80. (Concentration gradient, diffusion) **Demonstration:** A pair of cupric ion solutions, one concentrated and dark blue and the other dilute and light blue, are separated by a removable barrier. What will happen when the barrier is removed?

the solutions retain their respective colors, the dark solution becomes darker and the light solution becomes lighter, **the solutions become indistinguishable in color**

81. (Concentration cells) Refer to the figure below. What is the spontaneous direction of the system?

Cu^{2+} (in 1 M solution) ---> Cu(s) and Cu(s) --->Cu^{2+} (in 0.01 M solution),

Cu^{2+} (in 0.01 M solution) ---> Cu(s) and Cu(s) --->Cu^{2+} (in 1 M solution)

Will a voltage be measured?

yes, no

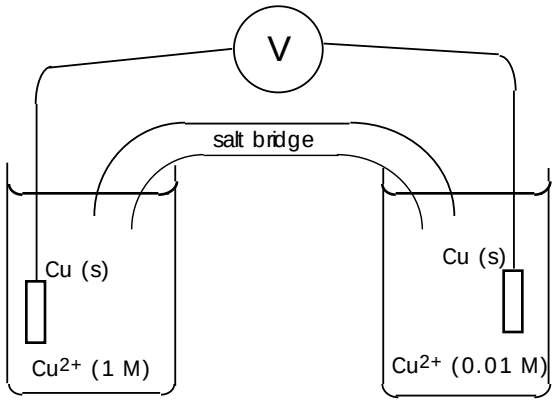
If the pictured solutions are mixed and then divided into separate cells, will a voltage be measured?

yes, **no**

When unmixed, in which direction do the electrons travel when current is allowed to flow?

right, **left**

Demonstration: With a concentration cell, demonstrate the answers to each of the questions above.



82. (Galvanic cells, redox, Le Châtelier's principle) $Ag^{+} + e^{-}$ --->Ag $E°= 0.80$ V;

$Cu^{2+} + 2e^{-}$---> Cu $E°= 0.34$ V

Will Ag react with Cu^{2+}?

yes, **no**

Will Cu react with Ag^{+}?

yes, no

Demonstration: $Cu + 2\ Ag^{+}$ ---> $Cu^{2+} + 2$ Ag Place a sheet of copper into a $AgNO_3$ solution. The submerged copper will be plated with silver at the end of the reaction.

Demonstration: Construct a galvanic cell: Cu|Cu^{2+}||Ag^{+}|Ag. Measure the voltage. If water is added to the Cu^{2+} cell, how will the voltage be affected?

voltage will increase, voltage will decrease, no change

If ammonia is added to the Cu^{2+} cell to form an amine complex, how will the voltage be affected?

voltage will increase, voltage will decrease, no change

If Cl^{-} solution is added to the Ag^{+} half cell to precipitate AgCl, how will the voltage be affected?

voltage will increase, **voltage will decrease**, no change

As current passes, the voltage

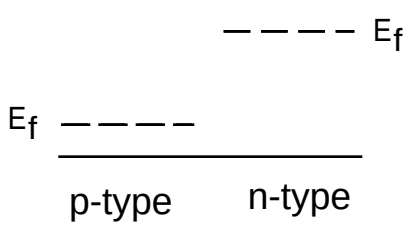
increases, **decreases**, stays constant

127. (Concentration cell, semiconductors, doping; Ch. 8 "Companion") To minimize diffusion of a dopant into a semiconductor, heat

at low temperature for a short time, at high temperature for a long time

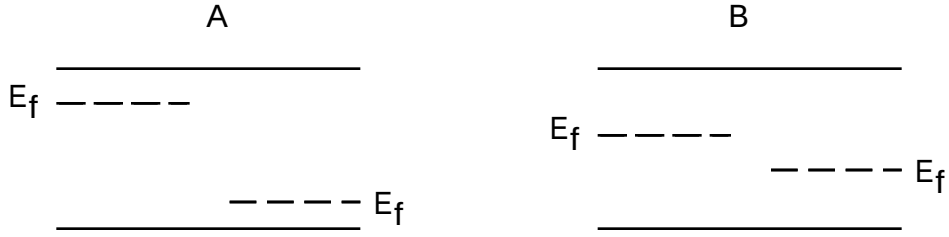
Which way do electrons want to go in a p-n junction to establish equilibrium?

n-type side to p-type side, p-type side to n-type side



Which p-n junction will give the larger voltage?

A, B

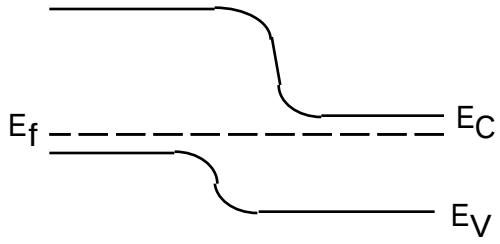


Consider a p-n junction formed by ZnSe (band gap 2.7 eV) and GaAs (band gap 1.4 eV). Which side of the junction is ZnSe?

left, right

Which side of the junction is p-type?

left, right



206. If the reduction of mercury (I) in a voltaic cell is desired, the half reaction is:

$$Hg_2^{2+}{}_{(aq)} + 2e^- \longrightarrow 2Hg_{(l)} \qquad E^o = 0.80\ V$$

Which of the following reactions could be used as the anode (oxidation)?

A. $Zn^{2+} + 2e^- \longrightarrow Zn$ $\qquad E^o = -0.76\ V$

B. $Br_{2(l)} + 2e^- \longrightarrow 2Br^-{}_{(aq)}$ $\qquad E^o = 1.07\ V$

A, B

212. A concentration cell is made, having Ag electrodes immersed in AgNO3 solutions of different concentrations. When the two cell compartments have AgNO3 concentration of 1 M and 0.1 M, the measured voltage is 0.06 V. What will the voltage be if the two compartments have AgNO3 concentrations of 1 M and 0.01 M?

zero volts
0.03 volts
0.06 volts
0.12 volts

238. Both leads of a light-emitting diode are dipped in water, dried, and then dipped in mercury. In which liquid(s) will the LED light up?

H_2O, **Hg**, both, neither