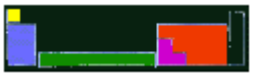
Revised August 2009



HONORS WORKSHEET 14s: Electrochemistry Summary

Use the table of standard electrode potentials attached to help answer the following questions.

1. When solid iron metal comes into contact with oxygen and water it forms aqueous iron(II) hydroxide. The half-equation representing the change in oxygen and water is shown below;

$$\tfrac{1}{2}O_{2(g)} + 2e^- + H_2O_{(l)} \rightleftarrows 2OH^-_{(aq)} \quad +0.40$$

   (a) Write a balanced chemical equation for this REDOX reaction. (3)

   (b) Calculate $E^{\ominus}_{cell}$ for this reaction. (2)

   (c) When left exposed to air the iron(II) hydroxide that is formed in the above reaction oxidizes further to hydrated iron(III) oxide or rust. Write the half equation that summarizes the change in the ***iron*** species in this process. (2)

2. Magnesium metal will react with acid (hydrogen ions) in a vigorous reaction.

   (a) Write the cell diagram for this reaction ***and*** calculate the $E^{\ominus}_{cell}$. (4)

   (b) Write a balanced chemical equation for the REDOX process. (3)

   (c) ***Specifically***, which species is oxidized in the reaction? (2)

   (d) Would you expect the reaction between calcium metal and acid to be more or less vigorous? Explain your answer. (3)

3. Which of the halogens listed in the standard electrode potential table attached, is the best oxidizing agent? Explain your answer. (3)

4. This question concerns the standard hydrogen electrode.

   (a) Draw ***and label*** a sketch of the standard hydrogen electrode. (4)

   (b) Under what conditions is the electrode run? (3)

5. An experiment is performed where these two half-cells are connected using a salt bridge and a high resistance voltmeter under standard conditions.

$Cu^{2+}_{(aq)} + 2e^- \leftrightarrows Cu_{(s)}$
$Mn^{2+}_{(aq)} + 2e^- \leftrightarrows Mn_{(s)}$

(a) What is the role of the salt bridge? (2)

(b) What is the salt bridge usually made from? (2)

(c) Why is a ***high resistance*** voltmeter used? (2)

(d) When the cell is functioning the reading on the voltmeter is +1.52 V. Calculate the $E^{\ominus}$ for the manganese half-cell. Copper is the positive half-cell. (2)

6. Use standard electrode potentials to make predictions about the following scenarios. In each case justify your prediction ***clearly***. (6)

   (a) Will solid silver metal react with a 1.00 M solution of hydrochloric acid (H^+ ions)? Fully explain your prediction.

   (b) Will a solution containing aqueous dichromate(VI) ions ($Cr_2O_7^{2-}{}_{(aq)}$) be a strong enough oxidizing agent to produce aqueous iodine ($I_{2(aq)}$) from a solution containing aqueous iodide ions ($I^-_{(aq)}$)? Fully explain your prediction.

Revised August 2009

STANDARD REDUCTION POTENTIALS IN AQUEOUS SOLUTION AT 25°C

Half-reaction			E^0(V)
$F_2(g) + 2e^-$	→	$2F^-$	2.87
$Co^{3+} + e^-$	→	Co^{2+}	1.82
$Au^{3+} + 3e^-$	→	$Au(s)$	1.50
$Cl_2(g) + 2e^-$	→	$2Cl^-$	1.36
$O_2(g) + 4H^+ + 4e^-$	→	$2H_2O(l)$	1.23
$Br_2(l) + 2e^-$	→	$2Br^-$	1.07
$2Hg^{2+} + 2e^-$	→	Hg_2^{2+}	0.92
$Hg^{2+} + 2e^-$	→	$Hg(l)$	0.85
$Ag+ + e^-$	→	$Ag(s)$	0.80
$Hg_2^{2+} + 2e^-$	→	$2Hg(l)$	0.79
$Fe^{3+} + e^-$	→	Fe^{2+}	0.77
$I_2(s) + 2e^-$	→	$2I^-$	0.53
$Cu^+ + e^-$	→	$Cu(s)$	0.52
$Cu^{2+} + 2e^-$	→	$Cu(s)$	0.34
$Cu^{2+} + e^-$	→	Cu^+	0.15
$Sn^{4+} + 2e^-$	→	Sn^{2+}	0.15
$S(s) + 2H^+ + 2e^-$	→	$H_2S(g)$	0.14
$2H^+ + 2e^-$	→	$H_2(g)$	0.00
$Pb^{2+} + 2e^-$	→	$Pb(s)$	-0.13
$Sn^{2+} + 2e^-$	→	$Sn(s)$	-0.14
$Ni^{2+} + 2e^-$	→	$Ni(s)$	-0.25
$Co^{2+} + 2e^-$	→	$Co(s)$	-0.28
$Tl^+ + e^-$	→	$Tl(s)$	-0.34
$Cd^{2+} + 2e^-$	→	$Cd(s)$	-0.40
$Cr^{3+} + e^-$	→	Cr^{2+}	-0.41
$Fe^{2+} + 2e^-$	→	$Fe(s)$	-0.44
$Cr^{3+} + 3e^-$	→	$Cr(s)$	-0.74
$Zn^{2+} + 2e^-$	→	$Zn(s)$	-0.76
$Mn^{2+} + 2e^-$	→	$Mn(s)$	-1.18
$Al^{3+} + 3e^-$	→	$Al(s)$	-1.66
$Be^{2+} + 2e^-$	→	$Be(s)$	-1.70
$Mg^{2+} + 2e^-$	→	$Mg(s)$	-2.37
$Na^+ + e^-$	→	$Na(s)$	-2.71
$Ca^{2+} + 2e^-$	→	$Ca(s)$	-2.87
$Sr^{2+} + 2e^-$	→	$Sr(s)$	-2.89
$Ba^{2+} + 2e^-$	→	$Ba(s)$	-2.90
$Rb^+ + e^-$	→	$Rb(s)$	-2.92
$K^+ + e^-$	→	$K(s)$	-2.92
$Cs^+ + e^-$	→	$Cs(s)$	-2.92
$Li^+ + e^-$	→	$Li(s)$	-3.05