CONCEPT: CELL POTENTIAL AND GIBBS FREE ENERGY

- In terms of electrochemical cells, Gibbs Free Energy (___) represents the _____ electrical work that can be created.
  - □ Connections between spontaneity, Gibbs Free Energy and standard cell potential are illustrated by the formula:

E°_{Cell} – ΔG Formula

ΔG° = – ___ • ___ • _____

- □ ΔG° = Gibbs Free Energy in _____.
- □ _____ = moles of e^- transferred
- □ _____ = Faraday's Constant in _____
- □ _____ = Cell Potential in _____ (V)

EXAMPLE: Calculate the maximum electrical work that can be produced by this cell.

$$3\ Co^{2+}\ (aq) + 2\ Cr\ (s) \longrightarrow 2\ Cr^{3+}\ (aq) + 3\ Co\ (s)$$

Given the following reduction potentials:

$Cr^{3+} + 3\ e^- \longrightarrow Cr$ $\quad E^{\circ}_{red} = -0.74$ Volts

$Co^{2+}\ (aq) + 2\ e^- \longrightarrow Co$ $\quad E^{\circ}_{red} = -0.28$ Volts

Faraday's Constant

- Represents the _____ (C) in coulombs of 1 mole of electrons and is named after the British scientist Michael Faraday.
  - □ The _____ that passes through the cell equals the moles of e^- times Faraday's constant.

Electrochemical Cell Charge

Charge = ___ • ___

- □ The conversion factor between coulombs and Joules is 1 C = ____ J/V.

Faraday's Constant Units

When using C	Conversion Factor	When using J/V
$\frac{C}{mol\ e^-}$		$\frac{J}{V \bullet mol\ e^-}$

EXAMPLE: Determine the overall charge (C) when an aluminum solid is oxidized as an anode.

CONCEPT: CELL POTENTIAL AND GIBBS FREE ENERGY

PRACTICE: What is the gibbs free energy change for the given reaction at 25ºC?

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

Given the following reduction potentials:

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

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

PRACTICE: The reduction of chlorate is given by the equation:

$$ClO_3^{-}\,(aq) + 6\,H_3O^{+}\,(aq) \longrightarrow Cl^{-}\,(aq) + 9\,H_2O\,(l)$$

If the standard cell potential is given as 1.373 V, how many electrons are transferred under standard conditions?

Substance	$G°_f$ (kJ/mol)
$ClO_3^{-}\,(aq)$	- 717.5
$H_3O^{+}\,(aq)$	- 103.4
$Cl^{-}\,(aq)$	- 131.2
$H_2O\,(l)$	- 237.1