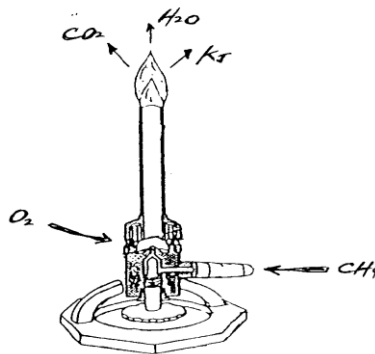
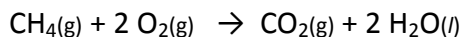


## Aim: What makes a reaction spontaneous?

**spontaneous** reaction - once it gets started, it continues to react on its own

- 1) Demo: combustion (burning) of methane  
Refer to Table I.

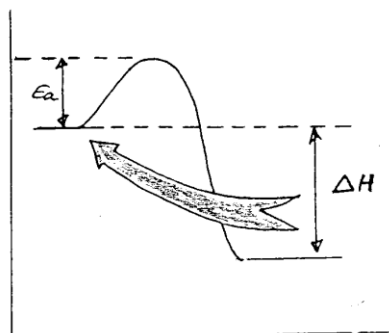


- a) The same occurs for  $\text{C}_3\text{H}_8$ ,  $\text{C}_8\text{H}_{18}$ ,  $\text{CH}_3\text{OH}$ , etc... all combustions, all spontaneous.

Also, they are all exothermic ( $-\Delta H$ ).

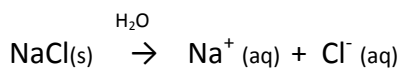
- b) So, if a reaction is exothermic, it's probably spontaneous. **WHY?**

Some of the energy released is used to supply the  $E_a$  so that the reaction can continue.

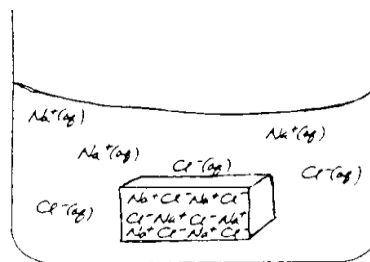


- c) **\*Therefore, nature favors a loss of energy (PE, enthalpy).**

- 2) Demo: dissolving of sodium chloride



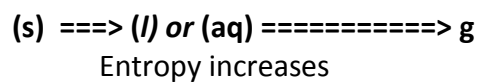
$$\Delta H = + 3.88 \text{ kJ}$$



- a) Based on energy alone, you'd expect dissolving to be nonspontaneous. However, dissolving is spontaneous because as  $\text{NaCl}(\text{s})$  dissolves **entropy** increases.

**entropy** – is a measure of the disorder or randomness of a system

b) To know if entropy is increasing, look at the phases of the reactants and products.



Also, higher Temp, higher entropy

c) \* Therefore, nature favors a gain in entropy

3) Altogether, any reaction that loses energy and gains entropy is always spontaneous.

“Nature is lazy and sloppy”

