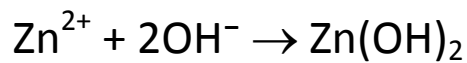
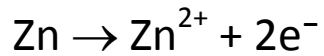


## Lab 8: Electrochemistry: The Study of Corrosion in Metals

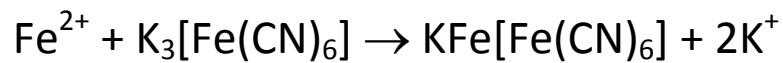
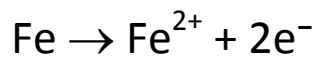
### Part A - Corrosion and Electrodes

White indicates Zn is oxidized



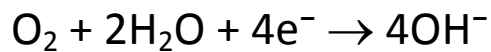
white

Blue indicates Fe is oxidized

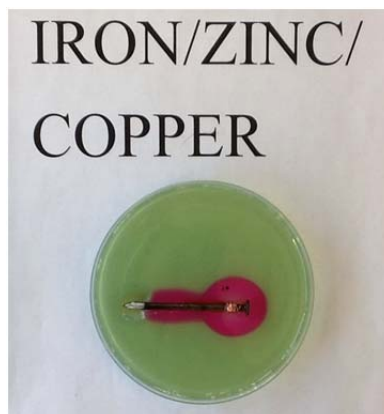
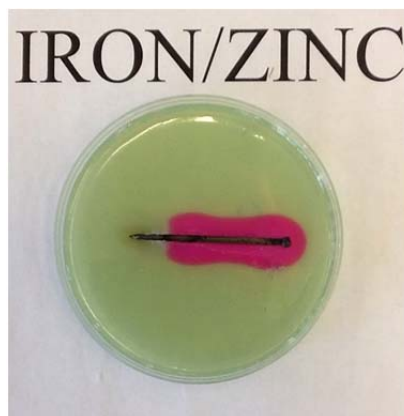
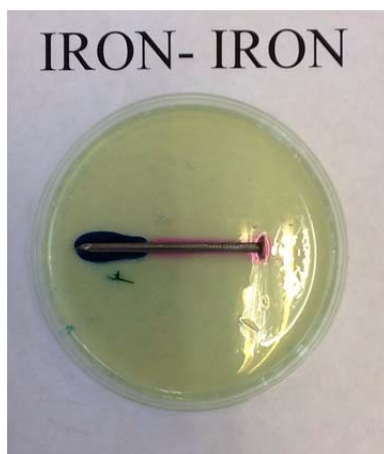


