

Lecture 18.1 2nd Law of Thermodynamics

Note Title

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2nd Law of Thermodynamics: For spontaneous change, the entropy (S) of the universe increases.



Spontaneously
H₂O freezes

$$\Delta S_{univ} > 0$$

2nd Law

H₂O

$$\Delta S_{system}$$

T = -10



$$S_l > S_s$$

$$\Delta S_{sys} = S_s - S_l < 0$$

entropy decreases

cup, sidewalk
mpts, solusystem

$$+ \Delta S_{surrounds} = \Delta S_{univ} > 0 \text{ spont.}$$

$$\Delta S_{surroundings} > 0$$

incr S.

1) Entropy increases with additional heat
More heat, more microstates avail, more S.

$$\Delta S \propto q$$

2) Entropy increases are larger at low temperatures.

$$\Delta S \propto 1/T$$

3) Define $\Delta S = \frac{q}{T}$ units. J/K, kJ/K

4) exothermic rxn: System $\xrightarrow{\text{heat}}$ Surroundings

$$- \Delta H_{rxn} = q_{surroundings}$$

2nd Law: $\Delta S_{sys} + \Delta S_{surroundings} = \Delta S_{univ} > 0$ Spontaneous.

$$\Delta S_{rxn} + \Delta S_{sur} = \Delta S_{univ}$$

$$\Delta S_{rxn} + \frac{q_{sur}}{T} = \Delta S_{univ}$$

$$\Delta S_{rxn} + \frac{-\Delta H_{rxn}}{T} = \Delta S_{univ}$$

🚩 $\Delta S_{rxn} - \frac{\Delta H_{rxn}}{T} = \Delta S_{univ} > 0$ spont. change