* Exam.

1 a. $\Delta G_{sys} > 0$, does not imply process forbidden.

∵ it depends on definition of system.

& coupling allows them to occur.

1b. $\Delta G_{universe} > 0 \Rightarrow$ Process forbidden.

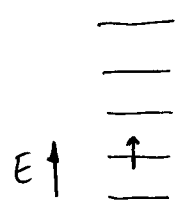
$$\Delta G = \Delta H - T\Delta S$$

we can say that $\Delta H_{universe} = 0$, energy conserved

$\Rightarrow \Delta S < 0$ for $\Delta G > 0$

∴ process forbidden.

1c. electronic states



Energy of the state is conserved.

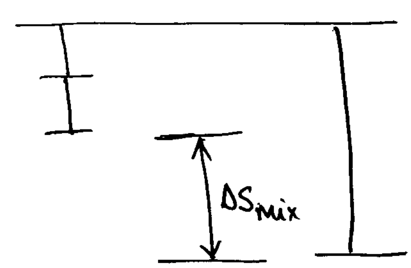
max S. & constant E. (ie) constraint of constant E of system.

∴ NOT true.

2. ΔS = change of entropy between 2 states.

<a> straight forward application of entropy of mixing expression.

<b>

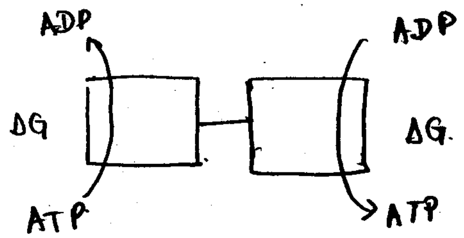


<c> max work $\equiv \Delta G$.

<d> $\Delta G = -T\Delta S$.

<e> adiabatically less work

3. (a)

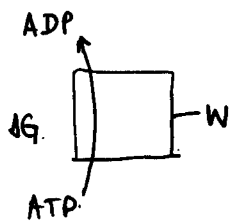


looks like a perpetual motion machine.

$\Delta G = 0$ for entire process.

would imply there is no force resisting it.
but there is work done due to rotation, heat is lost to work.

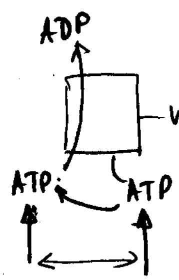
(b)



rate $\propto$ [ATP]

rotational work per molecule of ATP
$\Rightarrow$ independent of [ATP].

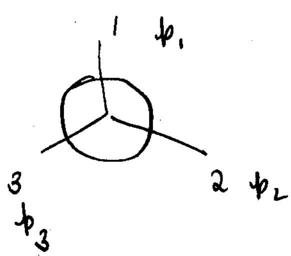
(c).



$\Rightarrow$ Probability of 2 ATPs binding to F_1-ATPase

$\propto$ [ATP] * [ATP] $\longrightarrow$ Prob. 2nd ATP binds to F_1
↓
Prob one ATP binds to F_1

4.

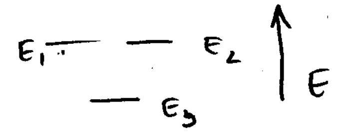


$$p_1 = p_2 = 0.2\, p_3$$

$$p_i \propto e^{-E_i / k_B T}$$

$$0.2 = \frac{p_1}{p_3} = \frac{e^{-E_1/k_B T}}{e^{-E_3/k_B T}} = e^{-(E_1 - E_3)/k_B T}$$

$$\Rightarrow E_1 - E_3 = -k_B T \ln 0.2 \Rightarrow$$



* as T ↑, under the assumption that energies of the state does not change, prob. of being in higher energy state increases .. (or) $T \to \infty$, $p_1 = p_2 = p_3$.

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