Department of Chemistry

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GALVANIC CELL AND THE NERNST EQUATION

Aim:

To determine the standard reduction potential, E^o, of different metals.

Principle:

An electrode at which oxidation takes place is the anode and the electrode at which reduction takes place is the cathode. When a metal is in contact with its own ion solution it develops a potential with respect to the electrolyte. The potential difference developed at the anode-electrolyte interface is called oxidation potential and the potential difference developed at the cathode -electrolyte interface is called reduction potential. The potential difference between the anode and cathode is called the EMF of the cell. In a galvanic, electrodes are made of different metals and the solutions in the cells are of the respective electrodes. The difference between the cells lies in the metal ion concentration. In this case, the chemical reaction is given below.

$$Zn\,(s) \mid Zn^{2+}(aq) \parallel Cu^{2+}\,(aq) \mid Cu\,(s)$$

The Nernst equation becomes the following.

$$E = E° - \frac{0.0591}{n} log \frac{x}{y}$$

In this experiment, you will learn how E depends on the concentration of ions in a concentration cell and compare the calculated value of E° with the experimental value.

Requirements:

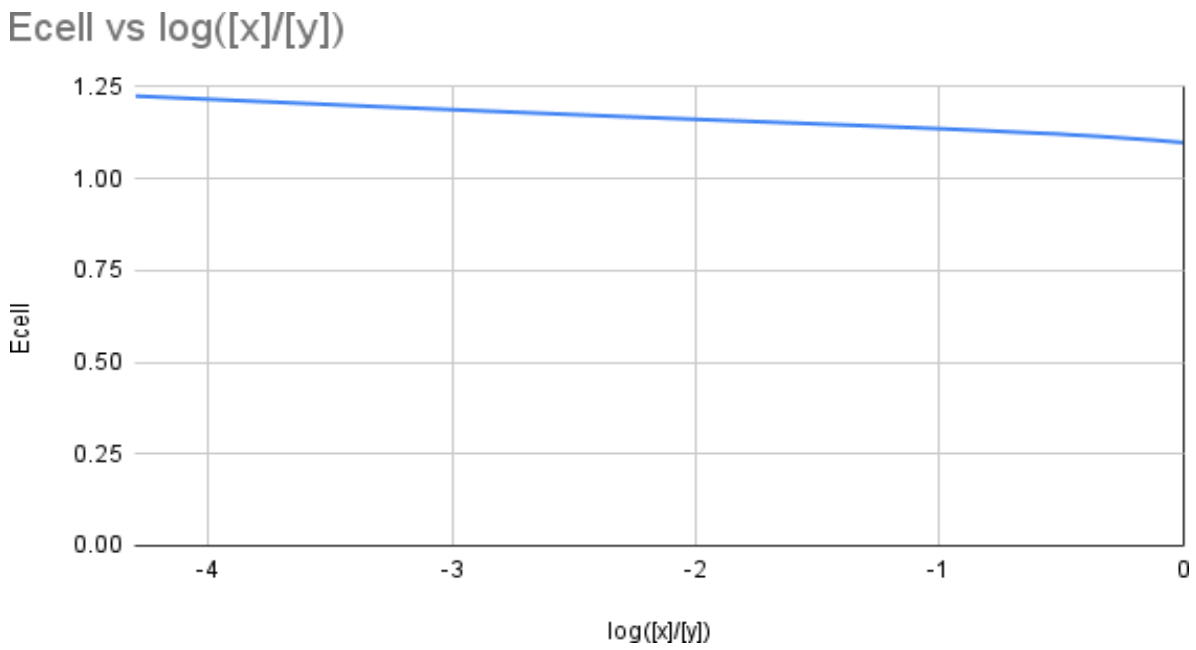
https://web.mst.edu/~gbert/Electro/Electrochem.html

Procedure:

- Set up a Galvanic cell (Zn and Cu electrodes immersed in its respective salt solution)
- Set the concentration of the cathode (cell on right) to 2.0 M.
- Set the concentration of the anodic cell (cell on left) to 0.0001 M and measure the cell potential.
- Vary the concentration of the anodic cell to the values given below and record the cell potential.
- Plot E_{cell} vs. log([x]/[y]).
- Fit the best straight line to your data points. Determine the slope of the best fit line. Compare your experimental slope with the actual value, which is (–0.0591 V/n).
- Determine the intercept of the best fit line. Compare your experimental intercept with the actual value, which is E^{o}_{cell} of the $Zn|Zn^{2+}||Cu^{2+}|Cu$ galvanic cell..

x M	y M	log([x]/[y])	E_{cell}
0.0001	2.0	-4.30103	1.225
0.001	2.0	-3.30103	1.196
0.01	2.0	-2.30103	1.169
0.1	2.0	-1.30103	1.144
0.2	2.0	-1	1.136
0.3	2.0	-0.82390874	1.131
0.4	2.0	-0.69897	1.127
0.5	2.0	-0.60205999	1.124
0.6	2.0	-0.52287875	1.122
0.7	2.0	-0.45593196	1.119
0.8	2.0	-0.39794001	1.117
0.9	2.0	-0.34678749	1.115
1.0	2.0	-0.30103	1.113
1.5	2.0	-0.12493874	1.105
2.0	2.0	0	1.098

Plot:



Result:

The calculated value of the slope is **-0.058**.

The calculated value of the intercept is **1.098**.

Percentage Measurement error in E°: $\frac{|Measured\ value - actual\ value|}{actual\ value} \times 100$

$$\therefore \frac{|1.098-1.100|}{1.100} \times 100 = \frac{0.2}{1.100} = \mathbf{0.18\%}$$

Percentage Measurement error in intercept: $\frac{|Measured\ value - actual\ value|}{actual\ value} \times 100$

$$\therefore \frac{|1.098-1.100|}{1.100} \times 100 = \frac{0.2}{1.100} = \mathbf{0.18\%}$$