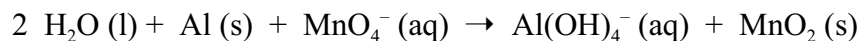
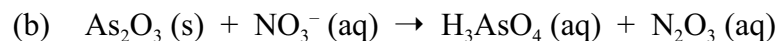
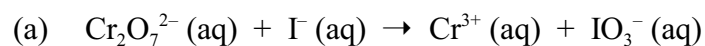


## CH 223 – Worksheet 7

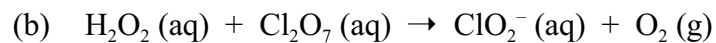
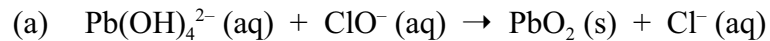
1. Identify the oxidizing and reducing agents in the oxidation-reduction reaction



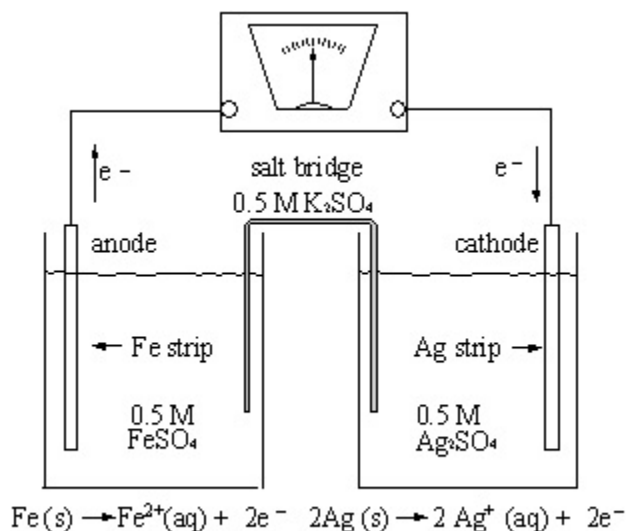
2. Complete and balance the following two equations in **acidic** solution:



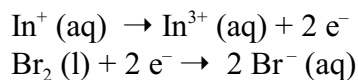
3. Complete and balance the following two equations in **basic** solution:



4. A voltaic cell similar to that shown below is constructed. One electrode compartment consists of a silver strip placed in a solution of  $\text{Ag}_2\text{SO}_4$ , and the other has an iron strip placed in a solution of  $\text{FeSO}_4$ . The overall reaction is  $\text{Fe}(\text{s}) + 2 \text{Ag}^+(\text{aq}) \rightarrow \text{Fe}^{2+}(\text{aq}) + 2 \text{Ag}(\text{s})$  (a) What is being oxidized, and what is being reduced? (b) Write the half-reactions that occur in the two electrode compartments. (c) Which electrode is the anode, and which is the cathode? (d) Indicate the signs of the electrodes. (e) Do electrons flow from the silver electrode to the iron electrode, or from the iron to the silver? (f) In which directions do the cations and anions migrate through the solution?



5. A voltaic cell is based on the half-reactions



The standard emf for this cell is 1.46 V. Using the standard reduction potentials listed in Appendix E (see attached), calculate  $E^\circ_{\text{red}}$  for the reduction of  $\text{In}^{3+}$  to  $\text{In}^+$ .

