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McCord CH302
50375 / 50380

Exam 4

Spring 2017

Reminder: Be sure and correctly bubble in your name, uteid, and version number on your bubblesheet.

The Periodic Table, conversion factors, constants, and a Table of Standard Potentials are all provided on a separate sheet.

NOTE: Please keep your Exam copy intact (all pages still stapled). You must turn in your exam copy, bubble sheet, handouts, and scratch paper.

This print-out should have 29 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 4.0 points

Calculate the emf of the following electrochemical cell:

$$\mathrm{Pt(s)}\left|\begin{array}{c}\mathrm{H_2SO_3(aq)}\ ,\\ \mathrm{SO_4^{2-}(aq)\,,H^+(aq)}\end{array}\right|\left|\begin{array}{c}\mathrm{Cr_2O_7^{2-}(aq)}\ ,\\ \mathrm{Cr^{3+}(aq)\,,H^+(aq)}\end{array}\right|\mathrm{Pt(s)}$$

1. +0.24 V
2. −1.16 V
3. −1.50 V
4. +1.16 V
5. −0.24 V
6. +1.50 V

002 2.0 points

In order to make a voltaic cell using two half reactions from a standard potential table, you have to match the half reactions that have the exact same number of moles of electrons as shown on the table.

1. False
2. True

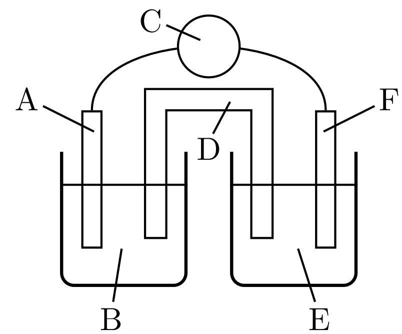
003 4.0 points

Indium metal is electroplated from a concentrated solution of indium(III) chloride. 12.5 amps of current is passed for a total of 96 hours. What mass of indium is plated?

1. 4.24 kg
2. 3.92 kg
3. 1.71 kg
4. 2.57 kg
5. 5.14 kg
6. 1.30 kg

004 (part 1 of 3) 2.0 points

The following three questions refer to this diagram for a voltaic cell.



What is the name of the component/part labeled C?

1. flow injector
2. salt bridge
3. oxidizing agent
4. cathode
5. voltmeter
6. anode
7. reducing agent

005 (part 2 of 3) 2.0 points

What is the component/part that is labeled F ?

1. voltmeter
2. salt bridge
3. cathode
4. battery
5. anode
6. stir bar

006 (part 3 of 3) 2.0 points

Cations can be found in area(s) ____. When the cell is discharging the cations will flow ____.

1. B, D, and E ; A to F

2. B only ; only from A to B

3. D only ; only from D to F

4. E only ; only from F to D

007 4.0 points

You are trying to create a voltaic cell in the lab with all the components necessary at your disposal (beakers, conductive wire, and a KCl salt bridge solution). However, all you can find is Fe metal and Fe^{3+}. Is it possible to create a voltaic cell? Why or why not?

1. Yes, it can be done by preparing a substantially higher Fe^{3+} concentration in the cathode compartment.

2. Yes, it can be done by preparing cells with very different masses of the Fe metal.

3. Yes, it can be done by preparing identical half cells.

4. Yes, it can be done by preparing a substantially higher Fe^{3+} concentration in the anode compartment

5. No, it is not possible to create a voltaic cell with identical half-reactions.

008 2.0 points

An *active* metal would be a good _____.

1. anode

2. cathode

009 4.0 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. $Mn^{2+}(aq)\,|\,Mn(s)\,||\,Ti(s)\,|\,Ti^{2+}(aq)$

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

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

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

010 4.0 points

What type of battery allows the depleted reactants to be regenerated by passing a direct electric current through the cell?

1. secondary cells

2. primary cells

3. dry cells

4. fuel cells

5. tertiary cells

011 2.0 points

A size D alkaline battery has a higher potential than a size AA alkaline battery.

