$$AgCl(s) \rightarrow Ag^+(aq) + Cl^-(aq)$$

$\Delta G^\circ = +56$ kJ/mol

Yes.

$$\Delta G = \Delta G^\circ + RT \ln Q$$

stand. cond.: $[Ag^+]$ & $[Cl^-] = 1M$

$\Delta S_{univ} > 0$ for a spontaneous process

rewrite

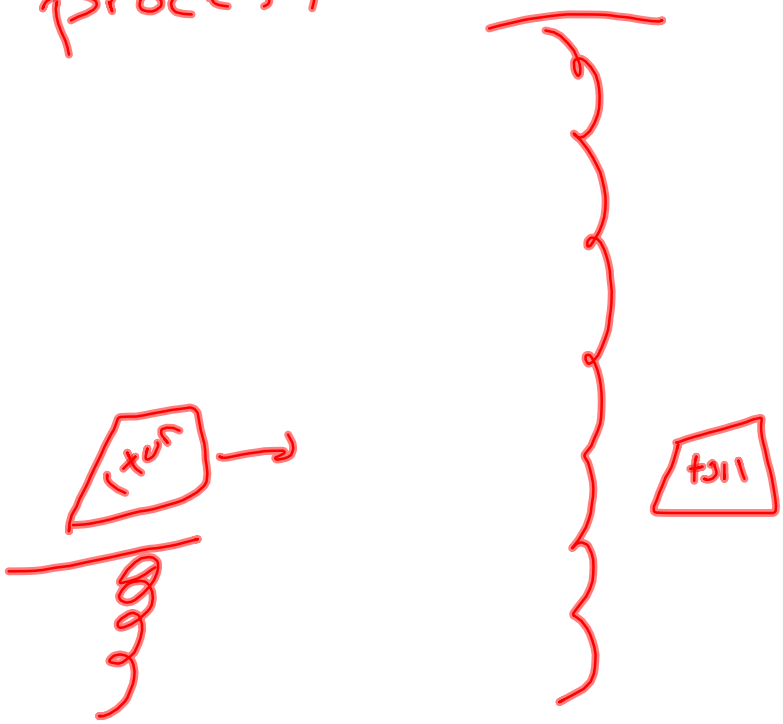
$\Delta G^{sys} < 0$

SYSTEM

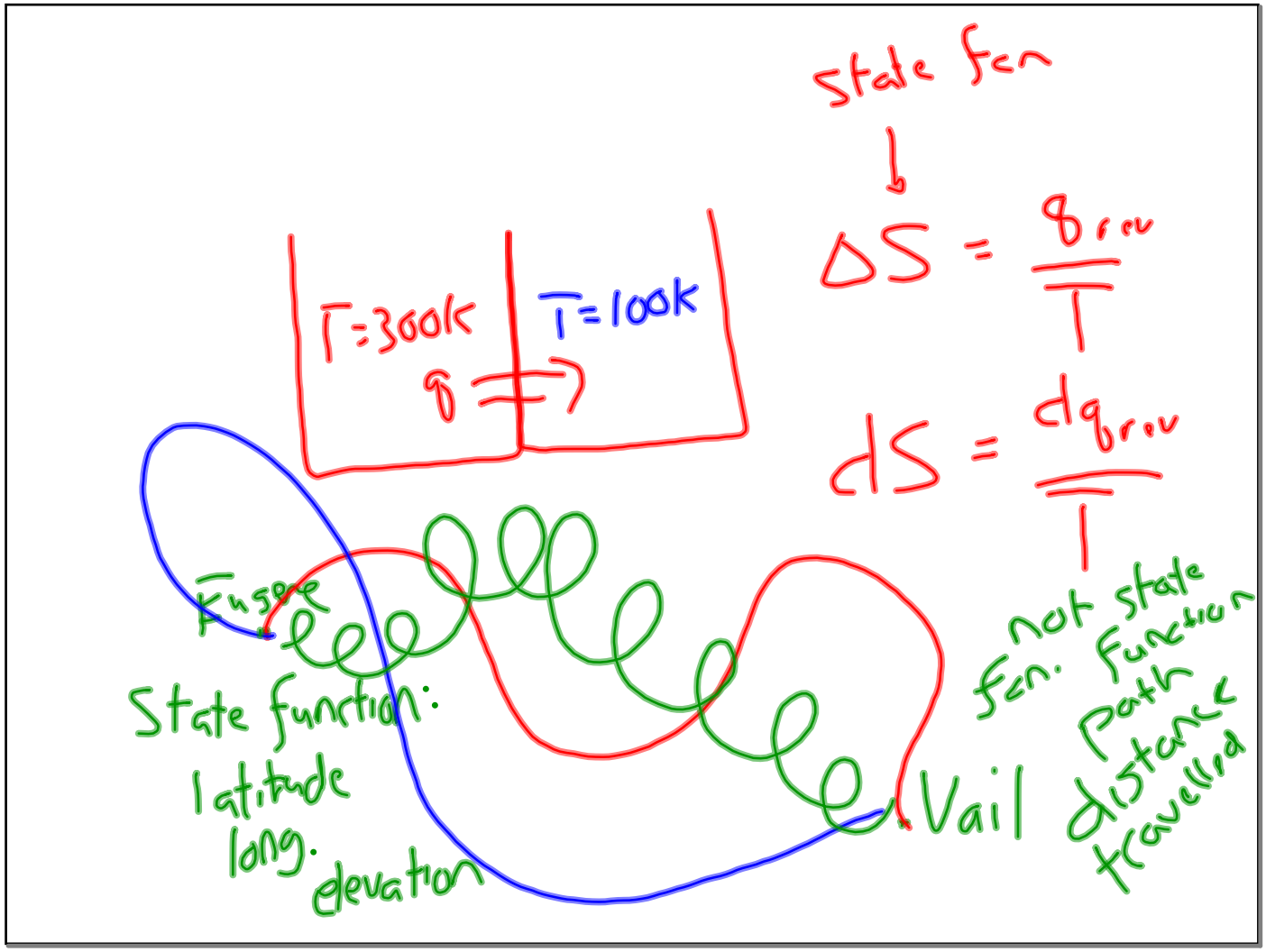
$\Delta G^{sys} = \Delta H^{sys} - T\Delta S^{sys}$