# E

## Standard Reduction Potentials at 25°C

Half-Reaction	E°(V)	Half-Reaction	E°(V)
$\text{Ag}^+(aq) + e^- \rightarrow \text{Ag}(s)$	+0.799	$\text{HO}_2^-(aq) + \text{H}_2\text{O}(l) + 2e^- \rightarrow 3\text{OH}^-(aq)$	+0.88
$\text{AgBr}(s) + e^- \rightarrow \text{Ag}(s) + \text{Br}^-(aq)$	+0.095	$\text{H}_2\text{O}_2(aq) + 2\text{H}^+(aq) + 2e^- \rightarrow 2\text{H}_2\text{O}(l)$	+1.776
$\text{AgCl}(s) + e^- \rightarrow \text{Ag}(s) + \text{Cl}^-(aq)$	+0.222	$\text{Hg}_2^{2+}(aq) + 2e^- \rightarrow 2\text{Hg}(l)$	+0.789
$\text{Ag}(\text{CN})_2^-(aq) + e^- \rightarrow \text{Ag}(s) + 2\text{CN}^-(aq)$	-0.31	$2\text{Hg}_2^{2+}(aq) + 2e^- \rightarrow \text{Hg}_2^{2+}(aq)$	+0.920
$\text{Ag}_2\text{CrO}_4(s) + 2e^- \rightarrow 2\text{Ag}(s) + \text{CrO}_4^{2-}(aq)$	+0.446	$\text{Hg}^{2+}(aq) + 2e^- \rightarrow \text{Hg}(l)$	+0.854
$\text{AgI}(s) + e^- \rightarrow \text{Ag}(s) + \text{I}^-(aq)$	-0.151	$\text{I}_2(s) + 2e^- \rightarrow 2\text{I}^-(aq)$	+0.536
$\text{Ag}(\text{S}_2\text{O}_3)_2^{3-}(aq) + e^- \rightarrow \text{Ag}(s) + 2\text{S}_2\text{O}_3^{2-}(aq)$	+0.01	$\text{IO}_3^-(aq) + 6\text{H}^+(aq) + 5e^- \rightarrow \text{I}_2(s) + 3\text{H}_2\text{O}(l)$	+1.195
$\text{Al}^{3+}(aq) + 3e^- \rightarrow \text{Al}(s)$	-1.66	$\text{K}^+(aq) + e^- \rightarrow \text{K}(s)$	-2.925
$\text{H}_3\text{AsO}_4(aq) + 2\text{H}^+(aq) + 2e^- \rightarrow$ $\text{H}_3\text{AsO}_3(aq) + \text{H}_2\text{O}(l)$	+0.559	$\text{Li}^+(aq) + e^- \rightarrow \text{Li}(s)$	-3.05
$\text{Ba}^{2+}(aq) + 2e^- \rightarrow \text{Ba}(s)$	-2.90	$\text{Mg}^{2+}(aq) + 2e^- \rightarrow \text{Mg}(s)$	-2.37
$\text{BiO}^+(aq) + 2\text{H}^+(aq) + 3e^- \rightarrow \text{Bi}(s) + \text{H}_2\text{O}(l)$	+0.32	$\text{Mn}^{2+}(aq) + 2e^- \rightarrow \text{Mn}(s)$	-1.18
$\text{Br}_2(l) + 2e^- \rightarrow 2\text{Br}^-(aq)$	+1.065	$\text{MnO}_2(s) + 4\text{H}^+(aq) + 2e^- \rightarrow$ $\text{Mn}^{2+}(aq) + 2\text{H}_2\text{O}(l)$	+1.23
$\text{BrO}_3^-(aq) + 6\text{H}^+(aq) + 5e^- \rightarrow$ $\text{Br}_2(l) + 3\text{H}_2\text{O}(l)$	+1.52	$\text{MnO}_4^-(aq) + 8\text{H}^+(aq) + 5e^- \rightarrow$ $\text{Mn}^{2+}(aq) + 4\text{H}_2\text{O}(l)$	+1.51
$2\text{CO}_2(g) + 2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2\text{C}_2\text{O}_4(aq)$	-0.49	$\text{MnO}_4^-(aq) + 2\text{H}_2\text{O}(l) + 3e^- \rightarrow$ $\text{MnO}_2(s) + 4\text{OH}^-(aq)$	+0.59
$\text{Ca}^{2+}(aq) + 2e^- \rightarrow \text{Ca}(s)$	-2.87	$\text{HNO}_2(aq) + \text{H}^+(aq) + e^- \rightarrow \text{NO}(g) + \text{H}_2\text{O}(l)$	+1.00
$\text{Cd}^{2+}(aq) + 2e^- \rightarrow \text{Cd}(s)$	-0.403	$\text{N}_2(g) + 4\text{H}_2\text{O}(l) + 4e^- \rightarrow$ $4\text{OH}^-(aq) + \text{N}_2\text{H}_4(aq)$	-1.16
$\text{Ce}^{4+}(aq) + e^- \rightarrow \text{Ce}^{3+}(aq)$	+1.61	$\text{N}_2(g) + 5\text{H}^+(aq) + 4e^- \rightarrow \text{N}_2\text{H}_5^+(aq)$	-0.23
$\text{Cl}_2(g) + 2e^- \rightarrow 2\text{Cl}^-(aq)$	+1.359	$\text{NO}_3^-(aq) + 4\text{H}^+(aq) + 3e^- \rightarrow$ $\text{NO}(g) + 2\text{H}_2\text{O}(l)$	+0.96
