HW03 - Electrochemistry

1 4 points

Match the term with the best pair:

- reduction
- oxidizing agent
- oxidization
- reducing agent

2 4 points

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

$$Pb \longrightarrow Pb^{2+} + 2e^-$$
$$Fe^{3+} + 3e^- \longrightarrow Fe$$

Type your answer...

3 4 points

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

$$Al \longrightarrow Al^{3+} + 3e^-$$
$$Cu^{2+} + 2e^- \longrightarrow Cu$$

Type your answer...

4 4 points

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

$$Cl_2(g) + S_2O_3^{2-}(aq) \longrightarrow Cl^-(aq) + SO_4^{2-}(aq)$$

- ○ Cl
- ○ $S_2O_3^{2-}$
- ○ Cl_2
- ○ S^{2+}

5 4 points

Balance the following redox reaction in acidic conditions:

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

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 H_2O and/or H^+ you added. Pick the right choice.

- ○ $9 \longrightarrow 7\ ,\ 12e^-$
- ○ $8 \longrightarrow 10\ ,\ 6e^-$
- ○ $9 \longrightarrow 11\ ,\ 12e^-$
- ○ $3 \longrightarrow 4\ ,\ 4e^-$
- ○ $12 \longrightarrow 17\ ,\ 4e^-$
- ○ $9 \longrightarrow 11\ ,\ 4e^-$
- ○ $12 \longrightarrow 17\ ,\ 12e^-$

6 4 points

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

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

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

7 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...

- ○ oxidizer
- ○ reducing agent
- ○ strong acid
- ○ oxidizing agent

8 4 points

What is the change in oxidation number of sulfur when SO_3 reacts to form SO^- in a redox reaction?

Type your answer...

9 4 points

When $Na_2Cr_2O_7$ reacts to form $Cr(OH)_3$, the Cr atom gets ________ and the change in oxidation number is equal to ____.

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

10 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?

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

11 4 points

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

Type your answer...

12 2 points

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

Type your answer...

13 2 points

What is the oxidation number of an individual sulfur in thiosulfate, $S_2O_3^{2-}$?

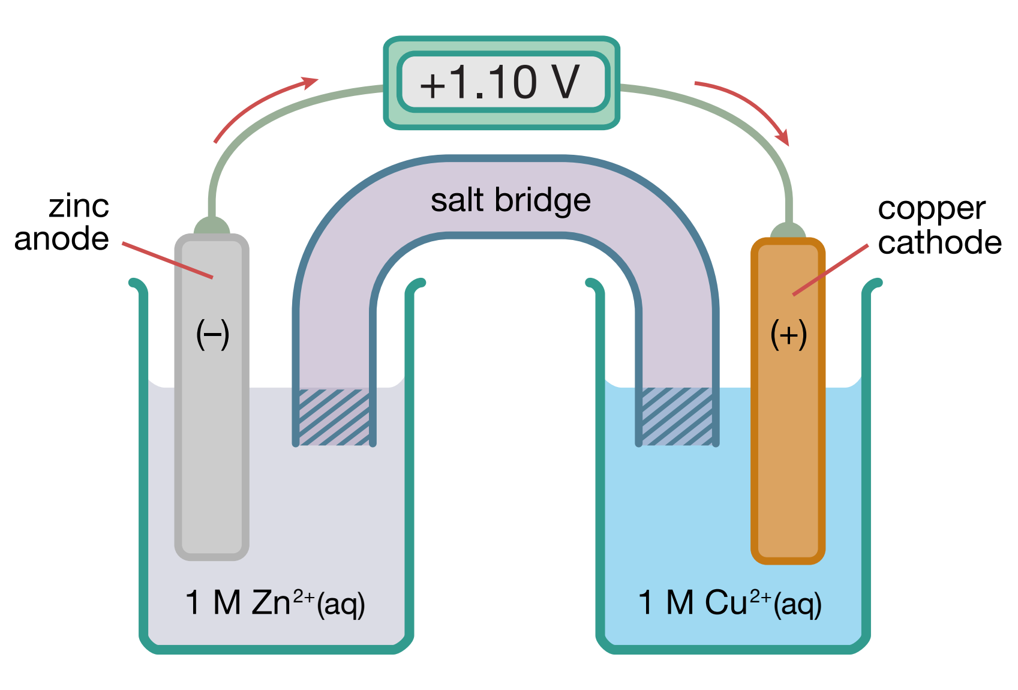
Type your answer...

14 2 points

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

Type your answer...

15 2 points



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

- ○ $Zn^{2+}(aq) + 2e^- \longrightarrow Zn(s)$
- ○ $Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$
- ○ $Zn(s) \longrightarrow Zn^{2+}(aq) + 2e^-$
- ○ $Cu(s) \longrightarrow Cu^{2+}(aq) + 2e^-$

16 2 points

Consider the cell reaction represented by the skeletal equation:

$$Mn(s) + Ti^{2+}(aq) \longrightarrow Mn^{2+}(aq) + Ti(s)$$

What is the proper cell diagram for this reaction?

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

17 4 points

Consider the cell:
$Zn(s)\ |\ Zn^{2+}(aq)\ ||\ Cl^-(aq)\ |\ AgCl(s)\ |\ Ag(s)$
Calculate E°.

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

18 4 points

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

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

19 4 points

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

$$Cu^{2+} + 2e^- \rightarrow Cu$$
$$Mg^{2+} + 2e^- \rightarrow Mg$$

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

20 2 points

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

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

21 4 points

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

$$Ag^+ + e^- \rightarrow Ag$$
$$Al^{3+} + 3e^- \rightarrow Al$$

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

22 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

Which out of the following is the strongest reducing agent?

- ○ Ag
- ○ Li
- ○ Mg
- ○ Li^+
- ○ Zn
- ○ Ag^+

23 4 points

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.

- ○ 3.05 V
- ○ 2.87 V
- ○ 0.00 V
- ○ 5.92 V

24 4 points

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

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

25 4 points

In a voltaic cell...

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

26 4 points

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

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

27 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?

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

28 4 points

The two half-reactions are arranged with the intention to reduce Au^+:

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

What reaction is occurring at the anode?

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