

# AP CHEMISTRY

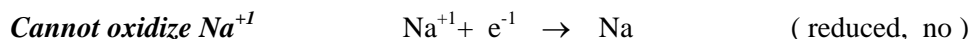
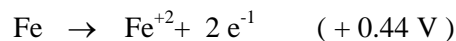
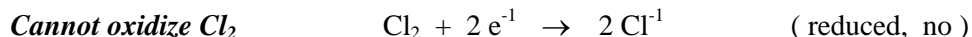
## TOPIC 11: ELECTROCHEMISTRY, PART A,

Day 125:

- Oxidation / Reduction (review)
- Reduction Potentials
- Voltage and Spontaneity

1. Which of the following would be the best reducing agent:  $\text{Cl}_2$ , Fe, Na,  $\text{Na}^+$ ,  $\text{F}^-$ ? **Explain why.**

**Reducing Agent = substance ( compound or element ) that allows another substance to be reduced (gain electrons) - Also, within the reducing agent, one of the elements is being oxidized (losing electrons).**



2. A piece of zinc metal is placed into solutions containing each of the following three cations. Which ion(s) will be reduced by the zinc metal:  $\text{Fe}^{2+}$ ,  $\text{Fe}^{3+}$ ,  $\text{Mn}^{2+}$ ? **Explain why.**

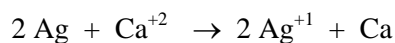
$\text{Zn} \rightarrow \text{Zn}^{2+} + 2 e^-$ ( + 0.76 V ) $\text{Fe}^{2+} + 2 e^- \rightarrow \text{Fe}$ ( - 0.44 V ) <hr/> + 0.32 V <b>YES !!!</b>	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2 e^-$ ( + 0.76 V ) $2 ( \text{Fe}^{3+} + e^- \rightarrow \text{Fe}^{2+} )$ ( + 0.77 V ) <hr/> + 1.53 V <b>YES !!!</b>	$\text{Zn} \rightarrow \text{Zn}^{2+} + 2 e^-$ ( + 0.76 V ) $\text{Mn}^{2+} + 2 e^- \rightarrow \text{Mn}$ ( - 1.18 V ) <hr/> - 0.42 V <b>NO !!!</b>
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3. A piece of cobalt metal is placed into solutions containing each of the following three cations. Which ion(s) will be reduced by the cobalt metal:  $\text{Au}^{3+}$ ,  $\text{Na}^+$ ,  $\text{Pb}^{2+}$ ? **Explain why.**

$\text{Au}^{3+} + 3 e^- \rightarrow \text{Au}$ ( + 1.50 V ) $\text{Co} \rightarrow \text{Co}^{2+} + 2 e^-$ ( + 0.28 V ) <hr/> + 1.78 V <b>YES !!!</b>	$\text{Na}^+ + e^- \rightarrow \text{Na}$ ( - 2.71 V ) $\text{Co} \rightarrow \text{Co}^{2+} + 2 e^-$ ( + 0.28 V ) <hr/> - 2.43 V <b>NO !!!</b>	$\text{Pb}^{2+} + 2 e^- \rightarrow \text{Pb}$ ( - 0.13 V ) $\text{Co} \rightarrow \text{Co}^{2+} + 2 e^-$ ( + 0.28 V ) <hr/> + 0.15 V <b>YES !!!</b>
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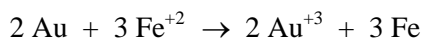
4. Is the reaction spontaneous or non-spontaneous? **Explain why.**

a)  $\text{Ag} + \text{CaCO}_3 \rightarrow$

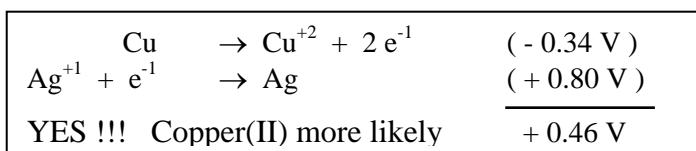
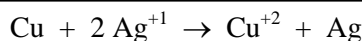
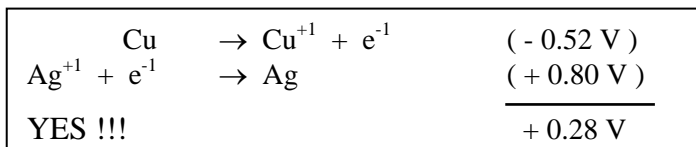
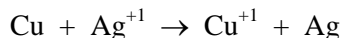
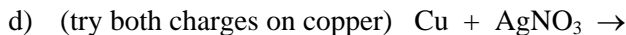
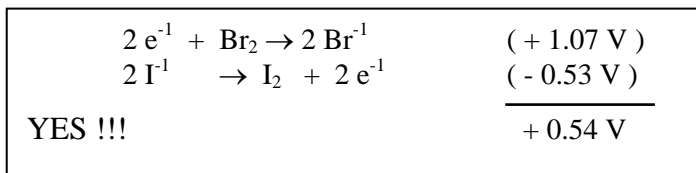
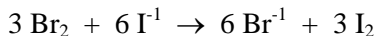
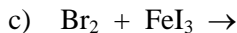


Ag $\rightarrow \text{Ag}^+ + e^-$ ( - 0.80 V )
$\text{Ca}^{2+} + 2 e^- \rightarrow \text{Ca}$ ( - 2.87 V )
<b>NO !!! negative voltage, N.R.</b> <hr/> - 3.67 V

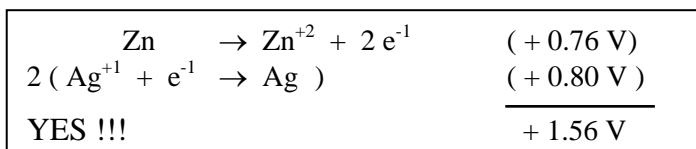
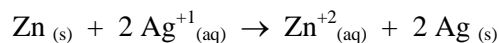
b)  $\text{Au} + \text{FeSO}_4 \rightarrow$



Au $\rightarrow \text{Au}^{3+} + 3 e^-$ ( - 1.50 V )
$\text{Fe}^{2+} + 2 e^- \rightarrow \text{Fe}$ ( + 0.44 V )
<b>NO !!! negative voltage, N.R.</b> <hr/> - 1.06 V



5. Calculate the standard free-energy change for the reaction shown below:

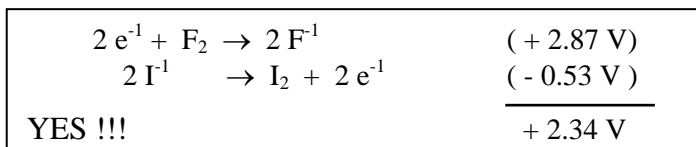
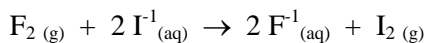


$$\Delta G = - n \mathfrak{F} E^0$$

$$\Delta G = - ( 2 \text{ mol } e^- ) \left( \frac{96,500 \text{ J}}{\text{V} \cdot \text{mol } e^-} \right) ( +1.56 \text{ V} ) = -3.01 \times 10^5 \text{ J}$$

**Negative  $\Delta G = spontaneous$**

6. Calculate the standard free-energy change for the reaction shown below:



$$\Delta G = - n \mathfrak{F} E^0$$

$$\Delta G = - ( 2 \text{ mol } e^- ) \left( \frac{96,500 \text{ J}}{\text{V} \cdot \text{mol } e^-} \right) ( +2.34 \text{ V} ) = -4.52 \times 10^5 \text{ J}$$

**Negative  $\Delta G = spontaneous$**