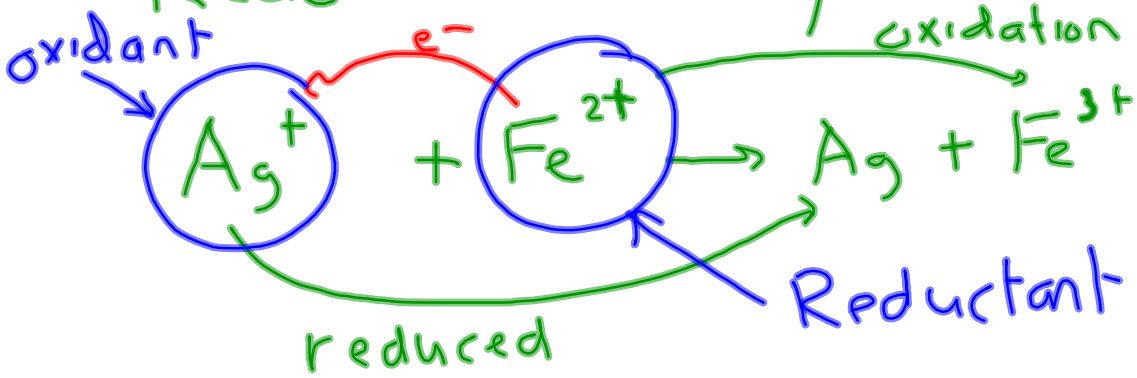
Overview of EChem

Professor Lonergan (Mark)
learns to use a
SmartBoard

# Redox chemistry




OIL RIG

OIL = oxidation is loss of e⁻

RIG = reduction is gain of e⁻

oxidant - does the oxidation gets reduced

reductant - does the reduction get oxidized

$Ag^+/Ag$ or $Fe^{3+}/Fe^{2+}$ } redox couples O/R

$$Ag(NO_3) + Fe(NO_3)_2 \rightarrow Ag + Fe(NO_3)_3$$

$e^-$

$NO_3^-$

$NO_3$ : "spectators"

