

Energy Changes Not Involving Changes in Temperature (no ΔT)

- Energy changes during a physical or chemical process does not have to include any change in temperature
- Any phase change, for example, does not have a ΔT . The melting of ice occurs at 0 °C which requires energy. If the temperature does not change where did the energy go?
- To measure energy change when $\Delta T = 0$, we must determine the change in **enthalpy** (ΔH)

ENTHALPY - the energy lost or gained during a chemical change or phase change at constant pressure

- ΔH can be positive or negative (endothermic or exothermic)
- ΔH can be written for many processes:

ΔH_{comb} (enthalpy of combustion)

ΔH_{soln} (enthalpy of solution)

ΔH_{f} (enthalpy of formation)

ΔH_{fus} (enthalpy of fusion - melting)

ΔH_{sold} (enthalpy of solification)

ΔH_{vap} (enthalpy of vaporization)

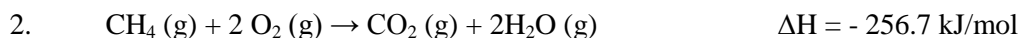
ΔH_{cond} (enthalpy of condensation)

ΔH_{r} (enthalpy of reaction)

- ΔH for specific processes is **always** given in the units kJ/mol
- Writing energy in this form is called enthalpy notation (ΔH notation)
- During a chemical reaction bonds are broken and reformed
- If the energy contained in the bonds broken is more than the energy required to make the new bonds, the change in enthalpy will be negative therefore the temperature does not rise
- since specific amounts of substances undergo changes in enthalpy, the term **molar enthalpy** is used
- **molar enthalpy** - the difference between the potential energy of the products and the potential energy of the reactants. Its symbol is ΔH

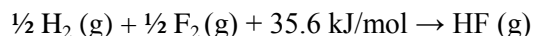
Energy Changes During A Chemical Change

The change in energy during a chemical reaction can be expressed within the reaction statement two different ways:



What type of reaction was this? endothermic or exothermic?

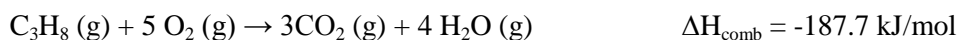
Example:



Note the use of fractions - this is because we want to express the formation of one mole of HF (g)

Thermochemistry Equations and E_p diagrams

- ▶ Thermochemical equations are written for one mole of the substance in question
- ▶ For example, if you need to determine the molar enthalpy of combustion of propane, then you need the balanced equation in terms of one mole of propane



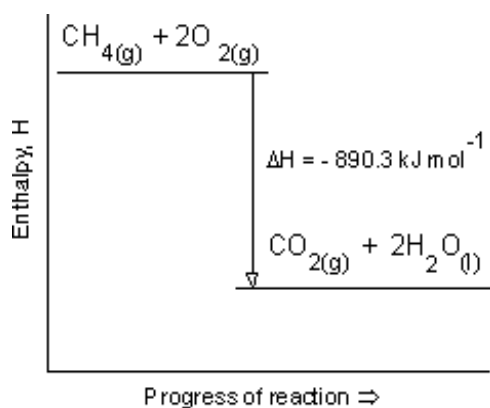
- ▶ They are usually written in ΔH notation



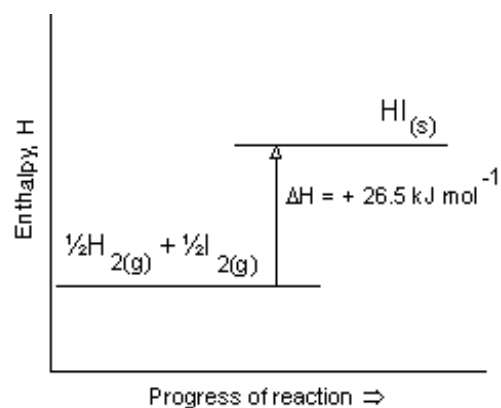
- ▶ thermochemical equation can be represented by enthalpy diagrams/ E_p diagrams. They are almost identical to the ones we've covered in reaction rates except:

1. They are not curvy
2. ΔH must be included
3. Reactants and products must be written with phases and coefficients
4. Must have a specific title

Combustion of Methane



Formation of HI (s)



Do diagrams for the examples written on the previous page

Thermochemical Equations that Represent Specific Processes/Reactions

You should be familiar with the following notations:

1. (s) → (l) ΔH_{fus}
2. (l) → (s) ΔH_{solid}
3. (l) → (g) ΔH_{vap}
4. (g) → (l) ΔH_{cond}
5. (s) → (aq) ΔH_{soln}

1-5 all physical processes

6. $C_xH_y + O_2 \rightarrow$ ΔH_{comb}
7. $A + B \rightarrow \text{salt} + H_2O$ ΔH_{neut}
8. $C + D \rightarrow CD$ ΔH_F
9. $CD \rightarrow C + D$ ΔH_D

6-9 all chemical reactions