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Practice Exam 2

TTh Classes · Spring 2016

REMEMBER: Bubble in ALL Bubblesheet information!

This includes your first and last name, your UTEID, and your version number.

Please refer to the back of the bubble sheet for more info.

$F = 96{,}485$ C/mol of e^{-1}

1 Ampere = 1 C/s

$N_a = 6.022\times10^{23}$

$E^\circ_{cell} = E^\circ_{cat} - E^\circ_{an}$

$E_{cell} = E^\circ_{cell} - \left(\frac{0.05916}{n}\right)\cdot \log Q$

$\Delta G^\circ = -n\cdot F\cdot E^\circ_{cell}$

Standand Potentials at 25° C	E°
$F_2(g) + 2\ e^- \rightleftharpoons 2\ F^-(aq)$	+2.87 V
$Au^{3+}(aq) + 3\ e^- \rightleftharpoons Au(s)$	+1.40 V
$Cl_2(g) + 2\ e^- \rightleftharpoons 2\ Cl^-(aq)$	+1.36 V
$Pt^{2+}(aq) + 2\ e^- \rightleftharpoons Pt(s)$	+1.20 V
$Br_2(g) + 2\ e^- \rightleftharpoons 2\ Br^-(aq)$	+1.08 V
$Ag^+(aq) + e^- \rightleftharpoons Ag(s)$	+0.80 V
$Cu^{2+}(aq) + 2\ e^- \rightleftharpoons Cu(s)$	+0.34 V
$2\ H^+(aq) + 2\ e^- \rightleftharpoons H_2(g)$	**0.000** V
$Fe^{3+}(aq) + 3\ e^- \rightleftharpoons Fe(s)$	−0.040 V
$Ni^{2+}(aq) + 2\ e^- \rightleftharpoons Ni(s)$	−0.236 V
$Cd^{2+}(aq) + 2\ e^- \rightleftharpoons Cd(s)$	−0.40 V
$Fe^{2+}(aq) + 2\ e^- \rightleftharpoons Fe(s)$	−0.44 V
$Cr^{3+}(aq) + 3\ e^- \rightleftharpoons Cr(s)$	−0.74 V
$Cr^{2+}(aq) + 2\ e^- \rightleftharpoons Cr(s)$	−0.91 V
$Al^{3+}(aq) + 3\ e^- \rightleftharpoons Al(s)$	−1.66 V
$Li^+(aq) + e^- \rightleftharpoons Li(s)$	−3.040 V

This print-out should have 25 questions. Multiple-choice questions may continue on the next column or page – find all choices before answering.

001 5.0 points

In the reaction
$2\,MnO_4^- + 16\,H^+ + 10\,I^- \rightarrow 2\,Mn^{2+} + 8\,H_2O + 5\,I_2$
of permanganate anion with iodide in acidic solution, what has been reduced and what is the change in oxidation number?

1. hydrogen, from +1 to 0

2. manganese, from +7 to +2

3. iodine, from −1 to 0

4. iodine, from −10 to −5

5. oxygen, from −1 to −2

002 5.0 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 reduced and is the reducing agent.

2. is reduced and is the oxidizing agent.

3. is oxidized and is the reducing agent.

4. is oxidized and is the oxidizing agent.

003 5.0 points

If the standard potentials for the couples $Fe^{3+} \mid Fe^{2+}$, $MnO_4^{2-}, H^+ \mid Mn^{2+}, H_2O$, $Zn^{2+} \mid Zn$, $V^{3+} \mid V^{2+}$, and $Br_2 \mid Br^-$ are +0.77, +1.51, − 0.76, − 0.26, and +1.09 V, respectively, which is the strongest oxidizing agent?

1. Mn^{2+}

2. Zn^{2+}

3. MnO_4^{2-}

4. Fe^{3+}

5. Br_2

004 5.0 points

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

$$MnO_4^- + NO_2^- \rightarrow MnO_2 + NO_3^-$$

in basic solution, you get

1. $1\,H_2O$ on the right.

2. $3\,H_2O$ on the left.

3. $3\,OH^-$ on the left.

4. $2\,OH^-$ on the right.

005 5.0 points

Balance the net ionic equation

$$MnO_4^- + I^- \rightarrow I_2 + MnO_2$$

in basic solution. What is the sum of the coefficients for ONLY THE REACTANT SIDE of the equation?

