EXPERIMENT 10

ELECTROLYSIS & AVOGADRO'S CONSTANT

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Spontaneity

Spontaneous Chemical Reactions

Reactions that take place on their own
with a decrease in Gibbs free energy ($\Delta G < 0$).

$$Mg\ (s) + 2\ H^{+}\ (aq) \rightarrow Mg^{2+}\ (aq) + H_2\ (g)$$

Nonspontaneous Chemical Reactions

Reactions that do not take place on their own
with an increase in Gibbs free energy ($\Delta G > 0$).

The reverse of a spontaneous reaction will be nonspontaneous.

$$Mg^{2+}\ (aq) + H_2\ (g) \rightarrow Mg\ (s) + 2\ H^{+}\ (aq)$$

Today

REACTION OF INTEREST

$$Cu\ (s) + 2\ H^{+}\ (aq) \rightarrow Cu^{2+}\ (aq) + H_2\ (g)$$

This is a nonspontaneous reaction.

In an electrolytic cell, there are two half-reactions.

Oxidation at the (+) electrode: $Cu\ (s) \rightarrow Cu^{2+}\ (aq) + 2\ e^{-}$

Reduction at the (–) electrode: $2\ H^{+}\ (aq) + 2\ e- \rightarrow H_2\ (g)$

Purpose 1

Numerical value of Avogadro's constant (N_A)

$$N_A = \frac{\text{\# of electrons}}{\text{moles of electrons}}$$

$$\text{mol } e^- = 2 \times (\text{mol } H_2)$$

$$\text{mol } H_2 \rightarrow n_{H_2} = \frac{P_{H_2} V}{RT}$$

$$\text{\# of } e^- = \frac{\text{charge flowed}}{\text{charge on 1 } e^-}$$

$$\text{charge on 1 } e^- = 1.6022 \times 10^{-19} \text{ C}$$

$$\text{Charge (C)} = \text{Current (A)} \times \text{time(s)}$$

$$\text{Current (A)} = \frac{\text{Voltage (V)}}{\text{Resistance } (\Omega)}$$

Purpose 2

Molar mass of Cu

$Cu\ (s) + 2\ H^+\ (aq) \rightarrow Cu^{2+}\ (aq) + H_2\ (g)$

moles Cu lost = moles of H_2 (g) produced

Notes

1. Screw clamp needs to be tight.
2. Suck up the sulfuric acid through the gas buret slowly.

3. Next week: make-up week
    - Register/check with me today
    - Meet in SCL 111 at 1pm next week