

HW03 - Electrochemistry

1 4 points

Which best describes the process of oxidation ?

- oxidation is the numeric decrease in oxidation number
- oxidation is the gain of hydrogen atoms
- oxidation is the gain of electrons
- oxidation is the loss of electrons

2 4 points

Match the term with the best pair:

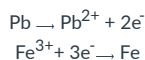
reduction	_____
oxidization	_____
oxidizing agent	_____
reducing agent	_____

Possible answers

<input type="checkbox"/> the species that gets oxidized	<input type="checkbox"/> the process of gaining electrons
<input type="checkbox"/> the process of losing electrons	<input type="checkbox"/> the species that gets reduced

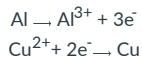
3 4 points

What is the coefficient of lead (Pb) in the redox reaction after the following half-reactions are balanced?



4 4 points

What is the sum of coefficients in the redox reaction after the following half-reactions are balanced?



5 4 points

In the reaction of thiosulfate ion with chlorine gas in an acidic solution, what is the reducing agent?



- Cl₂
- S₂²⁺
- S₂O₃²⁻
- Cl

6 4 points

Silicon tetrachloride will readily decompose in the presence of hydrogen into elemental silicon by the following reaction:



During this process, the Si is _____ and the change in oxidation number is equal to _____.

- reduced ; -2
- oxidized ; +4
- reduced ; +4
- reduced ; -4
- oxidized ; +2
- oxidized ; -2

7 4 points

Balance the following redox reaction in acidic conditions:

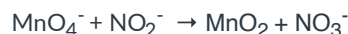


Choices below are the sum of reactant coefficients→ sum of product coefficients followed by the total number of electrons transferred. Note that the sums do include any H₂O and/or H⁺ you added. Pick the right choice.

- 12 → 17 , 12e⁻
- 9 → 11 , 4e⁻
- 9 → 11 , 12e⁻
- 12 → 17 , 4e⁻
- 8 → 10 , 6e⁻
- 3 → 4 , 4e⁻
- 9 → 7 , 12e⁻

8 4 points

What is the coefficient on H⁺ when you balance the following redox reaction in acid? Is H⁺ a product or reactant?



- 6, reactant
- 6, product
- 2, reactant
- 3, reactant
- 4, product
- 4, reactant
- 2, product
- 3, product
- 0, neither

9 4 points

Based on the push and pull of electrons in a redox reaction, it can be inferred that the species being oxidized is also the...

- strong acid
- oxidizing agent
- oxidizer
- reducing agent

10 4 points

What is the change in oxidation number of sulfur when SO₃ reacts to form SO⁻ in a redox reaction? (note that answer can be + or - so include the sign, no sign means positive)

11 4 points

When Na₂Cr₂O₇ reacts to form Cr(OH)₃, the Cr atom gets _____ and the change in oxidation number is equal to _____.

- reduced, +3
- oxidized, -6
- reduced, -3
- oxidized, +3
- reduced, -6

12 4 points

A methanol fuel source (CH_3OH) is burned to form CO_2 . What is the change in oxidation number for carbon? Is this an oxidation or reduction reaction?

- +1, oxidation
- 3, reduction
- +6, reduction
- +2, oxidation
- 1, oxidation
- +1, reduction
- +6, oxidation
- 1, reduction
- +5, oxidation
- 0, this is not a redox half-reaction

13 4 points

What is the oxidation number of chlorine in ClO_4^- ?

14 4 points

What is the oxidation number of sulfur in SO_4^{2-} ?

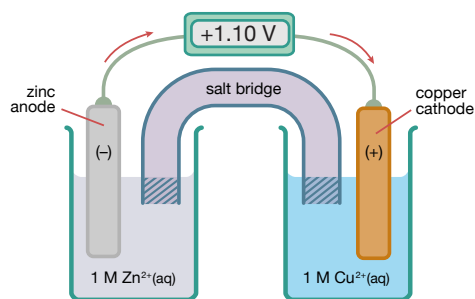
15 4 points

What is the oxidation number of an individual sulfur in thiosulfate, $\text{S}_2\text{O}_3^{2-}$?

16 4 points

What is the oxidation number of phosphorus in hydrogen phosphate, HPO_4^{2-} ?

17 4 points

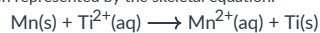


In this electrochemical cell, what is the reduction half reaction?

- $\text{Cu(s)} \rightarrow \text{Cu}^{2+}(\text{aq}) + 2\text{e}^-$
- $\text{Zn}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Zn(s)}$
- $\text{Cu}^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Cu(s)}$
- $\text{Zn(s)} \rightarrow \text{Zn}^{2+}(\text{aq}) + 2\text{e}^-$

18 4 points

Consider the cell reaction represented by the skeletal equation:

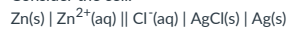


What is the proper cell diagram for this reaction?

