CONCEPT: THERMODYNAMICS OF MEMBRANE DIFFUSION: UNCHARGED MOLECULE

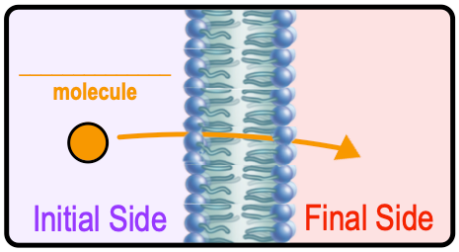
●Recall: the *change* in Gibbs Free Energy Equation: Gibbs Free Energy Under Any Conditions $\Delta G = \Delta G^\circ + RT \ln(Q)$ $Q = \frac{[\text{Products}]}{[\text{Reactants}]}$

□ Describes ΔG due to _____ *gradients/concentrations*.

●$\Delta G_{transport}$: the Gibbs Free Energy change associated with *membrane* _____.

□ When the "reaction" is simply *membrane transport*, ΔG° = _____, (since no bonds are created/formed).

EXAMPLE: $\Delta G_{transport}$ for Membrane Diffusion of Uncharged Solutes.



$$\Delta G_{transport} = RT \ln\left(\frac{[C_{\_\_\_\_\ side}]}{[C_{\_\_\_\_\ side}]}\right)$$

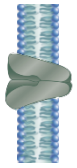
Chemical Gradient

R = 8.315 J/mol*K
T = Degrees Kelvin (K)

EXAMPLE: Calculate $\Delta G_{transport}$ for glucose diffusion across a cell membrane to the inside if [Glucose] outside cell = 10 mM, [Glucose] in cytosol = 0.1 mM, & the temperature = 20°C.

STEP 1: Determine *net charge* of diffusing molecule: Uncharged. Charged (+/–).

STEP 2: Determine *direction* of diffusion (establish *initial* & *final* sides). Drawing a sketch may be helpful.



STEP 3: Check *units* on all numbers & if necessary, *convert* units to ensure *compatibility*. (Ex. Temp. = *Kelvin* ; [X] = $M_{olarity}$).

STEP 4: *Plug in* all given values (with *appropriate units*) into the *correct equation* & *algebraically solve* for missing variable.

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PRACTICE: Calculate $\Delta G_{transport}$ for the diffusion of glucose from *outside to inside* a cell if extracellular [Glucose] = 5 mM, intacellular [Glucose] = 0.5 mM, & the temperature = 20˚C. Would this be an exergonic or endergonic process?

a) **–**5.61 KJ/mol.
b) 5.61 KJ/mol.
c) **–**0.383 KJ/mol.
d) 0.383 KJ/mol.

PRACTICE: Calculate $\Delta G_{transport}$ for the diffusion of glucose from *inside to outside* a cell if extracellular [Glucose] = 1 M, intacellular [Glucose] = 2.0 mM, & the temperature = 20˚C. Would this be a spontaneous or nonspontaneous process?

a) **–**15.15 KJ/mol.
b) 15.15 KJ/mol.
c) **–**1.03 KJ/mol.
d) 1.03 KJ/mol.

PRACTICE: Calculate the energy cost ($\Delta G_{transport}$) of pumping an uncharged solute across a cell's plasma membrane, against a 1.0×10^4-fold concentration gradient at 25˚C. Would this be an exergonic or endergonic process?

a) **–**95 KJ/mol.
b) 2 KJ/mol.
c) 23 KJ/mol.
d) **–**10 KJ/mol.