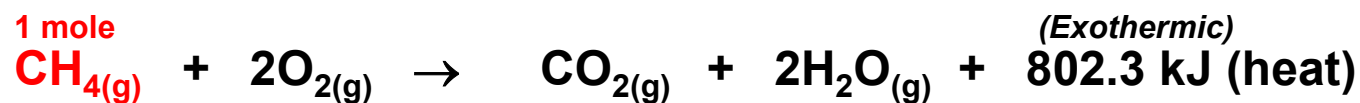


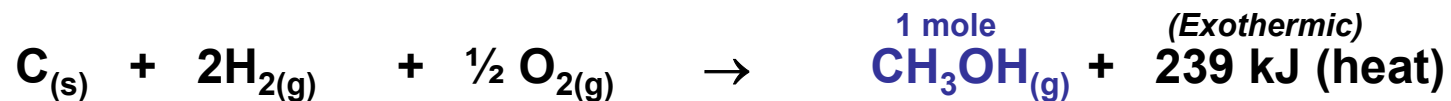
# Enthalpy and Chemical Reactions

## Combustion Reactions



$$\Delta H_{\text{combustion}} = - 802.3 \frac{\text{kJ}}{\text{mol}_{\text{CH}_4}} \quad (\dots \text{per mole of } \textit{substance burned})$$

## Formation Reactions



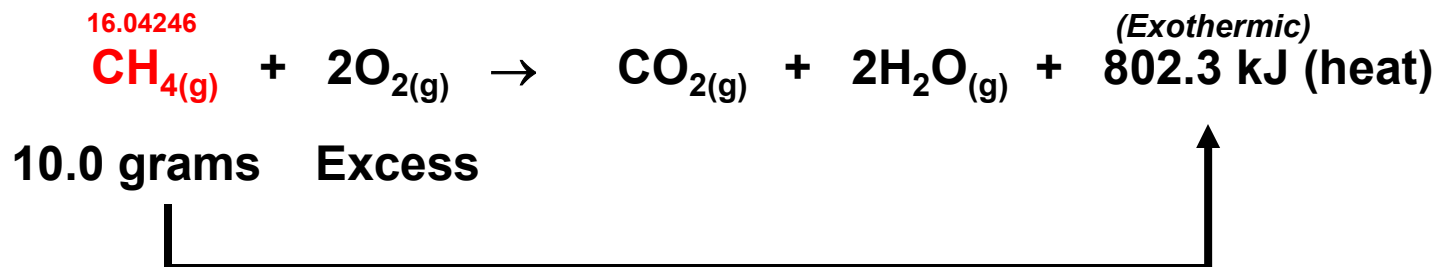
$$\Delta H_{\text{formation}} = - 239 \frac{\text{kJ}}{\text{mol}_{\text{CH}_3\text{OH}}} \quad (\dots \text{per mole of } \textit{substance formed})$$



# $\Delta H_{\text{combustion}}$ Problem



How much heat is produced when 10.0 grams of methane ( $\text{CH}_4$ ) burn in the presence of excess oxygen gas?



$$\frac{10.0 \text{ g}_{\text{CH}_4}}{1} \times \frac{1 \text{ mole}_{\text{CH}_4}}{16.04246 \text{ g}_{\text{CH}_4}} \times \left( -802.3 \frac{\text{kJ}}{\text{mol}_{\text{CH}_4}} \right) = -500. \text{ kJ}$$

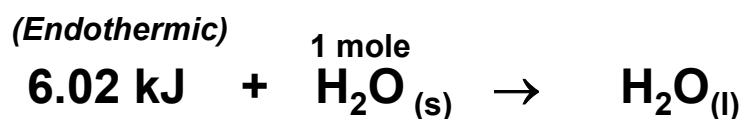
Negative sign tells us heat is released (exothermic) and...  
...that the system's energy has decreased.

*What has happened to the energy of the surroundings? ...the universe?*



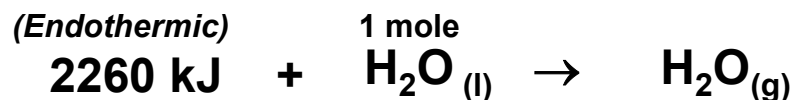
# Enthalpy and Chemical Reactions

## Heats of fusion: Melting a solid into a liquid



$$\Delta H_{\text{fusion}} = + 6.02 \frac{\text{kJ}}{\text{mol}_{\text{H}_2\text{O}}} \quad (\dots \text{per mole of substance melted})$$

## Heat of vaporization: Vaporizing a liquid into a gas.



$$\Delta H_{\text{vaporization}} = + 2260 \frac{\text{kJ}}{\text{mol}_{\text{H}_2\text{O}}} \quad (\dots \text{per mole of substance vaporized})$$

*Why should it require so much more energy to vaporize water in comparison to melt it?*

*Because it requires much more energy to separate molecules to great distances found in gases.*

