This print-out should have 27 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 (part 1 of 2) 10.0 points

Using oxidation and reduction half-reactions, balance the skeletal equation

$$N_2H_4(g) + ClO_3^-(aq) \rightarrow NO(g) + Cl^-(aq)$$

of hydrazine with chlorate ions. The reaction takes place in basic solution. What is the smallest possible integer coefficient of NO in the balanced equation?

002 (part 2 of 2) 10.0 points

Identify the oxidizing agent in the reaction.

1. NO
2. Cl^-
3. ClO_3^-
4. N_2H_4

003 (part 1 of 2) 10.0 points

In the reaction

$$Cl_2(g) + S_2O_3^{2-}(aq) \rightarrow Cl^-(aq) + SO_4^{2-}(aq)$$

of the thiosulfate ion with chlorine gas in an acidic solution, identify the oxidizing agent.

1. SO_4^{2-}
2. Cl^-
3. Cl_2
4. $S_2O_3^{2-}$

004 (part 2 of 2) 10.0 points

Balance the equation using oxidation and reduction half-reactions. What is the smallest possible integer coefficient of Cl^- in the combined balanced equation?

005 10.0 points

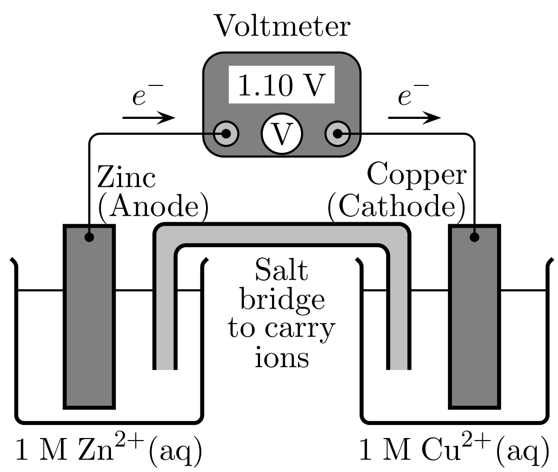
Consider the half-reactions and the balanced equation for the cell reaction represented by the skeletal equation

$$Mn(s) + Ti^{2+}(aq) \rightarrow Mn^{2+}(aq) + Ti(s)\,.$$

What is the proper cell diagram for this reaction?

1. $Ti^{2+}(aq)\,|\,Ti(s)\,||\,Mn(s)\,|\,Mn^{2+}(aq)$
2. $Ti(s)\,|\,Ti^{2+}(aq)\,||\,Mn^{2+}(aq)\,|\,Mn(s)$
3. $Mn(s)\,|\,Mn^{2+}(aq)\,||\,Ti^{2+}(aq)\,|\,Ti(s)$
4. $Mn^{2+}(aq)\,|\,Mn(s)\,||\,Ti(s)\,|\,Ti^{2+}(aq)$

006 10.0 points



In this electrochemical cell, what is the reduction half reaction?

1. $Zn^{2+}(aq) + 2\,e^- \rightarrow Zn(s)$
2. $Zn(s) \rightarrow Zn^{2+}(aq) + 2\,e^-$
3. $Cu^{2+}(aq) + 2\,e^- \rightarrow Cu(s)$
4. $Cu(s) \rightarrow Cu^{2+}(aq) + 2\,e^-$

007 10.0 points

What is the standard cell potential of a battery made from the half reactions

$2\,H^+ + 2\,e^- \longrightarrow H_2 \qquad E^\circ = 0.00$ V

$O_2 + 4\,H^+ + 4\,e^- \longrightarrow 2\,H_2O \quad E^\circ = +1.23$ V

1. 1.23

2. 2.46

3. −2.46

4. −1.23

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008 10.0 points

In an electrolytic cell, the negative terminal is the (cathode/anode) and is the site of the (oxidation/reduction) half reaction.

1. cathode, oxidation

2. cathode, reduction

3. anode, reduction

4. anode, oxidation

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009 10.0 points

In a galvanic cell,

1. electrolytes are added to carry electrons between electrodes.

2. oxidation and reduction take place at the same time but at different electrodes.

3. oxidation takes place at the cathode.

4. electrical energy is used to reverse spontaneous chemical reactions.

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010 10.0 points

Write the half reactions and the balanced equation for the galvanic cell

$Ag(s)\,|\,AgCl(s)\,|\,Cl^-(aq)\,||\,Cl^-(aq)\,|\,Hg_2Cl_2(s)\,|\,Hg(\ell)$

What is the smallest possible integer coefficient of $Hg_2Cl_2(s)$ in the combined balanced equation?

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011 10.0 points

Silver is plated on copper by immersing a piece of copper into a solution containing silver(I) ions. In the plating reaction, copper

1. is oxidized and is the reducing agent.

2. is reduced and is the reducing agent.

3. is reduced and is the oxidizing agent.

4. is oxidized and is the oxidizing agent.

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012 10.0 points

What is the E^0 for the following electrochemical cell where Zn is the cathode?

$$Fe\,|\,Fe^{2+}(1.0\text{ M})\,||\,Zn^{2+}(1.0\text{ M})\,|\,Zn$$

$E^0(Zn) = -0.76 \qquad E^0(Fe) = -0.44$

1. +1.20

2. −1.20

3. +0.32

4. −0.32

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013 10.0 points

Which of the metals in the list below will react with 1 M H_2SO_4 to produce hydrogen gas?

