

# HW03 - Electrochemistry

1 4 points

Which best describes the process of oxidation ?

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

2 4 points

Match the term with the best pair:

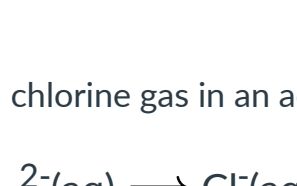
oxidization	_____	_____
reducing agent	_____	_____
reduction	_____	_____
oxidizing agent	_____	_____

Possible answers

- the process of losing electrons
- the species that gets reduced
- the species that gets oxidized
- the process of gaining electrons

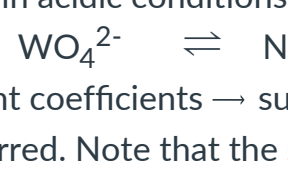
3 4 points

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?



- Cl
- Cl<sub>2</sub>
- S<sup>2+</sup>
- S<sub>2</sub>O<sub>3</sub><sup>2-</sup>

6 4 points

Balance the following redox reaction in acidic conditions:

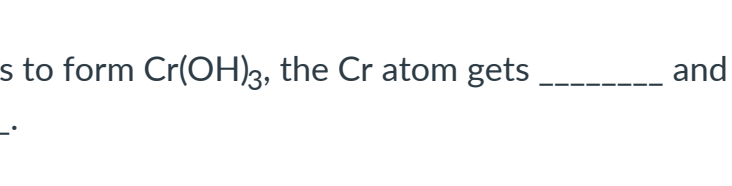


Choices below are the sum of reactant coefficients → sum of product coefficients followed by the total number of electrons transferred. Note that the sums do include any H<sub>2</sub>O and/or H<sup>+</sup> you added. Pick the right choice.

- 12 → 17 , 12e<sup>-</sup>
- 9 → 11 , 4e<sup>-</sup>
- 3 → 4 , 4e<sup>-</sup>
- 9 → 7 , 12e<sup>-</sup>
- 9 → 11 , 12e<sup>-</sup>
- 12 → 17 , 4e<sup>-</sup>
- 8 → 10 , 6e<sup>-</sup>

7 4 points

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



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

8 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...

- reducing agent
- oxidizing agent
- strong acid
- oxidizer

9 4 points

What is the change in oxidation number of sulfur when SO<sub>3</sub> reacts to form SO<sup>-</sup> in a redox reaction?

10 4 points

When Na<sub>2</sub>Cr<sub>2</sub>O<sub>7</sub> reacts to form Cr(OH)<sub>3</sub>, the Cr atom gets \_\_\_\_\_ and the change in oxidation number is equal to \_\_\_\_.

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

11 4 points

A methanol fuel source (CH<sub>3</sub>OH) is burned to form CO<sub>2</sub>. What is the change in oxidation number for carbon? Is this an oxidation or reduction reaction?

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

12 4 points

What is the oxidation number of chlorine in ClO<sub>4</sub><sup>-</sup>?

13 4 points

What is the oxidation number of sulfur in SO<sub>4</sub><sup>2-</sup>?

