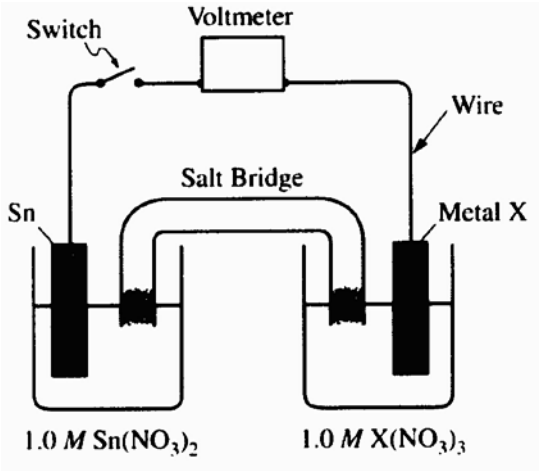
2004 D Required



An electrochemical cell is constructed with an open switch, as shown in the diagram above. A strip of Sn and a strip of unknown metal, X are used as electrodes. When the switch is closed, the mass of the Sn electrode increases. The half-reactions are shown below.

$Sn^{2+}_{(aq)} + 2\ e^- \rightarrow Sn_{(s)}$ $\quad E^\circ = -0.14$ V

$X^{3+}_{(aq)} + 3\ e^- \rightarrow X_{(s)}$ $\quad E^\circ = ?$

(a) In the diagram above, label the electrode that is the cathode. Justify your answer.

(b) In the diagram above, draw an arrow indicating the direction of electron flow in the external circuit when the switch is closed.

(c) If the standard cell potential E°_{cell} is +0.60 V, what is the standard potential, in volts for the X^{3+}/X electrode?

(d) Identify metal X.

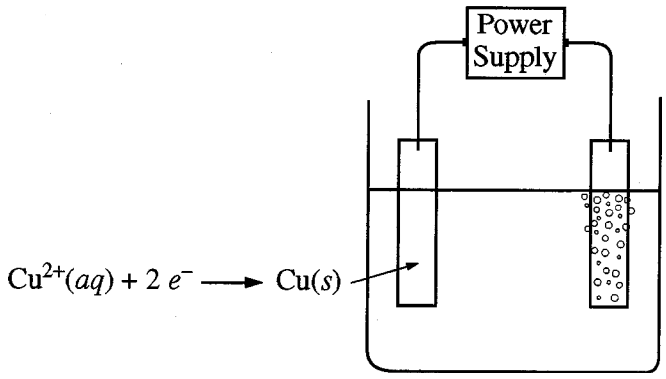
(e) Write balanced net-ionic equation for the overall chemical reaction occurring in the cell.

(f) In the cell, the concentration of Sn^{2+} is changed from 1.0 *M* to 0.50 *M*, and the concentration of X^{3+} is changed from 1.0 *M* to 0.10 *M*.

(i) Substitute all appropriate values for determining the cell potential, E_{cell}, into the Nernst equation. (Do <u>not</u> do any calculations.)

(ii) On the basis of your response in (f) (i), will the cell potential be greater than, less than, or equal to E°_{cell}? Justify your answer.

2007 *part A*, question #3



An external direct-current power supply is connected to two platinum electrodes immersed in a beaker containing 1.0 *M* $CuSO_{4(aq)}$ at 25°C, as shown in the diagram above. As the cell operates, copper metal is deposited onto one electrode and $O_{2(g)}$ is produced at the other electrode. The two reduction half-reactions for the overall reaction that occurs in the cell are shown in the table below.

Half-Reaction	E^0(V)
$O_{2(g)} + 4\ H^+_{(aq)} + 4\ e^- \rightarrow 2\ H_2O_{(l)}$	+1.23
$Cu^{2+}_{(aq)} + 2\ e^- \rightarrow Cu_{(s)}$	+0.34

(a) On the diagram, indicate the direction of electron flow in the wire.
(b) Write a balanced net ionic equation for the electrolysis reaction that occurs in the cell.
(c) Predict the algebraic sign of ΔG° for the reaction. Justify your prediction.
(d) Calculate the value of ΔG° for the reaction.

An electric current of 1.50 amps passes through the cell for 40.0 minutes.

(e) Calculate the mass, in grams, of the $Cu_{(s)}$ that is deposited on the electrode.
(f) Calculate the dry volume, in liters measured at 25°C and 1.16 atm, of the $O_{2(g)}$ that is produced.