blue

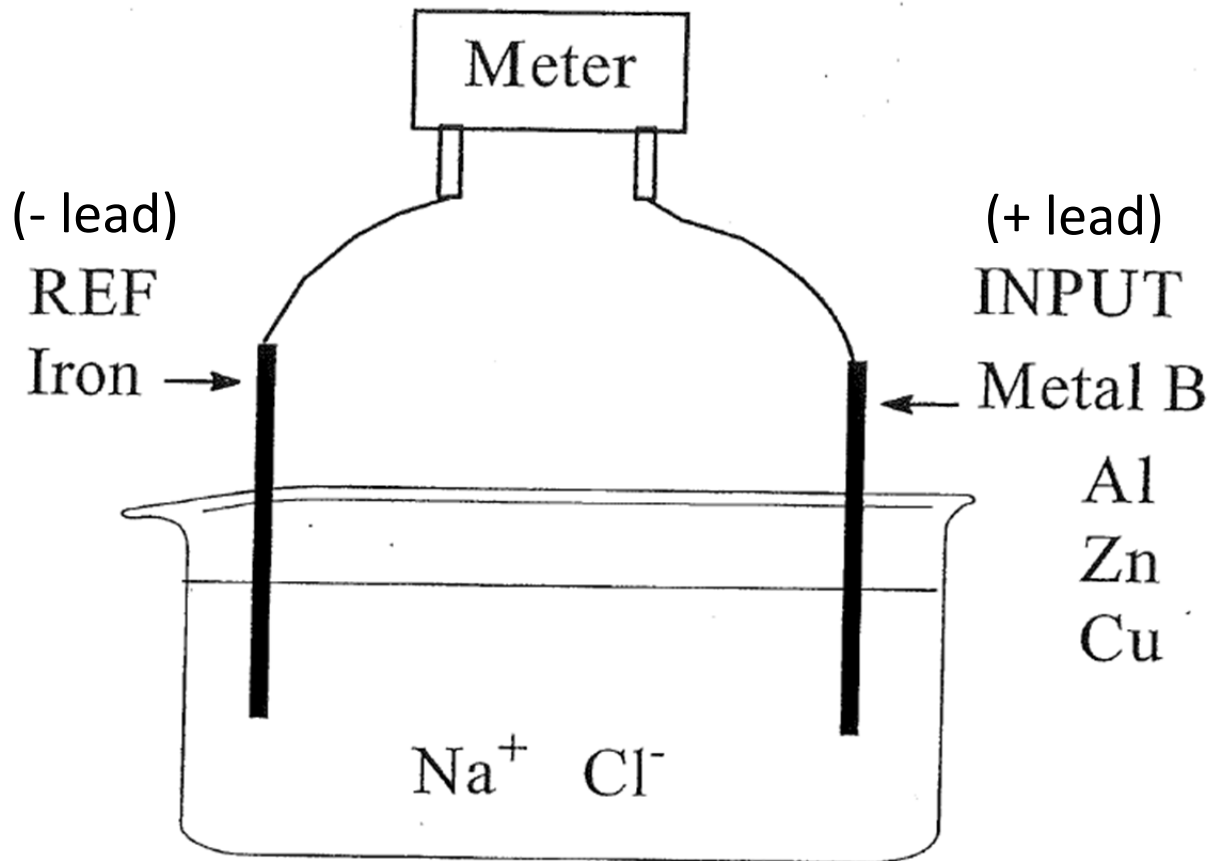
Pink indicates  $\text{O}_2$  is reduced



$\text{OH}^{-}$  causes phenolphthalein to turn pink



## Part B - Activities of Metals



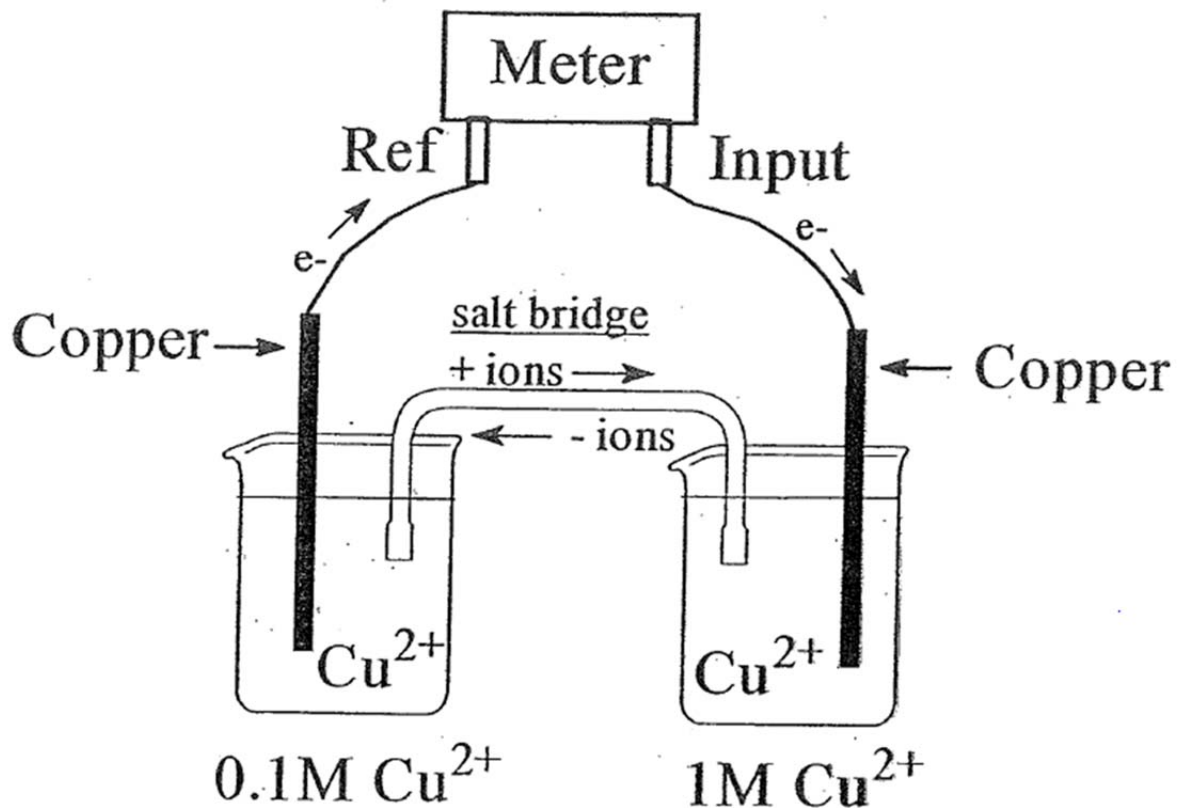
A **positive** voltage means oxidation occurs at the REF and reduction occurs at the INPUT. This indicates that Fe is more easily oxidized than Metal B.

