

Chapter 19 Worksheet 2 (galvanic cells, cell notation, cell potentials)

Name:

UGA ID:

Instructions:

- Please enter your first and last name as it appears on the eLC roster (do not use a nickname).
- Your UGA myID is a combination of letters and numbers (example: mine is wpe28548). **Do not use your 81x number.**
- If you do not have a printer, type your answers in the then upload the worksheet template to Gradescope by Thursday, April 29 at 11:59 pm. Write your work on separate sheets of paper, convert to a PDF and upload to eLC.
- If you have a printer download the worksheet, convert it to a PDF and upload to Gradescope by Thursday, April 29 at 11:59 pm. You do not need to upload anything to eLC.

1. When a piece of copper metal is put into a solution of silver nitrate (AgNO_3), silver metal is produced along with Cu^{2+} , the latter of which is responsible for the blue color of the solution. Which of the following statements is false?

- A. ΔG for the reaction is negative (the reaction is exergonic).
- B. For every mole of Cu reacted, two moles of Ag is produced.
- C. Cu is oxidized.
- D. Ag is an oxidizing agent.
- E. A solution of CuSO_4 will be blue.

2a. What is the strongest oxidizing agent?

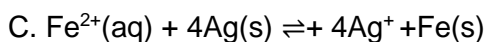
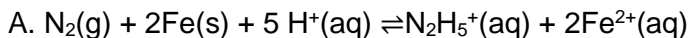
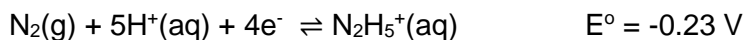
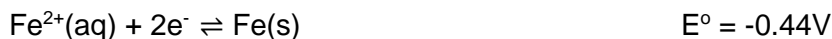
- A. MnO_4^-
- B.
- C. Hg_2^{2+}
- D.
- E. Fe^{2+}
- D. K^+

Reduction Half-Reaction	E° (V)
$\text{MnO}_4^- (\text{aq}) + 8 \text{H}^+ (\text{aq}) + 5 \text{e}^- \rightarrow \text{Mn}^{2+} (\text{aq}) + 4 \text{H}_2\text{O} (\text{l})$	1.51
$\text{Hg}_2^{2+} (\text{aq}) + 2 \text{e}^- \rightarrow 2 \text{Hg} (\text{l})$	0.855
$\text{Fe}^{2+} (\text{aq}) + 2 \text{e}^- \rightarrow 2 \text{Fe} (\text{s})$	-0.44
$\text{K}^+ (\text{aq}) + \text{e}^- \rightarrow \text{K} (\text{s})$	-2.925

b. Can the mercury(I) ion reduce the iron(II) ion to metallic iron?

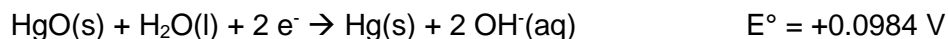
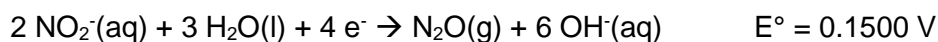
- A. Yes
- B. No

3. Given the standard electrode potentials, which of these is spontaneous?

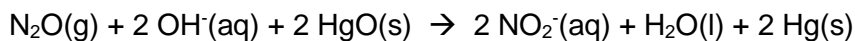


D. None of the above are spontaneous

4. You are given the following reduction half reactions in basic solution:

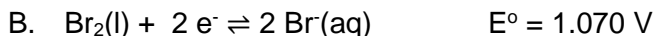
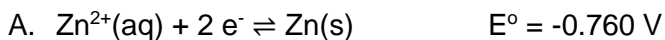
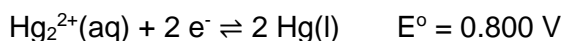


A. If this redox reaction occurs, how many total electrons will have to be transferred per mole of reaction?



B. What is the E°_{CELL} for this redox reaction?

5. A. It is desired to reduce mercury(I) at a mercury electrode in a voltaic electrochemical cell. Which of these reactions would do the trick for the anode reaction when combined with the mercury reduction at the cathode?



B. Calculate E°_{CELL} for each of the reactions above.

C. In this case, we would say the zinc(s) is a good:

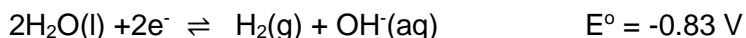
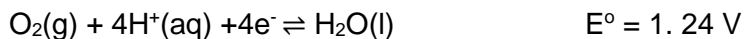
A. Oxidizing agent B. Reducing agent

C. Purging agent D. None of these

6. Which of these processes will occur at the cathode in an electrochemical cell?

- ☐ A. $\text{Cu}^{2+}(\text{aq}) + 2 \text{e}^- \rightleftharpoons \text{Cu}(\text{s})$
 B. $\frac{1}{2} \text{H}_2(\text{g}) \rightleftharpoons \text{H}^+(\text{g}) + \text{e}^-$
 C. Neither of these

7. When pure iron is put into pure water, it produces H_2 gas, and when pure iron is put into an acidic solution it produces H_2 gas. Using the data below, state whether the above statement is true or false.