Both $e^-$ & ions

$$H_2 + O_2 \rightarrow H_2O$$

# Electrochemistry

coupling electrical processes & chemical process

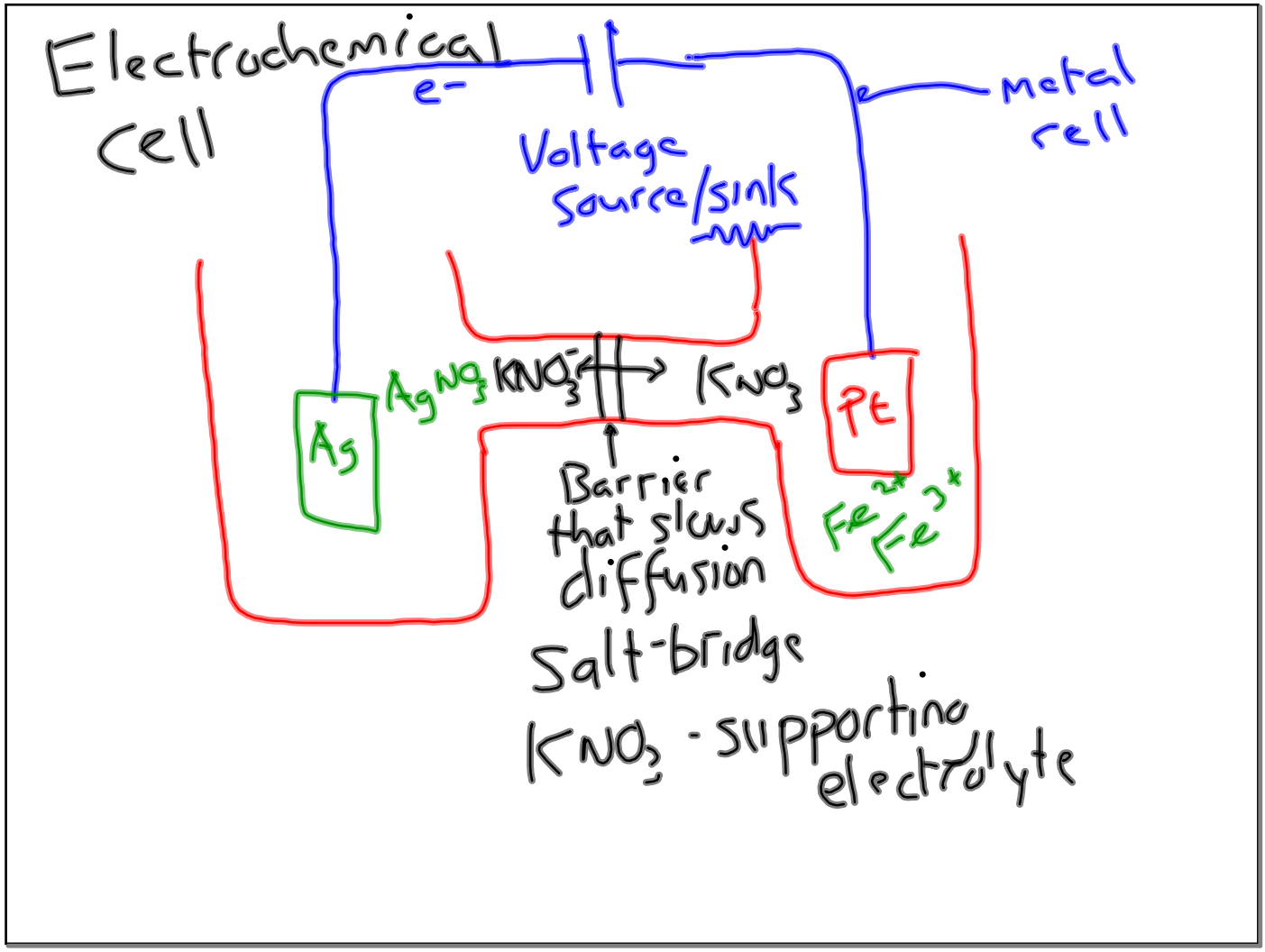
current through a wire

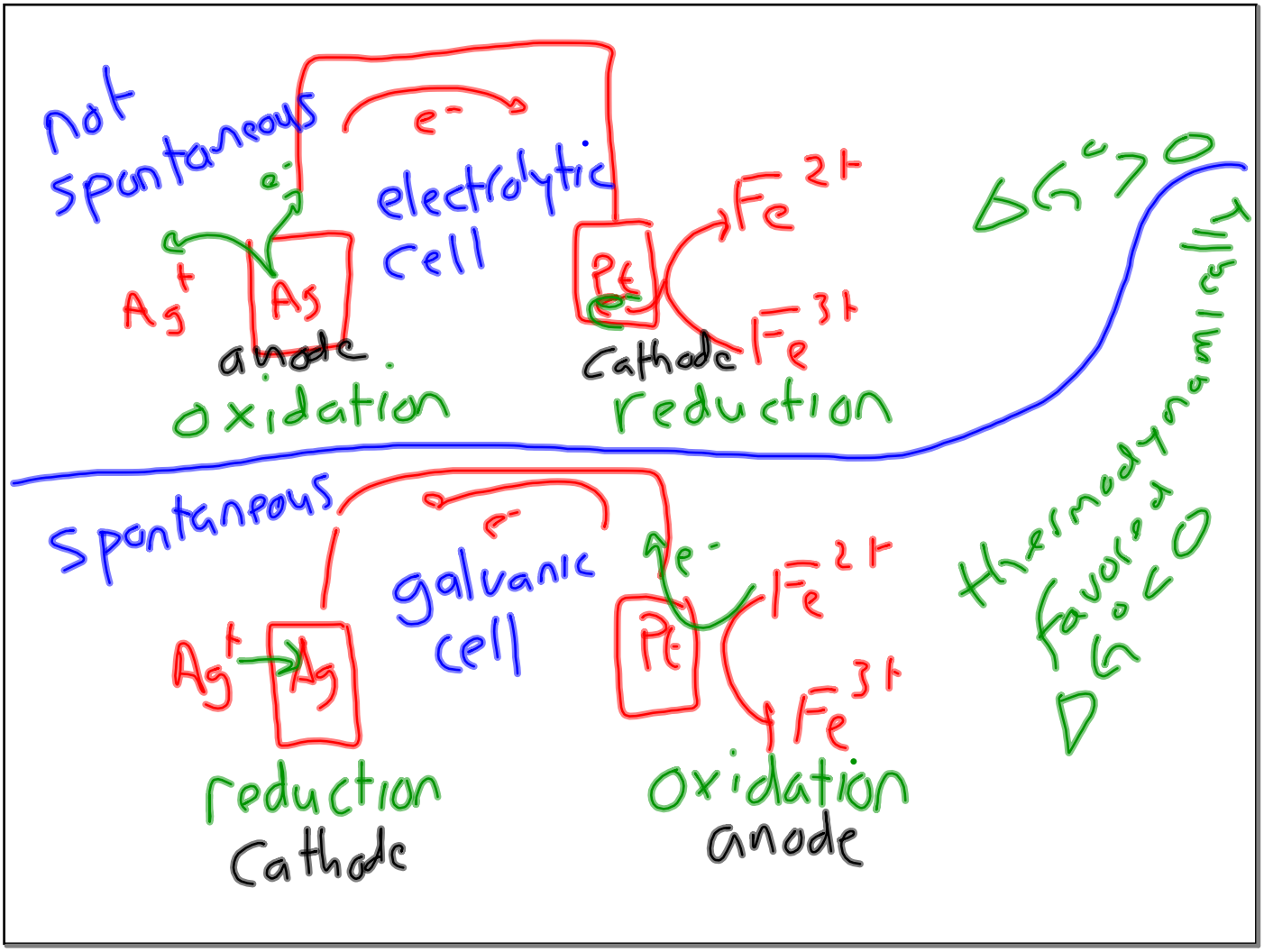
electrical processes only involve e⁻'s

In echem, there is typically some separation between e⁻ & ionic processes.

ions & electrons
O/R

interface between the chemical & electrical


Electrochemical cell
e-
Voltage source/sink
metal rell
Ag
AgNO3
KNO3
KNO3
Pt
Fe2+
Fe3+
Barrier that slows diffusion
Salt-bridge
KNO3 - supporting electrolyte


not spontaneous
e-
e-
electrolytic cell
Ag+
Ag
anode
oxidation
Pt
Fe2+
Fe3+
cathode
reduction
ΔG° > 0
Thermodynamically
spontaneous
e-
galvanic cell
e-
Ag+
Ag
reduction
cathode
Pt
Fe2+
Fe3+
oxidation
anode
Thermodynamically favored
ΔG° < 0

Why is electrochemistry useful?

