

AP CHEMISTRY

TOPIC 9: THERMODYNAMICS, PART B, EXAMPLES, PART II

Day 109:

- Hess's law
- Enthalpy of Formation
- Spontaneity
- Entropy
- Heat Capacity

HEAT CAPACITY:

Heat capacity, C_p , is a measure of how much the temperature of an object is raised when it absorbs heat. An object with a large heat capacity can absorb a lot of heat without undergoing much of a change in temperature, whereas an object with a small heat capacity shows a large increases in temperature even if a small amount of heat is absorbed.

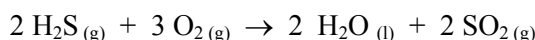
The equation that appears on your AP Chem equation sheet:

$$C_p = \frac{\Delta H}{\Delta T} \quad \text{units: } \frac{J}{^\circ C}$$

Example #1: Calculate the heat capacity of an unknown substance, with an initial temperature of $23.3^\circ C$, that was able to absorb 8735 joules of energy and its final temperature was $25.7^\circ C$.

$$C_p = \frac{\Delta H}{\Delta T} = \frac{8735 J}{(25.7^\circ C - 23.3^\circ C)} = 3640 J ^\circ C^{-1}$$

Example #2: . Determine the standard enthalpy of reaction for the combustion of hydrogen sulfide gas, which proceeds according to the reaction shown below:



The standard enthalpies for the constituents are as follows:

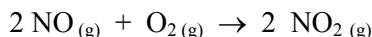
Formula	ΔH_f^0 (kJ mol ⁻¹)
H ₂ S _(g)	- 20
H ₂ O _(l)	- 285.8
SO _{2(g)}	- 296.8

Answer:

$$\Delta H_{rxn}^0 = n \Delta H_f^0 \text{ (products)} - m \Delta H_f^0 \text{ (reactants)}$$

$$\Delta H_{rxn}^0 = [(2)(- 285.8 \text{ kJ}) + (2)(- 2896.8 \text{ kJ})] - [(2)(20 \text{ kJ}) + 0] = - 1125.2 \text{ kJ}$$

Example #3: Use the information shown above to determine the standard enthalpy change for the formation of nitrogen dioxide shown in the reaction below:



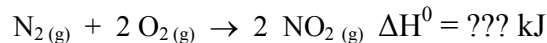
Formula	ΔH_f^0 (kJ mol ⁻¹)
NO _(g)	90.37
O _{2(g)}	0
NO _{2(g)}	33.84

Answer:

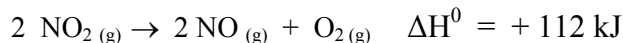
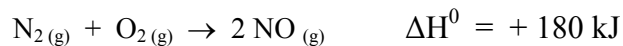
$$\Delta H_{rxn}^0 = n \Delta H_f^0 \text{ (products)} - m \Delta H_f^0 \text{ (reactants)}$$

$$\Delta H_{rxn}^0 = [(2)(33.84 \text{ kJ})] - [(2)(90.37 \text{ kJ}) + 0] = - 113.06 \text{ kJ}$$

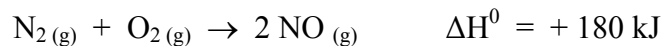
Example #4: Calculate the enthalpy for the following reaction:



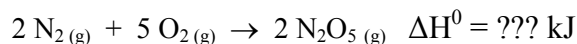
Using the following two equations:



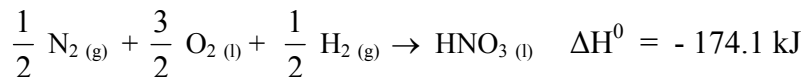
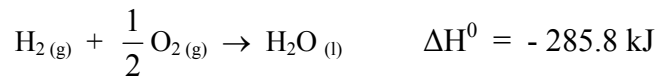
Answer



Example #5: Calculate the enthalpy for the following reaction:



Using the following two equations:



Answer