$\text{HClO}(aq) + \text{H}^+(aq) + e^- \rightarrow \text{Cl}_2(g) + \text{H}_2\text{O}(l)$	+1.63	$\text{Na}^+(aq) + e^- \rightarrow \text{Na}(s)$	-2.71
$\text{ClO}^-(aq) + \text{H}_2\text{O}(l) + 2e^- \rightarrow$ $\text{Cl}^-(aq) + 2\text{OH}^-(aq)$	+0.89	$\text{Ni}^{2+}(aq) + 2e^- \rightarrow \text{Ni}(s)$	-0.28
$\text{ClO}_3^-(aq) + 6\text{H}^+(aq) + 5e^- \rightarrow$ $\text{Cl}_2(g) + 3\text{H}_2\text{O}(l)$	+1.47	$\text{O}_2(g) + 4\text{H}^+(aq) + 4e^- \rightarrow 2\text{H}_2\text{O}(l)$	+1.23
$\text{Co}^{2+}(aq) + 2e^- \rightarrow \text{Co}(s)$	-0.277	$\text{O}_2(g) + 2\text{H}_2\text{O}(l) + 4e^- \rightarrow 4\text{OH}^-(aq)$	+0.40
$\text{Co}^{3+}(aq) + e^- \rightarrow \text{Co}^{2+}(aq)$	+1.842	$\text{O}_2(g) + 2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2\text{O}_2(aq)$	+0.68
$\text{Cr}^{3+}(aq) + 3e^- \rightarrow \text{Cr}(s)$	-0.74	$\text{O}_3(g) + 2\text{H}^+(aq) + 2e^- \rightarrow \text{O}_2(g) + \text{H}_2\text{O}(l)$	+2.07
$\text{Cr}^{3+}(aq) + e^- \rightarrow \text{Cr}^{2+}(aq)$	-0.41	$\text{Pb}^{2+}(aq) + 2e^- \rightarrow \text{Pb}(s)$	-0.126
$\text{Cr}_2\text{O}_7^{2-}(aq) + 14\text{H}^+(aq) + 6e^- \rightarrow$ $2\text{Cr}^{3+}(aq) + 7\text{H}_2\text{O}(l)$	+1.33	$\text{PbO}_2(s) + \text{HSO}_4^-(aq) + 3\text{H}^+(aq) + 2e^- \rightarrow$ $\text{PbSO}_4(s) + 2\text{H}_2\text{O}(l)$	+1.685
$\text{CrO}_4^{2-}(aq) + 4\text{H}_2\text{O}(l) + 3e^- \rightarrow$ $\text{Cr}(\text{OH})_3(s) + 5\text{OH}^-(aq)$	-0.13	$\text{PbSO}_4(s) + \text{H}^+(aq) + 2e^- \rightarrow \text{Pb}(s) + \text{HSO}_4^-(aq)$	-0.356
$\text{Cu}^{2+}(aq) + 2e^- \rightarrow \text{Cu}(s)$	+0.337	$\text{PtCl}_4^{2-}(aq) + 2e^- \rightarrow \text{Pt}(s) + 4\text{Cl}^-(aq)$	+0.73
$\text{Cu}^{2+}(aq) + e^- \rightarrow \text{Cu}^+(aq)$	+0.153	$\text{S}(s) + 2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2\text{S}(g)$	+0.141
$\text{Cu}^+(aq) + e^- \rightarrow \text{Cu}(s)$	+0.521	$\text{H}_2\text{SO}_3(aq) + 4\text{H}^+(aq) + 4e^- \rightarrow \text{S}(s) + 3\text{H}_2\text{O}(l)$	+0.45
$\text{CuI}(s) + e^- \rightarrow \text{Cu}(s) + \text{I}^-(aq)$	-0.185	$\text{HSO}_4^-(aq) + 3\text{H}^+(aq) + 2e^- \rightarrow$ $\text{H}_2\text{SO}_3(aq) + \text{H}_2\text{O}(l)$	+0.17
$\text{F}_2(g) + 2e^- \rightarrow 2\text{F}^-(aq)$	+2.87	$\text{Sn}^{2+}(aq) + 2e^- \rightarrow \text{Sn}(s)$	-0.136
$\text{Fe}^{2+}(aq) + 2e^- \rightarrow \text{Fe}(s)$	-0.440	$\text{Sn}^{4+}(aq) + 2e^- \rightarrow \text{Sn}^{2+}(aq)$	+0.154
$\text{Fe}^{3+}(aq) + e^- \rightarrow \text{Fe}^{2+}(aq)$	+0.771	$\text{VO}_2^+(aq) + 2\text{H}^+(aq) + e^- \rightarrow$ $\text{VO}^{2+}(aq) + \text{H}_2\text{O}(l)$	+1.00
$\text{Fe}(\text{CN})_6^{3-}(aq) + e^- \rightarrow \text{Fe}(\text{CN})_6^{4-}(aq)$	+0.36	$\text{Zn}^{2+}(aq) + 2e^- \rightarrow \text{Zn}(s)$	-0.763
$2\text{H}^+(aq) + 2e^- \rightarrow \text{H}_2(g)$	0.000		
$2\text{H}_2\text{O}(l) + 2e^- \rightarrow \text{H}_2(g) + 2\text{OH}^-(aq)$	-0.83		