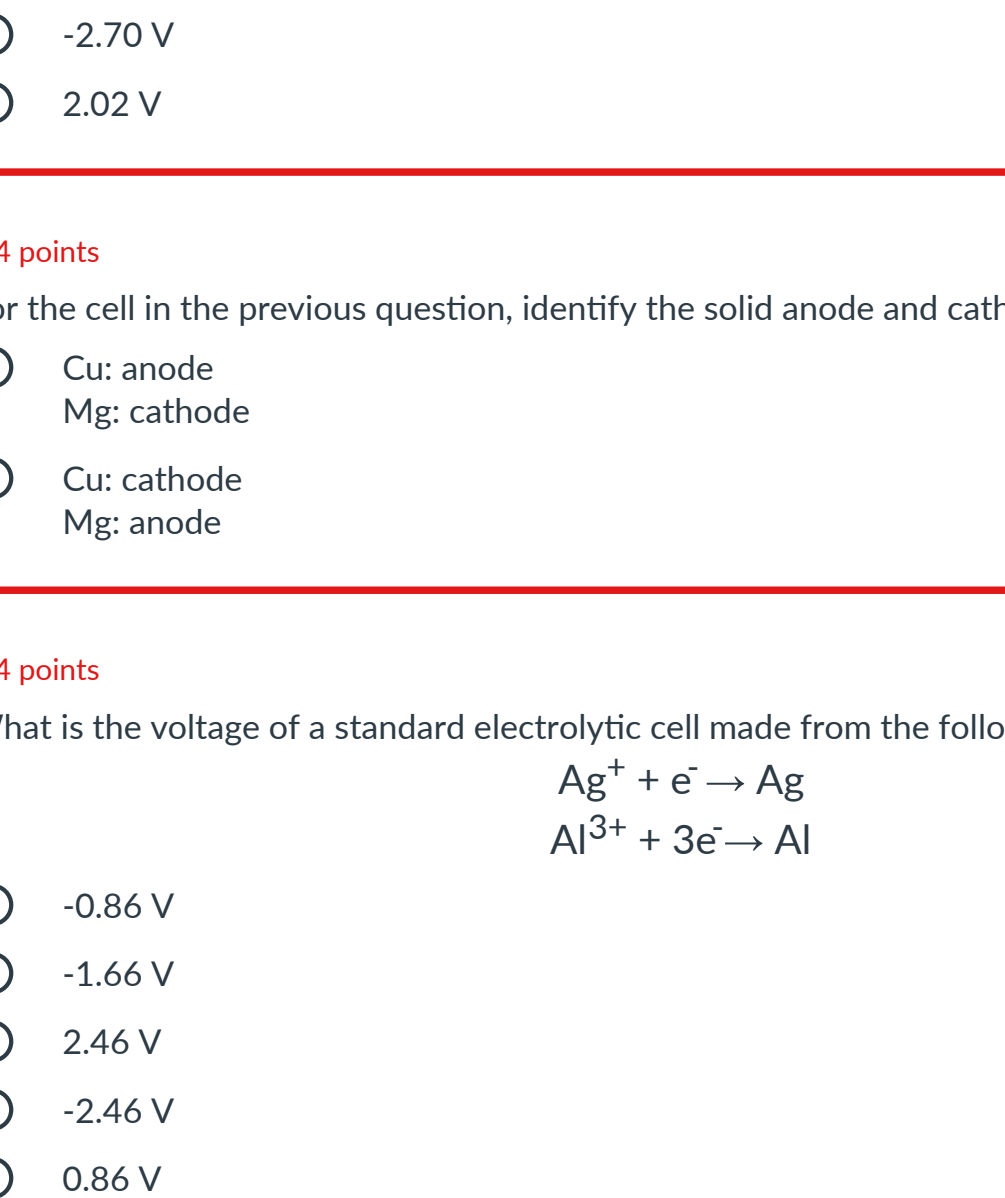
14 4 points

What is the oxidation number of an individual sulfur in thiosulfate, S<sub>2</sub>O<sub>3</sub><sup>2-</sup>?

15 4 points

What is the oxidation number of phosphorus in hydrogen phosphate, HPO<sub>4</sub><sup>2-</sup>?

16 4 points



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

- Zn(s) → Zn<sup>2+</sup>(aq) + 2e<sup>-</sup>
- Cu<sup>2+</sup>(aq) + 2e<sup>-</sup> → Cu(s)
- Cu(s) → Cu<sup>2+</sup>(aq) + 2e<sup>-</sup>
- Zn<sup>2+</sup>(aq) + 2e<sup>-</sup> → Zn(s)

17 4 points

Consider the cell reaction represented by the skeletal equation:



What is the proper cell diagram for this reaction?

- Ti<sup>2+</sup>(aq) | Ti(s) || Mn(s) | Mn<sup>2+</sup>(aq)
- Ti(s) | Ti<sup>2+</sup>(aq) || Mn<sup>2+</sup>(aq) | Mn(s)
- Mn<sup>2+</sup>(aq) | Mn(s) || Ti(s) | Ti<sup>2+</sup>(aq)
- Mn(s) | Mn<sup>2+</sup>(aq) || Ti<sup>2+</sup>(aq) | Ti(s)

18 4 points

Consider the cell:



Calculate E°.

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

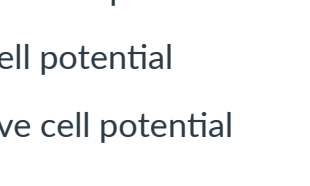
19 4 points

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

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

20 4 points

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



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

21 4 points

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

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

22 4 points

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



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

23 4 points

Use the following table for the next three questions:



Which out of the following is the strongest reducing agent?

- Ag<sup>+</sup>
- Li
- Mg
- Li<sup>+</sup>
- Ag
- Zn

24 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.

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

25 4 points

If you wanted to spontaneously reduce Al<sup>3+</sup> to form Al, you should pair it with...

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

26 4 points

In a voltaic cell...

- 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
- oxidation takes place at the cathode

27 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

28 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
- 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
- You can run this as a voltaic cell and get out a maximum of 2.00 V

29 4 points

The two half-reactions are arranged with the intention to reduce Au<sup>+</sup> :



What reaction is occurring at the anode?

- Li ⇌ Li<sup>+</sup> + e<sup>-</sup>
- Au ⇌ Au<sup>+</sup> + e<sup>-</sup>
- Li<sup>+</sup> + e<sup>-</sup> ⇌ Li
- Au<sup>+</sup> + e<sup>-</sup> ⇌ Au