$-T\Delta S^{surr}$

Thermodynamically reversible process

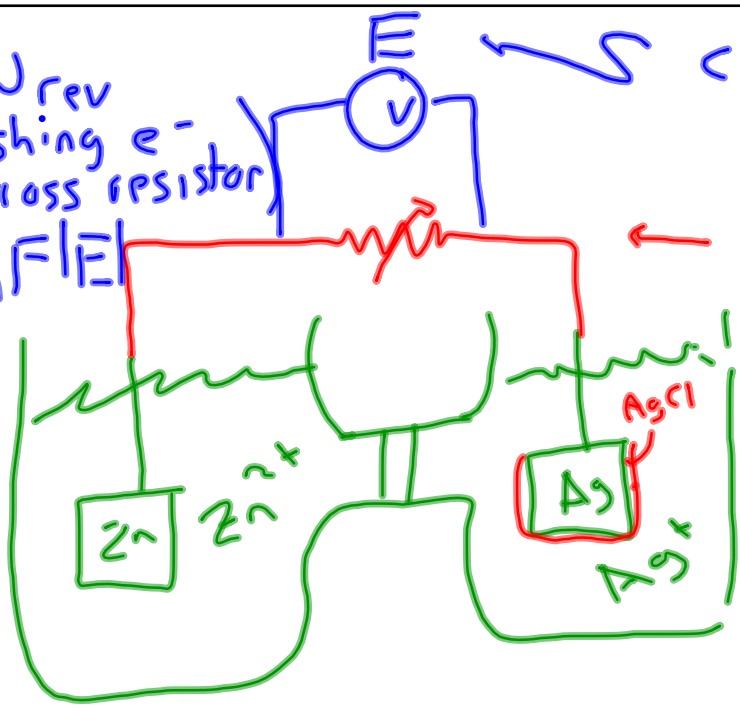


thermodynamically reversible path does maximum work


state fcn
$\Delta S = \frac{q_{rev}}{T}$
$dS = \frac{dq_{rev}}{T}$
T=300K
T=100K
q
Fuzzie
State function:
latitude
long.
elevation
Vail
not state fcn.
Function
path
distance travelled

$\Delta G = w_{rev}$ (pushing e^- across resistor)

$|\Delta G| = -nF|E|$



cell potential

Raise R of variable resistor to ∞ limit of thermodyn. rev.

$n = 2$

$Zn + 2AgCl \rightarrow ZnCl_2 + 2Ag$

ΔG°

molar quantity

$|\Delta G| = nF|E|$

# of charges in one mole

energy I have to raise the e^- across in going the resistor

$F \approx 96500\ C$

n = # of electrons transferred in the reaction

$Zn + 2AgCl(s) \rightarrow ZnCl_2 + 2Ag$ $\Delta G < 0$

$ZnCl_2 + 2Ag \rightarrow Zn + 2AgCl$ $\Delta G > 0$

$Ag/AgCl/Ag^+ \,//\, Zn^{2+}/Zn$

unenergizing reduction

phase boundary

salt bridge

~~Mega~~ measure right vs. left side $\Delta G = -nFE$

Normal Hydrogen electrode (NHE)

$Pt / H_2(g, a=1) / H^+(aq)(a=1) // \frac{1}{2}$ rxn

E vs. NHE

$Zn^{2+} + 2e^- \rightarrow Zn$

$AgCl + e^- \rightarrow Ag + Cl^-$

1/2 rxns for

$ZnCl_2 + 2Ag \rightarrow 2AgCl + Zn$

Standard Reduction potential → E° vs. NHE

$Ca^{2+} + H_2 \rightarrow Ca + 2H^+$ $\quad -2.76V$, $\Delta G^\circ = -nFE^\circ$

