We can measure enthalpy change, but we cannot measure absolute value of enthalpy.

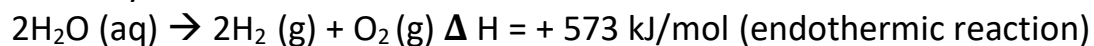
In an exothermic reactions heat is transferred from chemical reaction to the surrounding. Products have lower energy than reactants. Products are more stable.  $\Delta H$  will be negative.

In endothermic reactions the surrounding gets colder. Products are less stable, they have higher energy than reactants.  $\Delta H$  will be positive.

Lavoisier and Laplace law (1<sup>st</sup> law of thermodynamics) – the amount of energy released (or absorbed) during formation of a chemical compound is equal to the amount of energy absorbed (or released) when the same compound is destroyed.

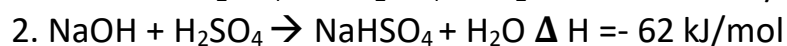


Electrolysis of water



Hess's law. Amount of heat given or taken in the reaction is independent of the pathway between the initial and final state.

We want to obtain  $\text{Na}_2\text{SO}_4$ .

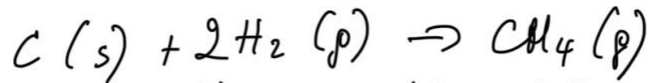


$$-69 - 62 = -131$$

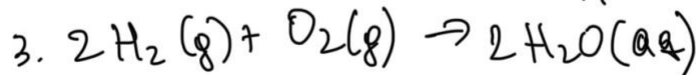
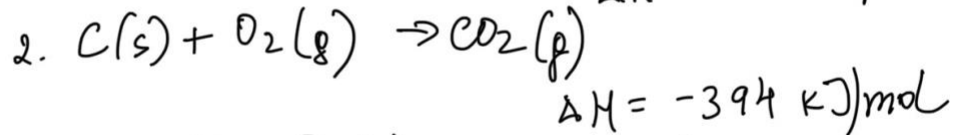
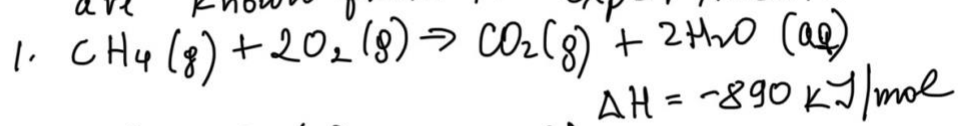
We can use Hess's law if we cannot find enthalpy change from the experiment.

We can take enthalpy changes from the known chemical reaction and

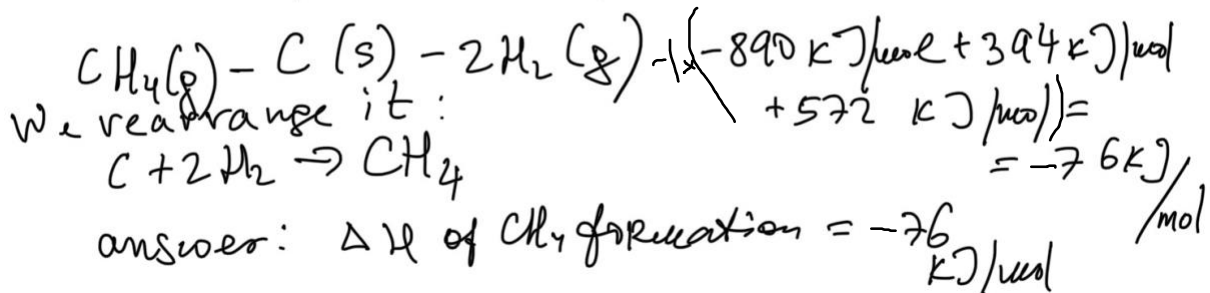
mathematically manipulate chemical equations. For example, we want to know the enthalpy change for synthesis of methane directly from carbon. This reaction is very difficult to perform in the lab. We can do the following manipulations:



$\Delta H$  for the reactions 1, 2 and 3 are known from the experiments



We can subtract reactions 2 and 3 from the first reaction, subtract  $\Delta H$  as well. After subtraction we have the following equation:



**CH<sub>4</sub> - C - 2H<sub>2</sub>**, we should multiply everything by -1, and transfer CH<sub>4</sub> to the right. We'll get the methane formation and its enthalpy change of -76 kJ/mol.

### Questions:

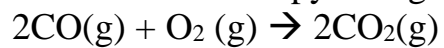
1. What is entropy in your own words?
2. How does entropy relate to the disorder of a system?
3. Can you give an example of a process where entropy increases?

4. What substance is more thermodynamically stable, graphite or diamond?





5. Calculate enthalpy change for the following reaction



The enthalpy change for these reactions are known



$\text{C(s)} + \text{O}_2\text{(g)} \rightarrow \text{CO}_2\text{(g)} \quad \Delta H = -394 \text{ kJ/mol}$  (hint: first step - Multiply this reaction by 2, because we need to count 2  $\text{CO}_2$  in the final reaction.)