1. False

2. True

012 4.0 points

What is the average current generated in the

$$Fe(s)\,|\,Fe^{3+}(aq)\,||\,Cu^{2+}(aq)\,|\,Cu(s)$$

electrochemical cell if the mass of the Cu electrode increases in mass by 75 g in a 24 hour period?

1. 111.85 amp

2. 42.17 amp

3. 13.00 amp

4. 1.76 amp

5. 2.64 amp

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013 4.0 points

Calculate the equilibrium constant for the following reaction by using a table of standard potentials.

$$3Cu + 2Bi^{3+} \rightleftharpoons 3Cu^{2+} + 2Bi$$

1. 4.3×10^{-3}

2. 8.0×10^{-8}

3. 6.3×10^{-15}

4. 1.8×10^{-5}

5. 1.3×10^{7}

6. 1.6×10^{14}

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014 4.0 points

1 Faraday is

1. the charge in Coulombs carried by one mole of electrons.

2. the charge in Coulombs on one mole of ions.

3. the current required to provide one mole of electrons.

4. the voltage (volts) associated with one mole of electrons.

5. the number of electrons in one mole.

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015 4.0 points

Balance the following redox reaction in acidic solution. You will have to provide the H_2O and the H^+ for the reaction. Make sure all the coefficients are whole numbers.

$$NbO_2 + W \rightarrow Nb + WO_4^{2-}$$

What is the coefficient for WO_4^{2-} in the balanced equation?

1. 2

2. 6

3. 5

4. 3

5. 1

6. 4

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016 4.0 points

In the redox conversion of SO_3 to SO^-, S is __?__ and its oxidation number goes from __?__ to __?__

1. reduced; 2 to 6

2. oxidized; 6 to 2

3. reduced; 6 to 2

4. reduced; 3 to −3

5. oxidized; 6 to 3

6. oxidized; 6 to 1

7. oxidized; 3 to −3

8. reduced; 6 to 1

9. oxidized; 2 to 6

10. reduced; 6 to 3

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017 3.0 points

The standard potential of the cell

$$Pb(s) \,|\, PbSO_4(s) \,|\, SO_4^{2-}(aq) \,||\, Pb^{2+}(aq) \,|\, Pb(s)$$

is +0.23 V at 25°C. Calculate the K_{sp} of $PbSO_4$.

1. 1.7×10^{-8}

2. 6.0×10^{7}

3. 1.3×10^{-4}

4. 1.3×10^{-18}

5. 2.7×10^{-17}

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018 2.0 points

When electroplating a metal, the metal is deposited on the ______.

1. anode

2. cathode

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019 4.0 points

You run your new flashlight until the batteries die and hence the flashlight will no longer shine light. Which of the following can be considered TRUE regarding the chemical state of these batteries?

I. ΔG for the battery reaction is positive.

II. $E_{\text{cell}} > 0$.

III. The batteries are at equilibrium.

1. I and II only

2. III only

3. I and III only

4. I only

5. II and III only

6. I, II and III

7. II only

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020 3.0 points

How many liters of F_2(g) at STP could be produced by the electrolysis of molten NaF with a constant 2.75 amp current for 160 minutes?

1. 0.0511 L

2. 6.13 L

3. 0.326 L

4. 3.06 L

5. 0.163 L

6. 0.102 L

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021 4.0 points

Consider the following equations. Which is the strongest oxidizing agent?

$$\text{Na(s)} \rightarrow \text{Na}^{+}\text{(aq)} + e^{-} \qquad E^\circ = 2.71\text{ V}$$
$$\text{Ti(s)} \rightarrow \text{Ti}^{2+}\text{(aq)} + 2\,e^{-} \qquad E^\circ = 1.63\text{ V}$$
$$\text{Pd(s)} \rightarrow \text{Pd}^{2+}\text{(aq)} + 2\,e^{-} \qquad E^\circ = -0.915\text{ V}$$

1. Pd^{2+}(aq)

2. Ti^{2+}(aq)

3. Na(s)

4. Na^{+}(aq)

5. Pd(s)

6. Ti(s)

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022 4.0 points

Using the set of smallest whole number coefficients to balance the redox equation

$$\text{MnO}_4^- + \text{NO}_2^- \rightarrow \text{MnO}_2 + \text{NO}_3^-$$

in basic solution, you get

1. 3 H_2O on the left.