1. Make stuff

chloralkali process

Al

$NaCl \longrightarrow NaOH + Cl_2 + H_2$

2. Power stuff batteries

chemical energy → electrical energy

· fuel cells

3. Switch stuff

electrochromic window

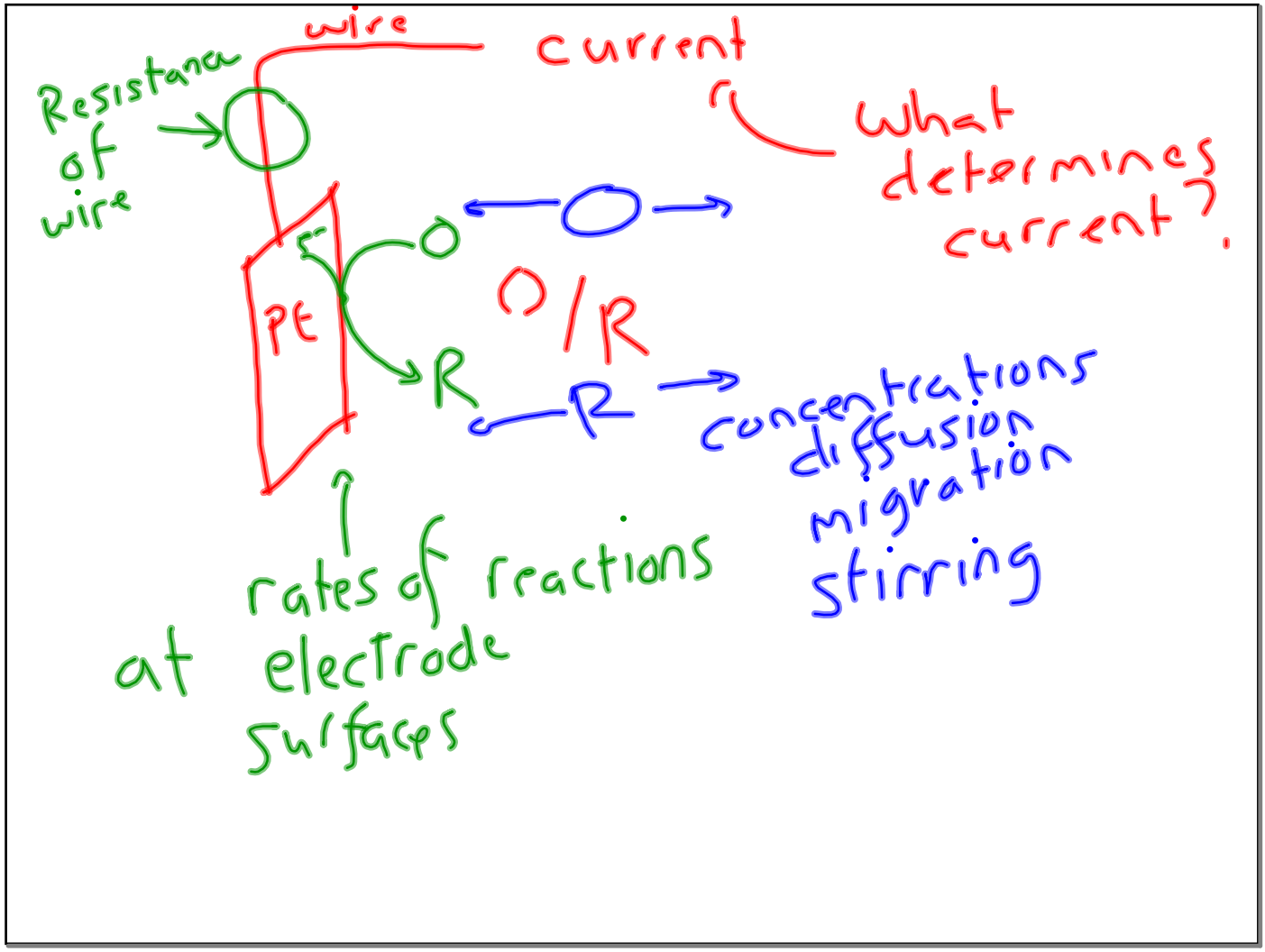
4. Analyze stuff

Focus

· characterize the thermodynamics of redox reactions

· mechanisms of redox reaction

· Kinetics/rates redox reaction


wire
current
What determines current?
Resistance of wire
Pt
O
R
O/R
concentrations
diffusion
migration
stirring
rates of reactions at electrode surfaces

$Q = [Ag^+][Cl^-]$

Rxn Quotient

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

standard states 1M in soln

$\Delta G^\circ = 56$ kJ/mol says 1M $Ag^+$ + 1M $Cl^-$ will ppt

when $Q = 0$, no AgCl dissolved

$\Delta G = -\infty$ spontaneous

at eq $Q = K$ $\Delta G^\circ = -RT \ln K$