Course 565/665 Lecturer Prof. Cavagnero
Day 3.4.04 Date 9:55 am
Notes Taken By Jiang Hong Total Number of Pages

Dealing with q and w in biology.

try to relate q and w to state fns.

$$du = \delta q + \delta w$$

for Adiabatic system: $\delta q = 0$. so $du = \delta w$.

under no work conditions. $\delta w = 0$, $du = \delta q$

$$du = TdS - pdV \quad \text{(for closed system)}$$
$$= \delta q + \delta w$$

$\Rightarrow$

* under quasistatic conditions,
* only pV work. $\delta w = -pdV$

$$\delta q = TdS \quad \text{or} \quad dS = \frac{\delta q}{T}$$

reversible processes.

$A \rightleftharpoons B$

* go back & forth
* under quasi-static condition, maximum of w is produced.

need $\Delta S_{tot} = 0$

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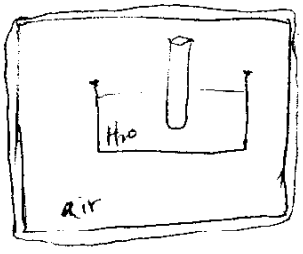
chapter 8: F. H. G

U. S: hard to measure.

- need new relations that apply to specific system.

Helmoholtz Free energy F:



$dS_{combined} = dS_{sys} + dS_{bath} \geq 0$ ... ①

$dU_{tot} = dU_{sys} + dU_{bath} = 0$

if only one kind of molecule in surrounding

& if T = const.; V_{sys} = const. $V_{surr.}$ = const

N_{sys}. $N_{surr.}$ = const

$$dS_{bath} = \frac{1}{T} dU_{bath} + \frac{P}{T} dV_{bath} - \frac{\mu}{T} dN_{bath}$$

$$\therefore \quad dU_{bath} = T dS_{bath} \quad , \quad \therefore \quad dS_{bath} = -\frac{dU_{sys}}{T}$$

$$= -dU_{sys}$$

back to eq ①: $dS_{sys} - \frac{dU_{sys}}{T} \geq 0$

$$\Rightarrow dU_{sys} - T dS_{sys} \leq 0 \qquad d(U_{sys} - TS_{sys}) \leq 0$$

define $F_{sys} = U_{sys} - TS_{sys}$ $\qquad dF_{sys} \leq 0$ const T.V.N.

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