This print-out should have 21 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 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?

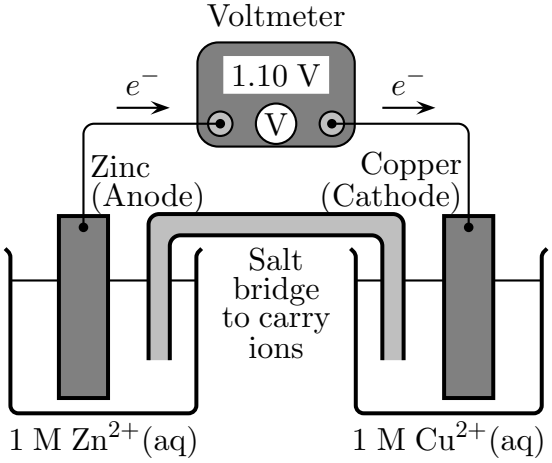
1. $Ti^{2+}(aq)\,|\,Ti(s)\,||\,Mn(s)\,|\,Mn^{2+}(aq)$

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

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

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

002 10.0 points



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

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

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

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

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

003 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

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

1. 2.46

2. 1.23

3. −1.23

4. −2.46

004 10.0 points

In a galvanic cell,

1. oxidation takes place at the cathode.

2. electrolytes are added to carry electrons between electrodes.

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

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

005 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 oxidizing agent.

2. is reduced and is the reducing agent.

3. is reduced and is the oxidizing agent.

4. is oxidized and is the reducing agent.

006 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. −0.32

3. +0.32

4. +1.20

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007 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, Cd, and Pb only

2. Na, Cd, Pb, and Cu

3. Na and Cd only

4. some other combination than those listed

5. Na only

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008 10.0 points

Consider the voltaic cell:

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

$Sn^{4+} + 2\,e^- \rightarrow Sn^{2+}$	$E^0 = +0.15$ V
$Ag^+ + 1\,e^- \rightarrow Ag(s)$	$E^0 = +0.80$ V

The electrons flow in the external circuit from

1. Ag to Pt.

2. Ag to Sn^{4+}.

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

4. Sn to Ag.

5. Pt to Ag.

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009 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. −3 V

2. 6 V

3. −6 V

4. 3 V

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010 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. + 0.98 V

4. − 0.54 V

5. − 1.20 V

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011 10.0 points

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

1. Zn^{2+}

2. Pb^{4+}

3. V^{3+}

4. Fe^{2+}

5. O_3 in acidic medium

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012 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. Ag

2. Ag^+

3. Fe^{2+}

4. Cu

5. Fe

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013 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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014 10.0 points

For the cell diagram

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

what reaction occurs at the cathode?

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

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

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015 10.0 points

What is the cathode in

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

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

1. Not enough information is provided.

2. Mg(s); an electrolytic cell

3. Mg(s); a voltaic cell

4. Au(s); an electrolytic cell

5. Au(s); a voltaic cell

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016 10.0 points

Consider the half-reactions

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

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

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

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

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

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

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

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017 10.0 points

Find the standard emf of the given cell

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

1. −0.91 V

2. −1.35 V

3. +1.35 V

4. −2.03 V

5. +2.03 V

6. +0.91 V

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018 10.0 points

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

1. Pt

2. Cr

3. Au

4. H_2

5. V

019 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 positive to most negative

2. From most common to least common

3. From most spontaneous to least spontaneous

4. From most negative to most positive

020 10.0 points

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

1. Li^+

2. F_2

3. F^-

4. Li

021 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. $I^-(aq)$

2. Au(s)

3. $I_2(s)$

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