- ☐ A. True
 B. False

8. Which species would be able to reduce iron(II) ion to elemental iron? (Multiple Answer)

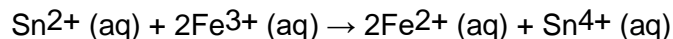
- ☐ A. Nickel metal
 A. Manganese(II) ion (acidic)
 B. Aluminum metal
 C. Silver metal
 D. Zinc metal

Standard Potential (V)	Reduction Half-Reaction
2.87	$\text{F}_2(\text{g}) + 2\text{e}^- \longrightarrow 2\text{F}^-(\text{aq})$
1.51	$\text{MnO}_4^-(\text{aq}) + 8\text{H}^+(\text{aq}) + 5\text{e}^- \longrightarrow \text{Mn}^{2+}(\text{aq}) + 4\text{H}_2\text{O}(\text{l})$
1.36	$\text{Cl}_2(\text{g}) + 2\text{e}^- \longrightarrow 2\text{Cl}^-(\text{aq})$
1.33	$\text{Cr}_2\text{O}_7^{2-}(\text{aq}) + 14\text{H}^+(\text{aq}) + 6\text{e}^- \longrightarrow 2\text{Cr}^{3+}(\text{aq}) + 7\text{H}_2\text{O}(\text{l})$
1.23	$\text{O}_2(\text{g}) + 4\text{H}^+(\text{aq}) + 4\text{e}^- \longrightarrow 2\text{H}_2\text{O}(\text{l})$
1.06	$\text{Br}_2(\text{l}) + 2\text{e}^- \longrightarrow 2\text{Br}^-(\text{aq})$
0.96	$\text{NO}_3^-(\text{aq}) + 4\text{H}^+(\text{aq}) + 3\text{e}^- \longrightarrow \text{NO}(\text{g}) + \text{H}_2\text{O}(\text{l})$
0.80	$\text{Ag}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Ag}(\text{s})$
0.77	$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \longrightarrow \text{Fe}^{2+}(\text{aq})$
0.68	$\text{O}_2(\text{g}) + 2\text{H}^+(\text{aq}) + 2\text{e}^- \longrightarrow \text{H}_2\text{O}_2(\text{aq})$
0.59	$\text{MnO}_4^-(\text{aq}) + 2\text{H}_2\text{O}(\text{l}) + 3\text{e}^- \longrightarrow \text{MnO}_2(\text{s}) + 4\text{OH}^-(\text{aq})$
0.54	$\text{I}_2(\text{s}) + 2\text{e}^- \longrightarrow 2\text{I}^-(\text{aq})$
0.40	$\text{O}_2(\text{g}) + 2\text{H}_2\text{O}(\text{l}) + 4\text{e}^- \longrightarrow 4\text{OH}^-(\text{aq})$
0.34	$\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Cu}(\text{s})$
0	$2\text{H}^+(\text{aq}) + 2\text{e}^- \longrightarrow \text{H}_2(\text{g})$
-0.28	$\text{Ni}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Ni}(\text{s})$
-0.44	$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Fe}(\text{s})$
-0.76	$\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \longrightarrow \text{Zn}(\text{s})$
-0.83	$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \longrightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$
-1.66	$\text{Al}^{3+}(\text{aq}) + 3\text{e}^- \longrightarrow \text{Al}(\text{s})$
-2.71	$\text{Na}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Na}(\text{s})$
-3.05	$\text{Li}^+(\text{aq}) + \text{e}^- \longrightarrow \text{Li}(\text{s})$

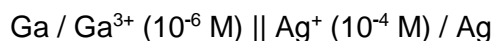
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Half-reaction	E° (V)
$\text{Cr}^{3+}(\text{aq}) + 3\text{e}^- \rightarrow \text{Cr}(\text{s})$	-0.74
$\text{Fe}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s})$	-0.440
$\text{Fe}^{3+}(\text{aq}) + \text{e}^- \rightarrow \text{Fe}^{2+}(\text{s})$	+0.771
$\text{Sn}^{4+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Sn}^{2+}(\text{aq})$	+0.154

The standard cell potential (E°_{cell}) for the voltaic cell based on the reaction below is _____ V.



10. Calculate the cell potential (in volts) for the voltaic cell indicated at 25 °C. (Use the table in your textbook for the reduction half reaction potentials.)



11. From the information given, which of the following statements is true?

Substance	Reduction Potential (V)
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$\text{F}_2 \rightarrow 2 \text{F}^-$	2.85
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$\text{Cl}_2 \rightarrow 2 \text{Cl}^-$	1.36
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$\text{Br}_2 \rightarrow 2 \text{Br}^-$	1.09
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$\text{I}_2 \rightarrow 2 \text{I}^-$	0.54
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- A. F_2 is the best oxidizing agent, F^- is the best reducing agent
- B. I_2 is the best oxidizing agent, F^- is the best reducing agent
- C. I_2 is the best oxidizing agent, I^- is the best reducing agent
- D. F_2 is the best oxidizing agent, I^- is the best reducing agent
- E. F_2 is the best oxidizing agent, I_2 is the best reducing agent

12. The two electrodes $\text{Cr(s)}/\text{Cr}^{3+}(\text{aq})$ and $\text{Sn(s)}/\text{Sn}^{2+}(\text{aq})$ are combined to afford a product– favored electrochemical equation. The standard reduction potentials in V for $\text{Cr}^{3+}(\text{aq})$ and $\text{Sn}^{2+}(\text{aq})$ are -0.74V and -0.14V , respectively. E° in V is:

- A. $+0.88\text{V}$
- B. -0.88V
- C. $+0.60\text{V}$
- D. -0.60V
- E. $+2.50\text{V}$