

# HW03 - Electrochemistry

## Question 1

4 pts

Match the term with the best pair:

reducing agent

oxidizing agent

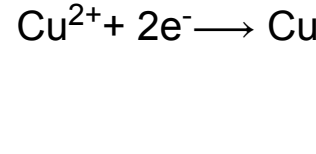
reduction

oxidization

## Question 2

4 pts

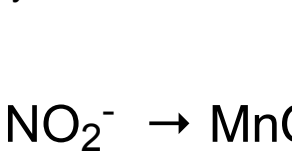
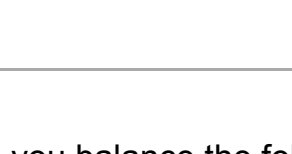
What is the coefficient of lead (Pb) in the redox reaction after the following half-reactions are balanced?




## Question 3

4 pts

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




## Question 4

4 pts

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

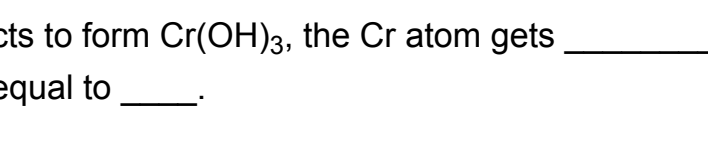

 Cl

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

## Question 5

4 pts

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

 0, neither

 4, reactant

 3, product

 6, reactant

 3, reactant

 2, product

 4, product

 2, reactant

## Question 6

4 pts

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

## Question 7

4 pts

What is the change in oxidation number of sulfur when SO<sub>3</sub> reacts to form SO<sup>2-</sup> in a redox reaction?

## Question 8

4 pts

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 \_\_\_\_\_.

 oxidized, +3

 oxidized, -6

 reduced, -6

 reduced, +3

 reduced, -3

## Question 9

4 pts

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

## Question 10

4 pts

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

## Question 11

4 pts

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

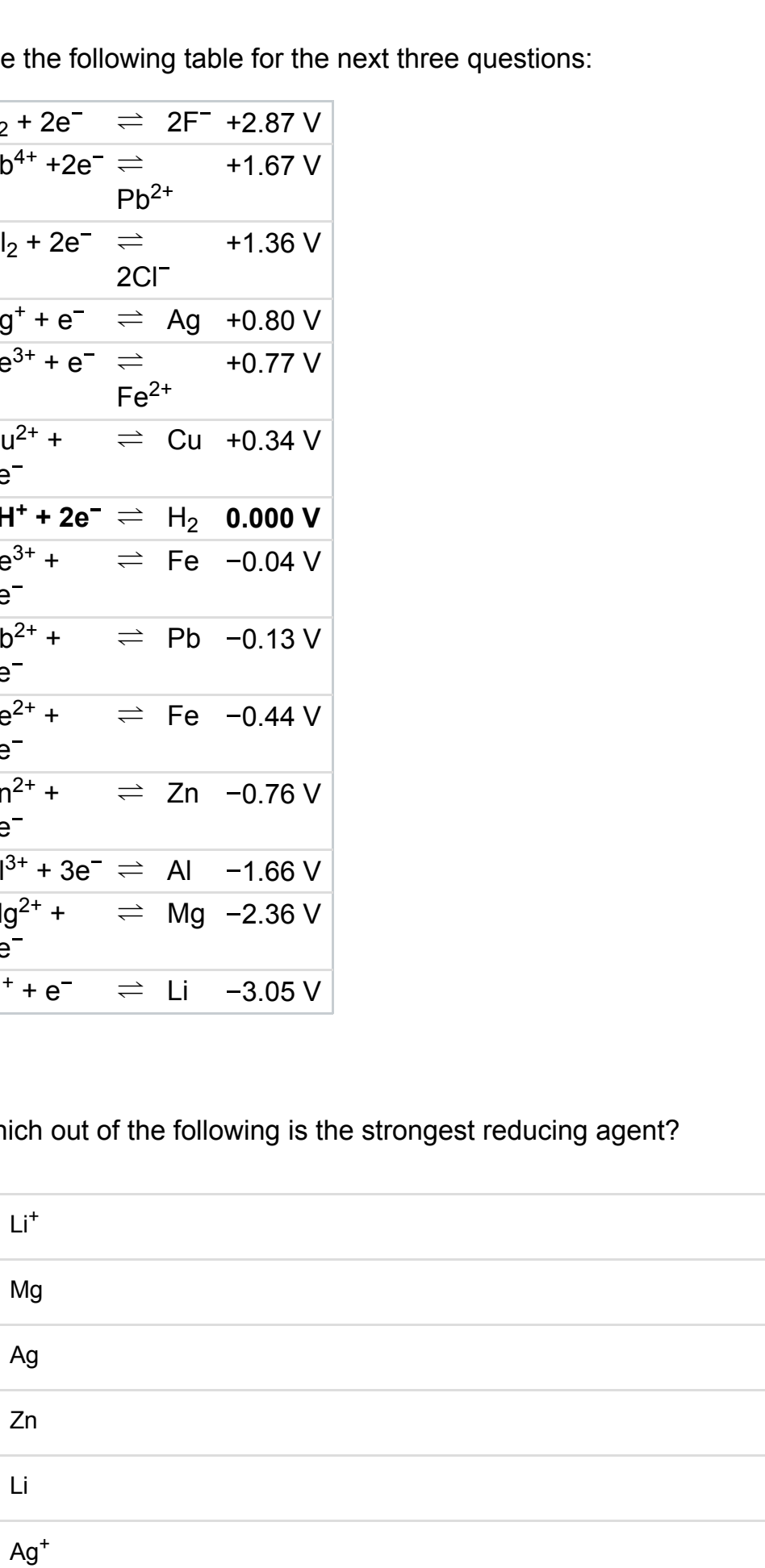
## Question 12

4 pts

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

## Question 13

4 pts



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

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

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

## Question 14

4 pts

Consider the cell reaction represented by the skeletal equation:



