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NCSSM Electrochemistry

Electrochemistry Lab 1 - Electrical Potentials

Guiding Question:
Which elements tend to release electrons most easily, and which ones retain electrons most strongly? How does the movement of electrons relate to electrical potentials and electronegativity trends within elements?

Importance:
This experiment helps determine the relative ease with which different metals oxidize. Understanding oxidation tendencies is crucial in electrochemistry, as it affects electrical potential, corrosion resistance, and electroplating applications.

Pre-Lab Predictions:
I was unsure about the oxidation order of the metals. Since they are all transition metals, their relative tendencies to oxidize are not immediately clear based on periodic trends. This lab aims to clarify these oxidation behaviors by testing the metal's reactivity next to each other.

Experimental Procedure:

1. We gathered small sample bottles containing Ag, Cu, Mg, Zn, and Pb metals.
2. Used small dropper bottles containing solutions of Ag+, Cu2+, Mg2+, Zn2+, and Pb2+.
3. We used tweezers to immerse each metal into each solution and observe physical changes.
4. Record changes in solution color, metal surface, release of gas, and other visible observations.

Summary of Experimental Findings:
Each metal was immersed in various solutions, and physical changes were observed. First off, we noticed that when each metal was dropped in its respective solutions there was absolutely no reaction occurring. WLOG, I did not record that data below. Below are the rest of the observations:

<u>Silver (Ag+) Solution:</u>

- Cu: Solution turned blue.
- Zn: Turned black and made the solution cloudy.
- Pb: Created a white precipitate and clouded the solution.
- Mg: Darkened and formed sediment.

Copper (Cu2+) Solution (Blue):

- Ag: No change.
- Zn: Darkened, solution turned light green.
- Pb: Darkened, bubbles formed.
- Mg: Gas bubbles actively formed, metal darkened, solution turned light green.

Zinc (Zn2+) Solution:

- No reaction for Ag, Cu, Pb, or Mg.

Lead (Pb2+) Solution:

- No reaction for Ag, Cu, Zn, or Mg.

Hydrochloric Acid (HCl):

- Ag: No reaction.
- Cu: No reaction.
- Zn: Very few bubbles, slow reaction.
- Pb: Turned whitish, subtle reaction.
- Mg: Rapid bubbling and dissolution.

Discussion:

- The data suggest that Mg oxidizes most easily, reacting in nearly every solution and dissolving rapidly in HCl.
- Zn also oxidizes, though more slowly.
- Pb exhibits moderate reactivity.
- Cu reacts only with Ag+ solution.
- Ag remains unchanged in all solutions, indicating its reluctance to oxidize.
- Initially, I was uncertain about oxidation trends. The experiment demonstrated a clear order of metal reactivity, contradicting any assumption that their oxidation order follows simple periodic trends.
    1. **Mg (most reactive)**
    2. **Zn**
    3. **Pb**
    4. **Cu**
    5. **Ag (least reactive)**

Proposed Further Experiments:

We could test additional metals (e.g., Fe, Al) to expand the oxidation trend analysis, measure voltage differences to quantify the oxidation tendencies, or even explore the effect of different acid concentrations on metal reactivity.