



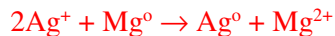
**TABLE 20.1** Some Selected Standard Electrode (Reduction) Potentials at 25 °C

Reduction Half-Reaction	$E^\circ, V$
<b>Acidic solution</b>	
$F_2(g) + 2 e^- \longrightarrow 2 F^-(aq)$	+2.866
$O_3(g) + 2 H^+(aq) + 2 e^- \longrightarrow O_2(g) + H_2O(l)$	+2.075
$S_2O_8^{2-}(aq) + 2 e^- \longrightarrow 2 SO_4^{2-}(aq)$	+2.01
$H_2O_2(aq) + 2 H^+(aq) + 2 e^- \longrightarrow 2 H_2O(l)$	+1.763
$MnO_4^-(aq) + 8 H^+(aq) + 5 e^- \longrightarrow Mn^{2+}(aq) + 4 H_2O(l)$	+1.51
$PbO_2(s) + 4 H^+(aq) + 2 e^- \longrightarrow Pb^{2+}(aq) + 2 H_2O(l)$	+1.455
$Cl_2(g) + 2 e^- \longrightarrow 2 Cl^-(aq)$	+1.358
$Cr_2O_7^{2-}(aq) + 14 H^+(aq) + 6 e^- \longrightarrow 2 Cr^{3+}(aq) + 7 H_2O(l)$	+1.33
$MnO_2(s) + 4 H^+(aq) + 2 e^- \longrightarrow Mn^{2+}(aq) + 2 H_2O(l)$	+1.23
$O_2(g) + 4 H^+(aq) + 4 e^- \longrightarrow 2 H_2O(l)$	+1.229
$2 IO_3^-(aq) + 12 H^+(aq) + 10 e^- \longrightarrow I_2(s) + 6 H_2O(l)$	+1.20
$Br_2(l) + 2 e^- \longrightarrow 2 Br^-(aq)$	+1.065
$NO_3^-(aq) + 4 H^+(aq) + 3 e^- \longrightarrow NO(g) + 2 H_2O(l)$	+0.956
$Ag^+(aq) + e^- \longrightarrow Ag(s)$	+0.800
$Fe^{3+}(aq) + e^- \longrightarrow Fe^{2+}(aq)$	+0.771
$O_2(g) + 2 H^+(aq) + 2 e^- \longrightarrow H_2O_2(aq)$	+0.695
$I_2(s) + 2 e^- \longrightarrow 2 I^-(aq)$	+0.535
$Cu^{2+}(aq) + 2 e^- \longrightarrow Cu(s)$	+0.340
$SO_4^{2-}(aq) + 4 H^+(aq) + 2 e^- \longrightarrow 2 H_2O(l) + SO_2(g)$	+0.17
$Sn^{4+}(aq) + 2 e^- \longrightarrow Sn^{2+}(aq)$	+0.154
$S(s) + 2 H^+(aq) + 2 e^- \longrightarrow H_2S(g)$	+0.14
$2 H^+(aq) + 2 e^- \longrightarrow H_2(g)$	0
$Pb^{2+}(aq) + 2 e^- \longrightarrow Pb(s)$	-0.125
$Sn^{2+}(aq) + 2 e^- \longrightarrow Sn(s)$	-0.137
$Fe^{2+}(aq) + 2 e^- \longrightarrow Fe(s)$	-0.440
$Zn^{2+}(aq) + 2 e^- \longrightarrow Zn(s)$	-0.763
$Al^{3+}(aq) + 3 e^- \longrightarrow Al(s)$	-1.676
$Mg^{2+}(aq) + 2 e^- \longrightarrow Mg(s)$	-2.356
$Na^+(aq) + e^- \longrightarrow Na(s)$	-2.713
$Ca^{2+}(aq) + 2 e^- \longrightarrow Ca(s)$	-2.84
$K^+(aq) + e^- \longrightarrow K(s)$	-2.924
$Li^+(aq) + e^- \longrightarrow Li(s)$	-3.040

1. You have the following materials from which to construct a galvanic cell: silver metal, magnesium metal, 1.0 M silver (I) nitrate and 1.0 M magnesium nitrate.
- a. Write the balanced overall reaction that will occur in the galvanic cell. (2 points)



Since the  $E^\circ$  for the reduction of  $\text{Ag}^+$  is more positive than the reduction of  $\text{Mg}^{2+}$ , silver will be reduced and magnesium will be oxidized:



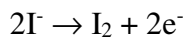
- b. What electrode will serve as the anode in your galvanic cell? (2 points)

Since magnesium is being oxidized, it is serving as the anode.

- c. What is the standard cell potential for your galvanic cell? (4 points)

$$E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}} = +0.800\text{V} - (-2.356\text{V}) = +3.156\text{V}$$

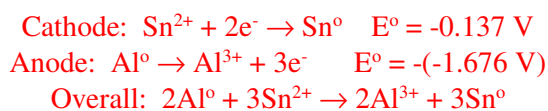
2. Calculate the time required to produce 2.79 grams of  $\text{I}_2$  at an electrode if a current of 1.75 A is passed through a concentrated solution of  $\text{KI}(\text{aq})$  (8 points)



$$2.79 \text{ g I}_2 \times \frac{1 \text{ mol I}_2}{253.9 \text{ g I}_2} \times \frac{2 \text{ mol e}^-}{1 \text{ mol I}_2} \times \frac{96485 \text{ C}}{1 \text{ mol e}^-} \times \frac{1 \text{ s}}{1.75 \text{ C}} = 1210 \text{ s}$$

3. Consider an electrochemical cell where the cathode compartment contains Sn(s) and 0.0155 M Sn<sup>2+</sup>(aq) and the anode compartment contains Al(s) and 0.0234 M Al<sup>3+</sup>(aq).

a. What is the E° for this electrochemical cell? (3 points)



$$E^\circ_{\text{cell}} = -0.137 \text{ V} + (+1.676 \text{ V}) = +1.539 \text{ V}$$

b. What is the potential for the cell under the conditions given? You may assume a temperature of 298K (6 points)

$$E = E^\circ - \frac{0.05916\text{V}}{n} \log \left( \frac{[\text{Al}^{3+}]^2}{[\text{Sn}^{2+}]^3} \right) = +1.539 \text{ V} - \frac{0.05916\text{V}}{6} \log \left( \frac{[0.0234 \text{ M}]^2}{[0.0155 \text{ M}]^3} \right) = +1.518 \text{ V}$$