Fe is the ANODE and Metal B is the Cathode.

A **negative** voltage means oxidation occurs at the INPUT and reduction occurs at the REF. This indicates that Metal B is more easily oxidized than Fe.

Metal B is the ANODE and Fe is the Cathode.

## Part C - Concentration Cells



Anode, Oxidation:  $\text{Cu(s)} \rightarrow \text{Cu}^{2+}(\text{dilute}) + 2\text{e}^-$

Cathode, Reduction:  $\text{Cu}^{2+}(\text{concentrated}) + 2\text{e}^- \rightarrow \text{Cu(s)}$

The salt bridge contains  $\text{KNO}_3$ .

$\text{K}^+$  ions move towards the cathode side.

$\text{NO}_3^-$  ions move towards the anode side.

# STANDARD REDUCTION POTENTIALS OF HALF-CELLS

*Ionic concentrations are at 1M in water at 25°C.*

	Oxidizing Agents	Reducing Agents	$E^\circ$ (Volts)
	$F_2(g) + 2e^-$	$\rightleftharpoons 2F^-$	+2.87
	$S_2O_8^{2-} + 2e^-$	$\rightleftharpoons 2SO_4^{2-}$	+2.01
	$H_2O_2 + 2H^+ + 2e^-$	$\rightleftharpoons 2H_2O$	+1.78
	$MnO_4^- + 8H^+ + 5e^-$	$\rightleftharpoons Mn^{2+} + 4H_2O$	+1.51
	$Au^{3+} + 3e^-$	$\rightleftharpoons Au(s)$	+1.50
	$BrO_3^- + 6H^+ + 5e^-$	$\rightleftharpoons \frac{1}{2}Br_2(l) + 3H_2O$	+1.48
	$ClO_4^- + 8H^+ + 8e^-$	$\rightleftharpoons Cl^- + 4H_2O$	+1.39
	$Cl_2(g) + 2e^-$	$\rightleftharpoons 2Cl^-$	+1.36
	$Cr_2O_7^{2-} + 14H^+ + 6e^-$	$\rightleftharpoons 2Cr^{3+} + 7H_2O$	+1.23
	$\frac{1}{2}O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons H_2O$	+1.23
	$MnO_2(s) + 4H^+ + 2e^-$	$\rightleftharpoons Mn^{2+} + 2H_2O$	+1.22
	$IO_3^- + 6H^+ + 5e^-$	$\rightleftharpoons \frac{1}{2}I_2(s) + 3H_2O$	+1.20
	$Br_2(l) + 2e^-$	$\rightleftharpoons 2Br^-$	+1.09
	$AuCl_4^- + 3e^-$	$\rightleftharpoons Au(s) + 4Cl^-$	+1.00
	$NO_3^- + 4H^+ + 3e^-$	$\rightleftharpoons NO(g) + 2H_2O$	+0.96
	$Hg^{2+} + 2e^-$	$\rightleftharpoons Hg(l)$	+0.85
	$\frac{1}{2}O_2(g) + 2H^+(10^{-7}M) + 2e^-$	$\rightleftharpoons H_2O$	+0.82
	$2NO_3^- + 4H^+ + 2e^-$	$\rightleftharpoons N_2O_4 + 2H_2O$	+0.80
	$Ag^+ + e^-$	$\rightleftharpoons Ag(s)$	+0.80
	$\frac{1}{2}Hg_2^{2+} + e^-$	$\rightleftharpoons Hg(l)$	+0.80
	$Fe^{3+} + e^-$	$\rightleftharpoons Fe^{2+}$	+0.77