- $\text{Ti(s)} | \text{Ti}^{2+}(\text{aq}) || \text{Mn}^{2+}(\text{aq}) | \text{Mn(s)}$
- $\text{Mn(s)} | \text{Mn}^{2+}(\text{aq}) || \text{Ti}^{2+}(\text{aq}) | \text{Ti(s)}$
- $\text{Ti}^{2+}(\text{aq}) | \text{Ti(s)} || \text{Mn(s)} | \text{Mn}^{2+}(\text{aq})$
- $\text{Mn}^{2+}(\text{aq}) | \text{Mn(s)} || \text{Ti(s)} | \text{Ti}^{2+}(\text{aq})$

19 4 points

Consider the cell:



Calculate E° .

- +0.54 V
- +1.20 V
- 1.20 V
- +0.98 V

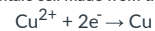
20 4 points

In a working electrochemical cell (a voltaic or a battery), the cations in the salt bridge move toward the cathode.

- It is impossible to tell unless we know if the cathode is "+" or "-".
- False
- True
- It depends on the charge of the cation.

21 4 points

What is the voltage of a standard voltaic cell made from the following half-reactions?



- 2.70 V
- 2.70 V
- 2.02 V
- 2.02 V

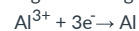
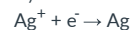
22 4 points

For the cell in the previous question, identify the solid anode and cathode.

- Cu: anode
Mg: cathode
- Cu: cathode
Mg: anode

23 4 points

What is the voltage of a standard electrolytic cell made from the following half-reactions?



- 2.46 V
- 0.86 V
- 0.86 V
- 1.66 V
- 2.46 V

24 4 points

Use the following table for the next three questions:

$F_2 + 2e^-$	$\rightleftharpoons 2F^-$	+2.87 V
$Pb^{4+} + 2e^-$	$\rightleftharpoons Pb^{2+}$	+1.67 V
$Cl_2 + 2e^-$	$\rightleftharpoons 2Cl^-$	+1.36 V
$Ag^+ + e^-$	$\rightleftharpoons Ag$	+0.80 V
$Fe^{3+} + e^-$	$\rightleftharpoons Fe^{2+}$	+0.77 V
$Cu^{2+} + 2e^-$	$\rightleftharpoons Cu$	+0.34 V
$2H^+ + 2e^-$	$\rightleftharpoons H_2$	0.000 V
$Fe^{3+} + 3e^-$	$\rightleftharpoons Fe$	-0.04 V
$Pb^{2+} + 2e^-$	$\rightleftharpoons Pb$	-0.13 V
$Fe^{2+} + 2e^-$	$\rightleftharpoons Fe$	-0.44 V
$Zn^{2+} + 2e^-$	$\rightleftharpoons Zn$	-0.76 V
$Al^{3+} + 3e^-$	$\rightleftharpoons Al$	-1.66 V
$Mg^{2+} + 2e^-$	$\rightleftharpoons Mg$	-2.36 V
$Li^+ + e^-$	$\rightleftharpoons Li$	-3.05 V

(Part 1 of 3) Which out of the following is the strongest reducing agent?

- Li^+
 Zn
 Li
 Mg
 Ag^+
 Ag

25 4 points

(Part 2 of 3) What is the standard cell potential for the strongest battery possible using the table? Note: for this question, only compare standard cell potential to assess the strength of the battery.

- 5.92 V
 3.05 V
 2.87 V
 0.00 V

26 4 points

(Part 3 of 3) If you wanted to spontaneously reduce Al^{3+} to form Al, you should pair it with...

- the reduction of Mg
 the oxidation of Pb
 the oxidation of Mg
 the S.H.E reaction

27 4 points

In a voltaic cell...

- oxidation and reduction take place at the same time, but at different electrodes
 oxidation takes place at the cathode
 electrolytes are added to carry electrons between electrodes
 electrical energy is used to reverse spontaneous chemical reactions

28 4 points

A discharging battery is a voltaic cell, meaning it is...

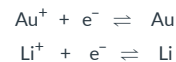
- spontaneous with a positive cell potential
 non-spontaneous with a negative cell potential
 spontaneous with a negative cell potential
 non-spontaneous with a positive cell potential

29 4 points

Suppose you set up an electrochemical cell. In one beaker, you have a 1 M copper(II) ion solution with a copper metal electrode. You use an external wire to connect the copper electrode to an aluminum electrode in another beaker with a 1 M aluminum ion solution. Then you add a salt bridge with sodium sulfate ions. All things are in place to have a functional cell. Which of the following statements is FALSE?

- Nothing will happen until you add an external power source.
 You can run this as a voltaic cell and get out a maximum of 2.00 V
 Without a power source, electrons will travel from the aluminum beaker to the copper beaker
 You can run this as an electrolytic cell only if you input a minimum of 2.00 V

30 4 points

The two half-reactions below must be arranged (a red and an ox) such that overall, Au^+ is reduced.

After correctly arranging this cell, what reaction is occurring at the anode?

- $Li^+ + e^- \rightleftharpoons Li$
 $Li \rightleftharpoons Li^+ + e^-$
 $Au \rightleftharpoons Au^+ + e^-$
 $Au^+ + e^- \rightleftharpoons Au$