	E^0 (volts)
$Na^+ + 1\,e^- \rightarrow Na$	−2.714
$Cd^{2+} + 2\,e^- \rightarrow Cd$	−0.403
$Pb^{2+} + 2\,e^- \rightarrow Pb$	−0.126
$Cu^{2+} + 2\,e^- \rightarrow Cu$	+0.337

1. Na and Cd only

2. Na only

3. Na, Cd, and Pb only

4. Na, Cd, Pb, and Cu

5. some other combination than those listed

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014 10.0 points

Consider the voltaic cell:

$Pt\,|\,Sn^{2+}\ (0.10\text{ M}),\ Sn^{4+}\ (0.0010\text{ M})\ ||\,Ag^+\ (0.010\text{ M})\,|\,Ag$

$Sn^{4+} + 2\,e^- \rightarrow Sn^{2+} \qquad E^0 = +0.15$ V

$Ag^+ + 1\,e^- \to Ag(s)$ $E^0 = +0.80$ V

The electrons flow in the external circuit from

1. Ag to Pt.

2. Pt to Ag.

3. Ag to Sn^{4+}.

4. Sn to Ag.

5. Sn^{2+} to Ag^+.

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015 10.0 points

Using the standard potential tables, what is the largest approximate E^0 value that can be achieved when two half cell reactions are combined to form a battery?

1. −6 V

2. −3 V

3. 3 V

4. 6 V

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016 10.0 points

Consider the cell

$$Zn(s)\,|\,Zn^{2+}(aq)\,||\,Cl^-(aq)\,|\,AgCl(s)\,|\,Ag(s)$$

Calculate E°.

1. − 0.54 V

2. − 1.20 V

3. + 0.54 V

4. + 0.98 V

5. + 1.20 V

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017 10.0 points

Which species will oxidize Cr^{2+} but not Mn^{2+}?

1. O_3 in acidic medium

2. V^{3+}

3. Fe^{2+}

4. Zn^{2+}

5. Pb^{4+}

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018 10.0 points

If the standard potentials for the couples $Cu^{2+}\,|\,Cu$, $Ag^+\,|\,Ag$, and $Fe^{2+}\,|\,Fe$ are +0.34, +0.80, and − 0.44 V, respectively, which is the strongest reducing agent?

1. Fe^{2+}

2. Ag^+

3. Ag

4. Cu

5. Fe

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019 10.0 points

In a working electrochemical cell (+ cell voltage), the cations in the salt bridge move toward the cathode.

1. True

2. False

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020 10.0 points

For the cell diagram

$$Cd(s)\,|\,CdSO_4(aq)\,||\,Hg_2SO_4\,|\,Hg(\ell)$$

what reaction occurs at the cathode?

1. $CdSO_4(s) + 2\,e^- \to 2\,Cd(\ell) + SO_4^{2-}(aq)$

2. $Hg_2SO_4(s) + 2\,e^- \to 2\,Hg(\ell) + SO_4^{2-}(aq)$

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021 10.0 points

What is the cathode in

$$Mg(s) \mid Mg^{2+}(aq) \mid\mid Au^{+}(aq) \mid Au(s)$$

$Mg^{2+} + 2\,e^- \rightarrow Mg \qquad \mathcal{E}^\circ_{red} = -2.36$
$Au^{+} + e^- \rightarrow Au \qquad \mathcal{E}^\circ_{red} = +1.69$
and what is the cell type?

1. Mg(s); an electrolytic cell

2. Not enough information is provided.

3. Au(s); a voltaic cell

4. Mg(s); a voltaic cell

5. Au(s) an electrolytic cell

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022 10.0 points

Consider the half-reactions
$Mn^{2+} + 2\,e^- \rightarrow Mn \qquad E^0 = -1.029$ V
$Ga^{3+} + 3\,e^- \rightarrow Ga \qquad E^0 = -0.560$ V
$Fe^{2+} + 2\,e^- \rightarrow Fe \qquad E^0 = -0.409$ V
$Sn^{2+} + 2\,e^- \rightarrow Sn \qquad E^0 = -0.136$ V

Using the redox couples to establish a voltaic cell, which reaction would be non-spontaneous?

1. $2\,Ga + 3\,Sn^{2+} \rightarrow 2\,Ga^{3+} + 3\,Sn$

2. $Fe^{2+} + Mn \rightarrow Mn^{2+} + Fe$

3. $Sn^{2+} + Mn \rightarrow Sn + Mn^{2+}$

4. $2\,Ga^{3+} + 3\,Fe \rightarrow 2\,Ga + 3\,Fe^{2+}$

5. $Sn^{2+} + Fe \rightarrow Sn + Fe^{2+}$

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023 10.0 points

Find the standard emf of the given cell

$$Cu(s) \mid Cu^{2+}(aq) \mid\mid Au^{+}(aq) \mid Au(s)$$

1. -2.03 V

2. $+2.03$ V

3. -1.35 V

4. -0.91 V

5. $+0.91$ V

6. $+1.35$ V

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024 10.0 points

Which species will reduce Ag^{+} but not Fe^{2+}?

1. H_2

2. V

3. Au

4. Cr

5. Pt

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025 10.0 points

If the table of standard reduction potentials is ordered with the strongest reducing agents at the top, how are the reduction potentials ordered (from top to bottom)?

1. From most common to least common

2. From most spontaneous to least spontaneous

3. From most positive to most negative

4. From most negative to most positive

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026 10.0 points

Which specie is the weakest reducing agent in the table of half reactions?

1. F^-

2. Li

3. F_2

4. Li^+

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027 10.0 points

If the two half reactions below were used to make an electrolytic cell, what species would be consumed at the anode?

Half reaction	E°
$Au^{3+}(aq) + 3\,e^- \longrightarrow Au(s)$	+1.50
$I_2(s) + 2\,e^- \longrightarrow 2\,I^-(aq)$	+0.53

1. $Au^{3+}(aq)$

2. $I^-(aq)$

3. $Au(s)$

4. $I_2(s)$