	$O_2(g) + 2H^+ + 2e^-$	$\rightleftharpoons H_2O_2$	+0.70
	$MnO_4^- + 2H_2O + 3e^-$	$\rightleftharpoons MnO_2(s) + 4OH^-$	+0.60
	$I_2(s) + 2e^-$	$\rightleftharpoons 2I^-$	+0.54
	$Cu^+ + e^-$	$\rightleftharpoons Cu(s)$	+0.52
	$H_2SO_3 + 4H^+ + 4e^-$	$\rightleftharpoons S(s) + 3H_2O$	+0.45
	$Cu^{2+} + 2e^-$	$\rightleftharpoons Cu(s)$	+0.34
	$SO_4^{2-} + 4H^+ + 2e^-$	$\rightleftharpoons H_2SO_3 + H_2O$	+0.17
	$Cu^{2+} + e^-$	$\rightleftharpoons Cu^+$	+0.15
	$Sn^{4+} + 2e^-$	$\rightleftharpoons Sn^{2+}$	+0.15
	$S(s) + 2H^+ + 2e^-$	$\rightleftharpoons H_2S(g)$	+0.14
	$2H^+ + 2e^-$	$\rightleftharpoons H_2(g)$	+0.00
	$Pb^{2+} + 2e^-$	$\rightleftharpoons Pb(s)$	-0.13
	$Sn^{2+} + 2e^-$	$\rightleftharpoons Sn(s)$	-0.14
	$Ni^{2+} + 2e^-$	$\rightleftharpoons Ni(s)$	-0.26
	$H_3PO_4 + 2H^+ + 2e^-$	$\rightleftharpoons H_3PO_3 + H_2O$	-0.28
	$Co^{2+} + 2e^-$	$\rightleftharpoons Co(s)$	-0.28
	$Se(s) + 2H^+ + 2e^-$	$\rightleftharpoons H_2Se$	-0.40
	$Cr^{3+} + e^-$	$\rightleftharpoons Cr^{2+}$	-0.41
	$2H_2O + 2e^-$	$\rightleftharpoons H_2 + 2OH^-(10^{-7}M)$	-0.41
	$Fe^{2+} + 2e^-$	$\rightleftharpoons Fe(s)$	-0.45
	$Ag_2S(s) + 2e^-$	$\rightleftharpoons 2Ag(s) + S^{2-}$	-0.69
	$Cr^{3+} + 3e^-$	$\rightleftharpoons Cr(s)$	-0.74
	$Zn^{2+} + 2e^-$	$\rightleftharpoons Zn(s)$	-0.76
	$Te(s) + 2H^+ + 2e^-$	$\rightleftharpoons H_2Te$	-0.79
	$2H_2O + 2e^-$	$\rightleftharpoons H_2(g) + 2OH^-$	-0.83
	$Mn^{2+} + 2e^-$	$\rightleftharpoons Mn(s)$	-1.19
	$Al^{3+} + 3e^-$	$\rightleftharpoons Al(s)$	-1.66
	$Mg^{2+} + 2e^-$	$\rightleftharpoons Mg(s)$	-2.37
	$Na^+ + e^-$	$\rightleftharpoons Na(s)$	-2.71
	$Ca^{2+} + 2e^-$	$\rightleftharpoons Ca(s)$	-2.87
	$Sr^{2+} + 2e^-$	$\rightleftharpoons Sr(s)$	-2.89
	$Ba^{2+} + 2e^-$	$\rightleftharpoons Ba(s)$	-2.91
	$K^+ + e^-$	$\rightleftharpoons K(s)$	-2.93
	$Rb^+ + e^-$	$\rightleftharpoons Rb(s)$	-2.98
	$Cs^+ + e^-$	$\rightleftharpoons Cs(s)$	-3.03
	$Li^+ + e^-$	$\rightleftharpoons Li(s)$	-3.04

STRONG

STRENGTH OF OXIDIZING AGENT

WEAK

WEAK

STRENGTH OF REDUCING AGENT

STRONG

Overpotential Effect

Overpotential Effect