Standard Enthalpies of Formation

Section 5.5

Homework
Pg. 323 Practice #1, 2
Pg. 324 #1-10

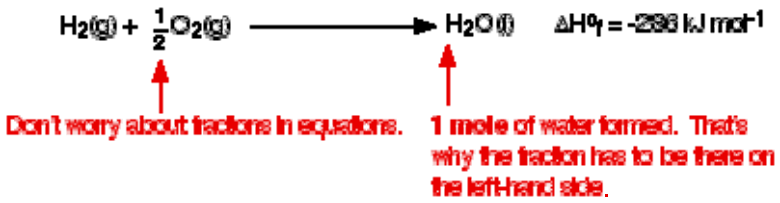
Standard Conditions
- Temp = 25°C and Pressure = 100 kPa

Standard State
- the most stable form of a substance, under standard conditions

Elements	Standard state
most	solid
noble gases; most diatomic elements	gas
bromine, mercury	liquid

Standard Enthalpy of Formation ($\Delta H_f°$)

The change in enthalpy that occurs when
1 mole of a compound is formed from its elements,
which are in their standard states.



Determining standard enthalpy of formation for a substance is easy enough…

- For COMPOUNDS: Table 1 on pg. 320

- For an ELEMENT in its standard state: $\Delta H_f°$ is always ZERO.

Table 1 Standard Enthalpies of Formation for Several Compounds

Compound	$\Delta H_f°$ (kJ/mol)
$AlCl_3(s)$	−704.2
$Al_2O_3(s)$	−1675.7
$CaSO_4(s)$	−1434.1
$Ca_3(PO_4)_2(s)$	−4120.8
$CH_3OH(l)$	−239.1
$CH_4(g)$	−74.4
$C_2H_2(g)$	+228.2
$C_2H_5OH(l)$	−235.2
$C_2H_6(g)$	−83.8
$C_3H_8(g)$	−104.7

Standard enthalpies ($\Delta H°_f$) can be used to calculate enthalpy of a reaction ($\Delta H°_{reaction}$)

$$\Delta H°_{reaction} = (\Sigma\, n_{products}\, \Delta H°_{products}) - (\Sigma\, n_{reactants}\, \Delta H°_{reactants})$$

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Example 1.

Calculate the **standard enthalpy of combustion** for the following reaction:

C_2H_5OH (l) + $\frac{7}{2}$ O_2 (g) → 2 CO_2 (g) + 3 H_2O (l)

$$\Delta H°_{comb} = \Sigma\, n_{products}\, \Delta H°_{products} - \Sigma\, n_{reactants}\, \Delta H°_{reactants}$$

$$= [2(\Delta H°_{CO2}) + 3(\Delta H°_{H2O})] - [1(\Delta H°_{C2H5OH}) + \frac{7}{2}(\Delta H°_{O2})]$$

$$= [2(-393.5) + 3(-286)] - [1(-278) + \frac{7}{2}(0)]$$

$$\Delta H°_{comb} = -1368 \text{ kJ/mol of } C_2H_5OH$$

Example 2.

Using enthalpies of formation, calculate the standard **change in enthalpy for the reaction**:

2 Al (s) + Fe_2O_3 (s) → Al_2O_3 (s) + 2 Fe (s)

		$\Delta H°_f$ (kJ/mol)
Reactants	Al (s)	
	Fe_2O_3 (s)	
Products	Al_2O_3 (s)	
	Fe (s)	

Example 3.

Complete combustion of 1.00 mol of acetone (C_3H_6O) releases 1790 kJ. Use this information to **calculate the enthalpy of formation of acetone**.

		$\Delta H°_f$ (kJ/mol)
Reactants	C_3H_6O (l)	?
	O_2 (g)	0
Products	CO_2 (g)	-393.5
	H_2O (l)	-285.8