CONCEPT: CELL POTENTIAL: STANDARD

- **Standard Cell Potential** (___): the _____ of the reduction potential ($E°_{red}$) in *volts* between two half-cells.
  - □ **Standard** refers to the ions within the half-cells having values of _____ M, _____ atm and pH = _____.
  - □ **Volts** (__): represents the amount of work done as the electrons travel from one electrode to another in _____.
    - _____ (___) is the SI unit for electric charge.
  - □ The standard cell potential of an electrochemical cell is calculated by the formula:

Standard Cell Potential Formula

E°_{Cell} = _____ – _____

EXAMPLE: What is $E°_{cell}$ for a voltaic cell based on the following reduction reactions in which the copper electrode is the cathode and the zinc electrode is the anode?

Zn^{2+} (aq) + 2 e^- ⟶ Zn (s) $\quad E°_{red}$ = - 0.7621

Cu^{2+} (aq) + 2 e^- ⟶ Cu (s) $\quad E°_{red}$ = + 0.3394

Spontaneity of a Chemical Reaction

- Recall, a standard cell potential value ___ 0 means the reaction is spontaneous.
  - □ For a galvanic (voltaic) cell, cathode = _____ E° and anode = _____ E° resulting in E°cell ____ 0.
  - □ For an electrolytic cell, cathode = _____ E° and anode = _____ E° resulting in E°cell ____ 0.

EXAMPLE: Given the following redox reaction: Ce (s) + Al^{3+} (aq) ⟶ Al (s) + Ce^{3+} (aq). Find its standard cell potential when given the following half-reactions.

Standard Reduction Potentials

Ce^{3+} + 3 e^- ⟶ Ce (s) $\quad E°_{red}$ = – 2.336

Al^{3+} + 3 e^- ⟶ Al (s) $\quad E°_{red}$ = – 1.677

STEP 1: Refer to the redox reaction to determine which species is _____ and which is _____.

□ The cathode = _____. □ The anode = _____.

STEP 2: Use the standard cell potential formula to find the final answer.

CONCEPT: CELL POTENTIAL: STANDARD

PRACTICE: Calculate the standard cell potential of an electrolytic cell when given the following half reactions.

Standard Reduction Potentials

$Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$ $\quad E°_{red} = +0.769\ V$

$Li^+(aq) + e^- \longrightarrow Li(s)$ $\quad E°_{red} = -3.04\ V$

PRACTICE: Use the standard half-cell potentials listed below to calculate the standard cell potential for the following reaction occurring in an electrochemical cell at 25°C.

$$3\ Cl_2(g) + 2\ Fe(s) \rightleftharpoons 6\ Cl^-(aq) + 2\ Fe^{3+}(aq)$$

Standard Reduction Potentials

$Cl_2(g) + 2\ e^- \longrightarrow 2\ Cl^-(aq)$ $\quad E°_{red} = +1.396\ V$

$Fe^{3+}(aq) + 3\ e^- \longrightarrow Fe(s)$ $\quad E°_{red} = -0.040\ V$

PRACTICE: Predict whether the following reaction will occur as written based on the calculated E°cell.

$$Ag^+(aq) + Au(s) \longrightarrow Ag(s) + Au^{3+}(aq)$$

Standard Reduction Potentials

$Ag^+(aq) + e^- \longrightarrow Ag(s)$ $\quad E°_{red} = +0.80\ V$

$Au^{3+}(aq) + 3\ e^- \longrightarrow Au(s)$ $\quad E°_{red} = +1.50\ V$