What is the proper cell diagram for this reaction?

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

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

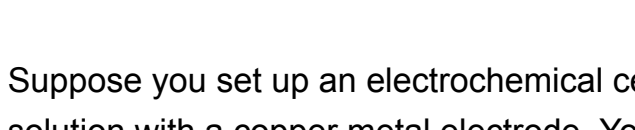
 Mn<sup>2+</sup>(aq) | Mn(s) || Ti(s) | Ti<sup>2+</sup>(aq)

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

## Question 15

4 pts

Consider the cell:



Calculate E<sup>o</sup>.

 +1.20 V

 -1.20 V

 +0.54 V

 +0.98 V

## Question 16

4 pts

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

 It depends on the charge of the cation.

 False

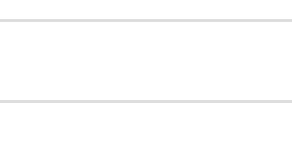
 It is impossible to tell unless we know if the cathode is "+" or "-".

 True

## Question 17

4 pts

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


 -2.02 V

 2.02 V

 2.70 V

 -2.70 V

## Question 18

4 pts

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

 Cu: anode

Mg: cathode

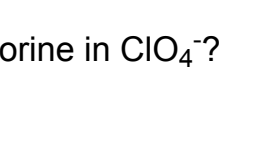
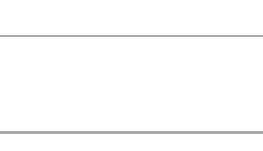
 Cu: cathode

Mg: anode

## Question 19

4 pts

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


 2.46 V

 -2.46 V

 -0.86 V

 0.86 V

 -1.66 V

## Question 20

4 pts

Use the following table for the next three questions:

$\text{F}_2 + 2\text{e}^-$	$\rightleftharpoons$	$2\text{F}^-$	+2.87 V
$\text{Pb}^{4+} + 2\text{e}^-$	$\rightleftharpoons$	$\text{Pb}^{2+}$	+1.67 V
$\text{Cl}_2 + 2\text{e}^-$	$\rightleftharpoons$	$2\text{Cl}^-$	+1.36 V
$\text{Ag}^+ + \text{e}^-$	$\rightleftharpoons$	$\text{Ag}$	+0.80 V
$\text{Fe}^{3+} + \text{e}^-$	$\rightleftharpoons$	$\text{Fe}^{2+}$	+0.77 V
$\text{Cu}^{2+} + \text{e}^-$	$\rightleftharpoons$	$\text{Cu}$	+0.34 V
$2\text{H}^+ + 2\text{e}^-$	$\rightleftharpoons$	$\text{H}_2$	0.000 V
$\text{Fe}^{3+} + \text{e}^-$	$\rightleftharpoons$	$\text{Fe}$	-0.04 V
$3\text{e}^-$	$\rightleftharpoons$	$\text{Pb}$	-0.13 V
$\text{Fe}^{2+} + \text{e}^-$	$\rightleftharpoons$	$\text{Fe}$	-0.44 V
$2\text{e}^-$	$\rightleftharpoons$	$\text{Zn}$	-0.76 V
$\text{Al}^{3+} + 3\text{e}^-$	$\rightleftharpoons$	$\text{Al}$	-1.66 V
$\text{Mg}^{2+} + 2\text{e}^-$	$\rightleftharpoons$	$\text{Mg}$	-2.36 V
$\text{Li}^+ + \text{e}^-$	$\rightleftharpoons$	$\text{Li}$	-3.05 V

Which out of the following is the strongest reducing agent?

 Li<sup>+</sup>
 Mg

 Ag

 Zn

 Li

 Ag<sup>+</sup>

## Question 21

4 pts

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.

 0.00 V

 5.92 V

 2.87 V

 3.05 V

## Question 22

4 pts

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

 the oxidation of Mg

 the S.H.E reaction

 the oxidation of Pb

 the reduction of Mg

## Question 23

4 pts

In a voltaic cell...

 oxidation takes place at the cathode

 electrolytes are added to carry electrons between electrodes

 electrical energy is used to reverse spontaneous chemical reactions

 oxidation and reduction take place at the same time, but at different electrodes

## Question 24

4 pts

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

 non-spontaneous with a negative cell potential

 spontaneous with a negative cell potential

 spontaneous with a positive cell potential

 non-spontaneous with a positive cell potential

## Question 25

4 pts

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 an electrolytic cell only if you input a minimum of 2.00 V

 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