Statistical Molecular Thermodynamics

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Video 7.6

Additivity of Entropies

Entropy is Additive for Reactions

Just as was true for enthalpy, one may define the entropy of rection to be

$$a\mathrm{A} + b\mathrm{B} \rightarrow y\mathrm{Y} + z\mathrm{Z}$$

$$\Delta_r S^\circ = yS^\circ[\mathrm{Y}] + zS^\circ[\mathrm{Z}] - aS^\circ[\mathrm{A}] - bS^\circ[\mathrm{B}]$$

Hydrogen Combustion Example

$$aA + bB \rightarrow yY + zZ$$

$$\Delta_r S^\circ = yS^\circ[Y] + zS^\circ[Z] - aS^\circ[A] - bS^\circ[B]$$

$$H_2(g) + \frac{1}{2}O_2(g) \rightarrow H_2O(l)$$

$$\Delta_r S^\circ = 70.0 - 130.7 - \frac{1}{2} \bullet 205.2 = -163.3 \ \ J \bullet K^{-1} \bullet mol^{-1}$$

very negative because the reaction converts 1.5 moles of "very disordered" gas into 1 mole of "less disordered" liquid

Water Shift Reaction Example

$$aA + bB \rightarrow yY + zZ$$

$$\Delta_r S^\circ = yS^\circ[Y] + zS^\circ[Z] - aS^\circ[A] - bS^\circ[B]$$

$$C(s) + H_2O(g) \rightarrow H_2(g) + CO(g)$$

$$\Delta_r S^\circ = 130.7 + 197.7 - 5.7 - 188.8 = 133.9 \ \ J \bullet K^{-1} \bullet mol^{-1}$$

very positive because the reaction converts 1 mole of "very ordered" solid into 1 mole of "very disordered" gas