Chemistry 30

Unit 6: Redox Reactions and Electrochemistry

Practice Set 5: Electrolytic Cells

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1. Using either an activity series (Table 11.2) or Table of Standard Reduction Potentials, predict whether a reaction takes place, and if so, give a balanced reaction equation.

   a. $Ag_{(s)} + HCl_{(aq)} \rightarrow$

   Answer:

   Using Activity Series - no reaction. Ag is lower on the list than H

   Using Standard Reduction Potentials

   Write out half-reactions in a way that will produce the equation in question (that is with solid Ag and aqueous H^+ ions as reactants (Cl^- will be a spectator ion). Remember to reverse the sign of E° if you reverse an equation:

		E°
$Ag(s) \rightarrow Ag^+ + e^-$		-0.80
$2H^+ + 2e^- \rightarrow H_2$		0.00
	Net Voltage	-0.80

   Conclusion – since voltage (E°) is negative, the reaction WILL NOT BE spontaneous. No reaction will occur.

   b. $Mg_{(s)} + FeSO_{4(aq)} \rightarrow$

   Answer:

   Using Activity Series - a reaction will occur. Mg is higher on the list than Fe

   Using Standard Reduction Potentials

   SO_4^{2-} will be a spectator ion.

		E°
$Mg\ (s) \rightarrow Mg^{2+} + 2e^-$		+2.37
$Fe^{2+} + 2e^- \rightarrow Fe$		-0.45
	Net Voltage	+1.92

   Conclusion – since a positive voltage results, the reaction WILL BE spontaneous.

   The balanced equation for the reaction will be:

   $$Mg_{(s)} + FeSO_{4\ (aq)} \rightarrow MgSO_{4(aq)} + Fe_{(s)}$$

c. $Cu_{(s)} + AuCl_{3(aq)} \rightarrow$

Answer:

Using Activity Series - a reaction will occur. Cu is higher on the list than Au

Using Standard Reduction Potentials

Cl^- will be a spectator ion.

	E°
$Cu\ (s) \rightarrow Cu^{2+} + 2e^-$	**-0.34**
$Au^{3+} + 3e^- \rightarrow Au$	**+1.50**
Net Voltage	**+1.16**

Conclusion – since a positive voltage results, the reaction WILL BE spontaneous.

The balanced equation for the reaction will be:

$3\ Cu_{(s)} + AuCl_{3(aq)} \rightarrow 3\ CuCl_{2(aq)} + 2\ Au(s)$

d. $Sn_{(s)} + Al_2(SO_4)_{3\ (aq)} \rightarrow$

Answer:

Using Activity Series - no reaction. Sn is lower on the list than Al

Using Standard Reduction Potentials

SO_4^{2-} will be a spectator ion.

	E°
$Sn\ (s) \rightarrow Sn^{2+} + 2e^-$	**+0.14**
$Al^{3+} + 3e^- \rightarrow Al$	**-1.66**
Net Voltage	**-1.52**

Conclusion – since the voltage is negative, this reaction WILL NOT BE spontaneous.

2 Consider the electrolysis of water. Describe the events at the anode in terms of:

a. the reaction — ***Oxidation always occurs at the anode. Thus the anode reaction is:***

$2\ H_2O\ (l) \rightarrow O_2\ (g) + 4\ H^+\ (aq) + 4\ e^-$

b. pH — ***H^+ are being produced. As $[H^+]$ increases, pH decreases (the solution becomes more acidic)***

c. gas produced — ***O_2 gas is produced at the anode***