NHE // Ca^{2+} / Ca

$Ni^{2+} + H_2 \rightarrow Ni + 2H^+$ $\quad -0.23V$, $\Delta G^\circ = -nFE^\circ$

NHE // Ni^{2+} / Ni

$Ni^{2+} + Ca \rightarrow Ca^{2+} + Ni$ $\quad \Delta G^\circ = ?$

Nernst Equation

$$\Delta G = \Delta G^\circ + RT \ln Q$$

NHE // Ca^{2+}/Ca

$$Ca^{2+} + H_2 \rightarrow Ca + 2H^+$$

$$-nFE = -nFE^\circ + RT \ln \frac{[Ca][H^+]^2}{[H_2][Ca^{2+}]}$$

$[H_2] = 1$

$$E = E^\circ - \frac{RT}{nF} \ln \frac{[Ca]}{[Ca^{2+}]}$$

$$E = E^\circ - \frac{RT}{nF} \ln \frac{[R]}{[O]}$$

soln more reducing

E more ⊖

$[O] = [R]$

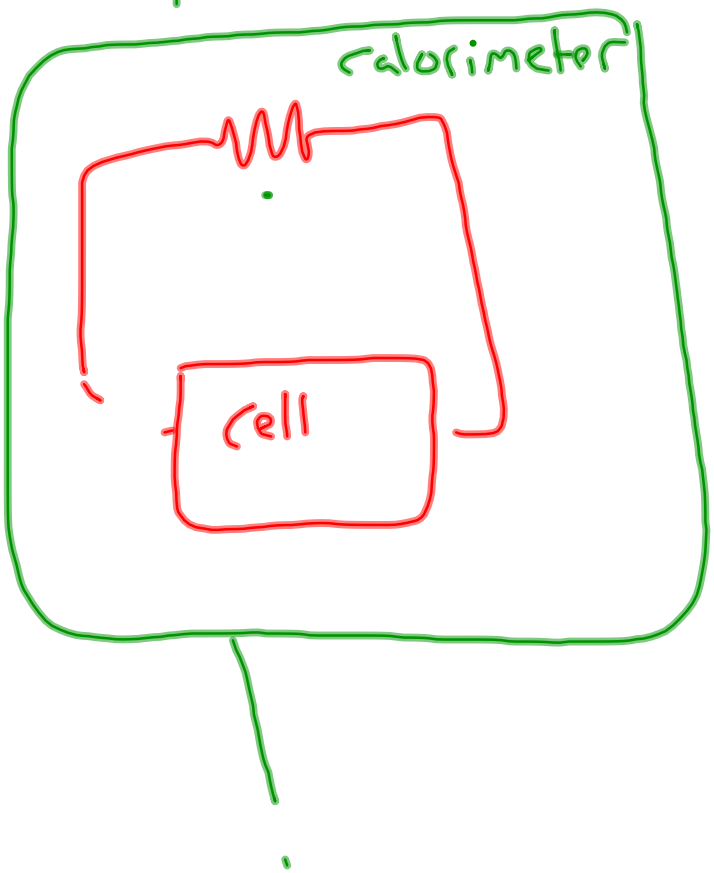
$E = E^\circ$

For $n = 1$

$$E = E^\circ - 0.059V \log \frac{[R]}{[O]}$$

$\Delta G = w_{rev}$

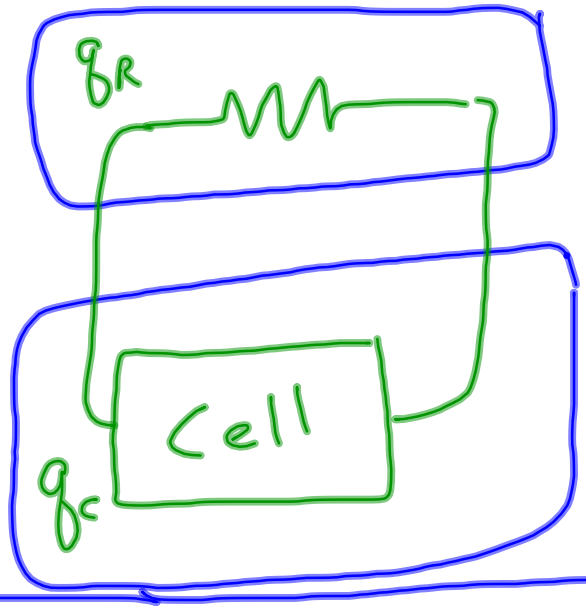
$\Delta G > w$



$\Delta H = q_p$

$-233\ kJ/mol$

constant pressure



$R = 0$

$q_R = 0$

$q_c = -233$ kJ/mol

$R \longrightarrow \infty$

reversible process

$q_c \leftarrow$ reversible

$q_c = -43$ kJ/mol

$q_R = -190$ kJ/mol

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

$G = H - TS$

$q_{c_{rev}} + q_R - T\Delta S$

$\Delta S = \dfrac{q_{c\,rev}}{T}$

$\Delta G = q_R$

represents the electrical work possible

so

$\Delta G = w_{el}$