Show your work. Write your answer in the indicated space. 10% of each problem will be deducted if you have the incorrect number of significant figures. Useful constant: \( F = 96,500 \) coul/mol.

1. Write the redox reaction that corresponds to the following cell notation: (20 points)
   \[
   \begin{align*}
   \text{Co(s)} & \mid \text{Co}^{2+} \mid \mid \text{Cu}^{2+} \mid \text{Cu(s)} \\
   \text{oxidation} & : \text{Co(s)} = \text{Co}^{2+} + 2e^- \\
   \text{reduction} & : \text{Cu}^{2+} + 2e^- = \text{Cu(s)} \\
   \text{redox rxn} & : \text{Co(s)} + \text{Cu}^{2+} = \text{Co}^{2+} + \text{Cu(s)} \quad \text{(must be completely correct)}
   \end{align*}
   \]

2. The standard cell potential \( \Delta E^0 \) for the preceding cell is +0.62 V. Calculate \( \Delta G^0 \) for the cell reaction. (30 points)
   \[
   \Delta G^0 = -nF\Delta E^0 \quad n = 2 \quad \text{(n must be correct or no credit)}
   \]
   \[
   \Delta G^0 = -(2)(96,500)(+0.62) = -1.2 \times 10^5 \ \text{J or} \ -120 \ \text{kJ} \quad \text{(sign must be correct or lose 10 points)}
   \]

3. Calculate the standard cell potential \( \Delta E^0 \) for the following redox reaction given the standard reduction potentials: (30 points)
   \[
   \begin{align*}
   \text{Redox reaction:} & \quad \text{Cu(s)} + 2\text{Ag}^+ = \text{Cu}^{2+} + 2\text{Ag(s)} \\
   \text{Half-reactions:} & \quad \text{Cu}^{2+} + 2e^- = \text{Cu(s)} \quad \text{E}^0 = +0.34 \ \text{V} \\
   & \quad \text{Ag}^+ + e^- = \text{Ag(s)} \quad \text{E}^0 = +0.80 \ \text{V}
   \end{align*}
   \]
   Since \( \text{Cu(s)} \) is oxidized to \( \text{Cu}^{2+} \), the copper half-rxn is the anodic half-rxn, and \( \text{E}_{\text{an}}^0 = -0.34 \ \text{V} \). \( \text{E}_{\text{cat}}^0 = +0.80 \ \text{V} \) for the silver half-rxn. Even though the redox rxn has \( 2\text{Ag}^+ \) and \( 2\text{Ag(s)} \), the \( \text{E}^0 \) is not multiplied by 2.
   \[
   \Delta E^0 = \text{E}_{\text{cat}}^0 + \text{E}_{\text{an}}^0 = (+0.80 \ \text{V}) + (-0.34 \ \text{V}) = +0.46 \ \text{V} \quad \text{(sign and magnitude must be correct)}
   \]

4. Of the 4 species in the preceding redox reaction (\( \text{Cu(s)} \), \( \text{Cu}^{2+} \), \( \text{Ag(s)} \), \( \text{Ag}^+ \)), identify which species is the stronger oxidant and which is the stronger reductant. \( \text{Cu}^{2+} \) and \( \text{Ag}^+ \) are the oxidants; \( \text{E}^0 \) for \( \text{Ag}^+ \) half rxn is more positive. \( \text{Cu(s)} \) and \( \text{Ag(s)} \) are the reductants; \( \text{E}^0 \) for \( \text{Cu} \) half-rxn is more negative.
   (10 points) stronger oxidant = \( \text{Ag}^+ \)
   (10 points) stronger reductant = \( \text{Cu(s)} \)