1. 14

2. 10

3. 8

4. 12

5. 16

6. 21

7. 9

006 5.0 points

Far a battery, the cathode is the (positive/negative) terminal and the electrons flow through the external circuit from (anode to cathode/cathode to anode).

1. negative, anode to cathode

2. positive, cathode to anode

3. negative, cathode to anode

4. positive, anode to cathode

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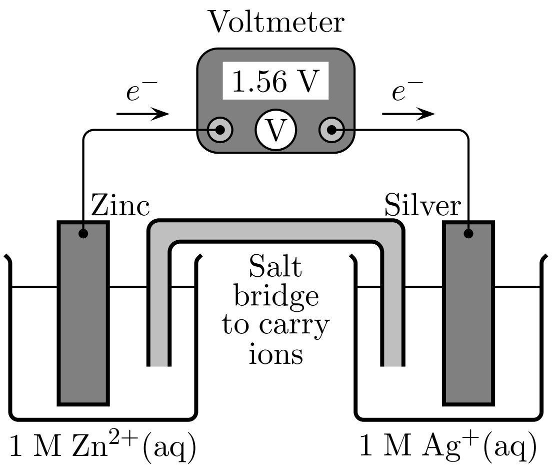
007 5.0 points



In this electrochemical cell, what is the cathode?

1. the Ag^+(aq) ions in the 1 M solution

2. the Zn^{2+}(aq) ions in the 1 M solution

3. the solid silver electrode

4. the solid zinc electrode

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008 5.0 points

What is the primary difference between a voltaic and an electrolytic cell?

1. The reaction in a voltaic cell is spontaneous; the one in an electrolytic cell is non-spontaneous.

2. Voltaic cells are used only in laboratories; electrolytic cells are used only in industrial applications.

3. The voltaic cell is a real reaction that is used in everyday applications; the electrolytic cell is a theoretical reaction that does not have any real-life applications.

4. The electrolytic cell can be used as a power supply; the voltaic cell must itself have power supplied in order to function.

5. The reaction in a voltaic cell is exothermic; the one in an electrolytic cell is endothermic.

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009 5.0 points

What is the cathode in

$$Ag(s) \mid Ag^+(aq) \parallel Fe^{2+}(aq) \mid Fe(s)$$

$Ag^+ + e^- \rightarrow Ag$ $\mathcal{E}^\circ_{red} = +0.80$
$Fe^{2+} + 2\,e^- \rightarrow Fe$ $\mathcal{E}^\circ_{red} = -0.44$
and what type cell is it?

1. Ag(s); a battery

2. Fe(s); a battery

3. Not enough information is provided.

4. Ag(s); an electrolytic cell

5. Fe(s); an electrolytic cell

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010 5.0 points

Standard reduction potentials are established by comparison to the potential of which half reaction?

1. $Li^+ + e^- \longrightarrow Li$

2. $F_2 + 2\,e^- \longrightarrow 2\,F^-$

3. $Na^+ + e^- \longrightarrow Na$

4. $2\,H_2O + 2\,e^- \longrightarrow H_2 + 2\,OH^-$

5. $2\,H^+ + 2\,e^- \longrightarrow H_2$

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011 5.0 points

If the reduction of fluorine gas to fluoride ion were used as the reference electrode for determining the standard reduction potentials of half reactions

$$F_2(g) + 2\,e^- \rightarrow 2\,F^-$$
$$2\,H^+ + 2\,e^- \rightarrow H_2(g)$$

what would be the standard reduction potential of the hydrogen electrode?

1. 2.87 V

2. −2.87 V

3. 3.04 V

4. 0 C

5. −3.04 V

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012 5.0 points

The standard potential of the $Cu^{2+}\,|\,Cu$ electrode is +0.34 V and the standard potential of the cell

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

is +0.47 V. What is the standard potential of the $Pb^{2+}\,|\,Pb$ electrode?

1. +0.81 V

2. – 0.13 V

3. – 0.26 V

4. +0.13 V

5. – 0.81V

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013 5.0 points

The Nernst equation contains the reaction quotient Q. For cells involving solids and aqueous solutions, it is not necessary to include the solids because

1. solids are insoluble in water.

2. solids do not undergo oxidation.

3. solid concentrations (activities) are defined as equal to 1.

4. solids participate but their concentrations are negligible.

5. solids do not participate in the reactions.

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014 5.0 points

What is the cell potential of the following cell?

