**Quiz 8**

# Directions: Answer each of the following questions. Be sure to use complete sentences where appropriate. For full credit be sure to show all of your work. Where appropriate answers should be boxed for clarity, written to the correct number of significant figures, and, include the proper units.

Use the following reduction potentials in the problems below:

Ag+ (aq) + e- → Ag (s) E° = 0.7994 V

Cu2+ (aq) + 2 e- → Cu (s) E° = 0.337 V

Ni2+ (aq) + 2 e- → Ni (s) E° = -0.257 V

Al3+ (aq) + 3 e- → Al (s) E° = -1.662 V

1. A Voltaic cell is made for the reduction of silver ions with copper metal at 25 °C (6 points).
	1. Write the balanced reaction:

Oxidation: Cu (s) → Cu2+ (aq) + 2 e-

Reduction: + **(**Ag+ (aq) + e- → 2 Ag (s)**) × 2**

2 Ag+ (aq) + 2 e- + Cu (s) → Cu2+ (aq) + 2 e- + 2 Ag (s)

2 Ag+ (aq) + Cu (s) → Cu2+ (aq) + 2 Ag (s)

* 1. Calculate the standard cell potential, E°cell, at 25 °C.

$$E\_{cell}^{°}=E\_{cathode}^{°}-E\_{anode}^{°}$$

$$E\_{cell}^{°}=0.7994 V-0.337 V=0.4624 V≈0.462 V$$

* 1. Calculate ∆rG° in kJ for this reaction.

$$∆\_{r}G^{°}=-nFE^{°}$$

$$∆\_{r}G^{°}=-\left(2 mol e^{-}\right)\left(96485 \frac{C}{mol e^{-}}\right)\left(0.462 V\right)=-89152.14 C V=-89.2 kJ$$

1. A Voltaic cell is set up at 25 °C with the half-cells Al3+(0.0010 M) |Al and Ni2+(0.50 M) |Ni (8 points).
2. Write an equation for the reaction that occurs when the cell generates an electric current.

Oxidation: **(**Al (s) → Al3+ (aq) + 3 e-**) × 2**

Reduction: + **(**Ni2+ (aq) + 2 e- → Ni (s)**) × 3**

2 Al (s) 3 Ni2+ (aq) + 6 e- → 2 Al3+ (aq) + 6 e- + 3 Ni (s)

2 Al (s) 3 Ni2+ (aq) → 2 Al3+ (aq) + 3 Ni (s)

1. What is the standard cell potential, E°cell?

$$E\_{cell}^{°}=E\_{cathode}^{°}-E\_{anode}^{°}$$

$$E\_{cell}^{°}=-0.257 V-\left(-1.662 V\right)=1.405 V$$

1. Determine the cell potential of the concentration cell.

$$E\_{cell}=E^{°}-\frac{RT}{nF}lnQ=E^{°}-\frac{RT}{nF}ln\left(\frac{[Al^{3+}]^{2}}{[Ni^{2+}]^{3}}\right)$$

$$E\_{cell}=1.405 V-\frac{\left(8.3145\frac{J}{mol K}\right)\left(298 K\right)}{\left(6 mol e^{-}\right)\left(96485\frac{C}{mol e^{-}}\right)}ln\left(\frac{(0.0010 M)^{2}}{(0.50 M)^{3}}\right)$$

$$E\_{cell}=1.405 V-(-0.050 V)=1.455 V$$