2. 3 OH^- on the left.

3. 2 OH^- on the right.

4. 1 H_2O on the right.

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023 4.0 points

Identify the oxidizing agent in the reaction

$$2\,\text{Al}(\ell) + \text{Cr}_2\text{O}_3\text{(s)} \xrightarrow{\Delta} \text{Al}_2\text{O}_3\text{(s)} + 2\,\text{Cr}(\ell)\,,$$

an example of a thermite reaction used to obtain some metals from their ores.

1. Al(s)

2. Al_2O_3(s)

3. Cr(l)

4. Cr_2O_3(s)

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024 4.0 points

Calculate the maximum non-expansion work possible for the following reaction at standard conditions:

$$Pd^{2+} + Zr \rightarrow Pd + Zr^{4+}$$

Note: You have to balance the reaction first and use smallest possible set of whole numbers.

1. 912.7 kJ

2. 912700 kJ

3. 1825 kJ

4. 456.4 kJ

5. 865.4 kJ

6. 1825500 kJ

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025 4.0 points

A student was given a standard Fe(s) | Fe^{2+}(aq) half-cell and another half-cell containing an unknown metal, M(s), immersed in 1 M MNO_3(aq). When these two half-cells were connected at 25°C, the complete cell functioned as a galvanic cell with $E = 1.24$ V. The reaction was allowed to proceed for a short amount of time and the two electrodes were weighed. The iron electrode was found to be lighter than its initial mass and the unknown metal electrode was heavier than its initial mass. What is the standard potential of the unknown M^+/M couple?

1. +0.8 V

2. +1.68 V

3. +2.04 V

4. −0.8 V

5. −0.36 V

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026 4.0 points

Determine the standard Gibbs free energy change ($\Delta G°$) for the following cell. (Note: balance the net reaction using the smallest possible whole numbers)

$$Li(s) \mid Li^+(aq) \parallel F^-(aq) \mid F_2(g) \mid Pt$$

1. +34.7 kJ

2. +1142 kJ

3. +571 kJ

4. −571 kJ

5. −34.7 kJ

6. −1142 kJ

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027 4.0 points

Consider the S.H.E. half-cell which has a hydrogen gas pressure of 1 atm and an unknown H^+ concentration. The potential of this half-cell is measured, and found to be −0.1923 V. Calculate the pH of the solution in this cell.

1. 2.00

2. 1.50

3. 2.65

4. 6.50

5. 3.25

6. 3.00

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028 4.0 points

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

Half reaction	$E°$
$Cu^{2+}(aq) + 2\,e^- \longrightarrow Cu(s)$	+0.34
$Fe^{3+}(aq) + e^- \longrightarrow 2\,Fe^{2+}(aq)$	+0.77

1. $Fe^{2+}(aq)$

2. $Fe^{3+}(aq)$

3. $Cu^{2+}(aq)$

4. Cu(s)

029 4.0 points

Consider the following voltaic cell:

$$\text{Pt}\,\Big|\,\underset{(0.050\text{ M})}{Sn^{2+}},\ \underset{(0.50\text{ M})}{Sn^{4+}}\,\Big\|\,\underset{(0.010\text{ M})}{Ag^{+}}\,\Big|\,\text{Ag}$$

The experimental cell potential for the cell is closest to

1. 0.946 V

2. 0.354 V

3. 0.739 V

4. 0.502 V

5. 0.650 V

6. 0.798 V

7. 0.561 V