$Pt(s)\,|\,Br^-(aq,\ 0.2\ M)\,|\,Br_2(\ell)\,||\,Au^+(aq,\ 0.7\ M)\,|\,Au(s)$

$Br_2 + 2\,e^- \rightarrow 2\,Br^-$ $\quad \mathcal{E}^\circ_{red} = +1.09$ V

$Au^+ + e^- \rightarrow Au$ $\quad \mathcal{E}^\circ_{red} = +1.69$ V

1. 0.55 V

2. 0.48 V

3. 0.60 V

4. 0.65 V

5. 0.72 V

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015 5.0 points

A battery formed from the two half reactions

$Fe^{2+} \longrightarrow Fe$ $\quad E^\circ = -0.44$ V

$Cd^{2+} \longrightarrow Cd$ $\quad E^\circ = -0.40$ V

dies (reaches equilibrium). If $[Fe^{2+}]$ was 0.24 M in the dead battery, find $[Cd^{2+}]$ in the dead battery?.

1. 0.0.0005 M

2. 5.4 M

3. 120.3 M

4. 0.01 M

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016 5.0 points

Sodium is produced by electrolysis of molten sodium chloride. What are the products at the anode and cathode, respectively?

1. $Cl_2(g)$ and $Na_2O(\ell)$

2. $O_2(g)$ and $Na(\ell)$

3. $Na(\ell)$ and $O_2(g)$

4. $Cl_2(g)$ and $Na(\ell)$

5. $Cl^-(aq)$ and $Na_2O(\ell)$

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017 5.0 points

The reaction

$$2\,Ag^+(aq) + Fe(s) \rightarrow Fe^{2+}(aq) + 2\,Ag(s)$$

taking place in a battery generates a current of 2 amp. How much Fe(s) is consumed in 1 hour?

1. 1.04 g

2. 4.16 g

3. 8.32 g

4. 3.46 g

5. 2.08 g

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018 5.0 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 equilibrium constant for the reaction of 1 M $Pb^{2+}(aq)$ with 1 M $SO_4^{2-}(aq)$.

1. 7.7×10^3

2. 1.7×10^{-8}

3. 6.0×10^7

4. 8.0×10^{17}

5. 3.7×10^{16}

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019 5.0 points

You are trying to build a battery, but all you have to work with are some beakers, some wire, a few pieces of Fe(s) and a solution of Fe^{3+}. Is it possible to build a battery? If so, how.

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

2. Yes, it can be done by preparing two half cells with very different concentrations of Fe^{3+}.

3. No, it is not possible.

4. Yes, it can be done by preparing two half cells with very different masses of Fe.

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020 5.0 points

Which type of widely used battery is NOT rechargeable?

1. alkaline

2. lead-acid (storage batteries)

3. nickel-cadmium (NiCad)

4. lithium-ion

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021 5.0 points

What condition must be met for a battery to be rechargeable?

1. The electrochemical reaction of the battery must be reversible.

2. Either its anode or its cathode must generate a gas as a result of the electrochemical reaction.

3. The battery must be open to the outside so that it can vent any internal pressure that builds up from gases within it.

4. It must generate electricity via an acid-base reaction rather than via an oxidation reduction reaction.

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022 5.0 points

The element Mg is used as a __?__ for underground pipes by connecting a piece of Mg metal to the pipe with a wire. This method works because Mg is __?__ .

1. sacrificial electrode; easy to oxidize

2. protective coating; chemically unreactive

3. sacrificial electrode; easy to reduce

4. protective coating; easy to oxidize

5. protective coating; easy to reduce

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023 5.0 points

A fuel cell is __?__ and the corresponding chemical reaction is __?__ .

1. a voltaic cell; a fusion reaction

2. an electrolytic cell; a combustion reaction

3. an electrolytic cell; a substitution reaction

4. a voltaic cell; a combustion reaction

5. a voltaic cell; an inihilation reaction

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024 5.0 points

Which of the following is/are desirable when scientists are developing new types of batteries?

I) made from cheap, abundant materials
II) have higher energy density
III) are non-toxic and can be safely recycled

1. I only

2. III only

3. II and III

4. II only

5. I and III

6. I and II

7. I, II and III

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025 5.0 points

A photovoltaic cell

1. uses electricity to emit light.

2. converts the energy of a photon into electrical potential energy.

3. is prohibitively expensive to build and will probably never be commercially available to the general public.

4. is used to plate (deposit) inert metals like gold and silver onto less expensive metals like copper and zinc.

5. is responsible for the functioning of a lead storage battery.