NAME Key

S2019/CHEM1401/Electrochem Quiz

50 Points Total

Multiple Choice: (3 Points Each)

D 1. What element is being reduced in the following redox reaction? gained e^-

$Cr(OH)_4^-(aq) + ClO^-(aq) \rightarrow CrO_4^{2-}(aq) + Cl^-(aq)$

+3 -2 +1   +1 -2   +6 -2   -1

lost $3e^-$ OIL   gained $2e^-$ RIG

A) Cr
B) O
C) H
D) Cl

A 2. Identify the reducing agent in the reaction in problem 1.

Caused oxidation

A) $Cr(OH)_4^-$
B) ClO^-
C) CrO_4^{2-}
D) Cl^-

A 3. Where does oxidation happen in an electrochemical cell.

A) the anode ox
B) the cathode red
C) the electrode
D) the salt bridge
E) the socket

C 4. Determine the cell notation for the redox reaction given below.

ox

$Sn(s) + 2\ Ag^+(aq) \rightarrow Sn^{2+}(aq) + 2\ Ag(s)$

+1   0

A) $Ag^+(aq)\ |\ Ag(s)\ ||\ Sn(s)\ |\ Sn^{2+}(aq)$
B) $Ag(s)\ |\ Ag^+(aq)\ ||\ Sn^{2+}(aq)\ |\ Sn(s)$
C) $Sn(s)\ |\ Sn^{2+}(aq)\ ||\ Ag^+(aq)\ |\ Ag(s)$
D) $Sn^{2+}(aq)\ |\ Sn(s)\ ||\ Ag(s)\ |\ Ag^+(aq)$
E) $Sn(s)\ |\ Ag(s)\ ||\ Sn^{2+}(aq)\ |\ Ag^+(aq)$

ox: $Sn(s) \rightarrow Sn^{2+}$

red: $2Ag^+ \rightarrow Ag(s)$

$Sn(s)\ |\ Sn^{2+}\ ||\ Ag^+(aq)\ |\ Ag(s)$

Anode   Cathode

Counted B correct, too!

D 5. Which of the following is the weakest oxidizing agent?

gains e-

A) $Sn^{2+}(aq)$
B) $Cr^{3+}(aq)$
C) $Sn^{4+}(aq)$
D) Cr(s)
E) Sn(s)

use chart. Lowest on left

Need Red Reaction : $Cr(s) + e^{-} \rightarrow Cr^{-}$ (not the reverse of $Cr \rightarrow Cr^{3+} + 3e^{-}$)

B 6. Determine which of the following pairs of reactants will result in a spontaneous reaction at 25°C.

So bad... it isn't even on chart!

A) $I^{-}(aq) + Zn^{2+}(aq)$ ×
B) $Ca(s) + Mg^{2+}(aq)$
C) $H_2(g) + Cd^{2+}(aq)$
D) $Ag(s) + Sn^{2+}(aq)$
E) All of the above pairs will react.

But, this is unintentionally tricky, so I counted B+D

D 7. Which of the following metals will not dissolve in either nitric acid or hydrochloric acid?
A) Zn (s)
B) Cu(s)
C) Ni (s)
D) Au(s)
E) all of the above

C 8. Which of the following reactions would have the smallest value of K at 298 K?

most neg E

A) A + B → C; $E°_{cell}$ = +1.22 V
B) A + 2 B → C; $E°_{cell}$ = +0.98 V
C) A + B → 2 C; $E°_{cell}$ = -0.030 V
D) A + B → 3 C; $E°_{cell}$ = +0.15 V
E) More information is needed to determine.

1. Refer to the balanced equation below to answer the following questions.

$$Mg(s) + Cu^{2+}(aq) \rightarrow Cu(s) + Mg^{2+}(aq)$$

$Mg^{2+}(aq) + 2\,e^- \rightarrow Mg(s)$ $E° = -2.38$ V

$Cu^{2+}(aq) + 2\,e^- \rightarrow Cu(s)$ $E° = +0.34$ V

a) (3 Points)Use the standard half-cell potentials listed ~~below~~ to calculate the standard cell potential for the following reaction occurring in an electrochemical cell at 25°C.

$$E^\circ_{cell} = 0.34V + 2.38V = 2.72V$$

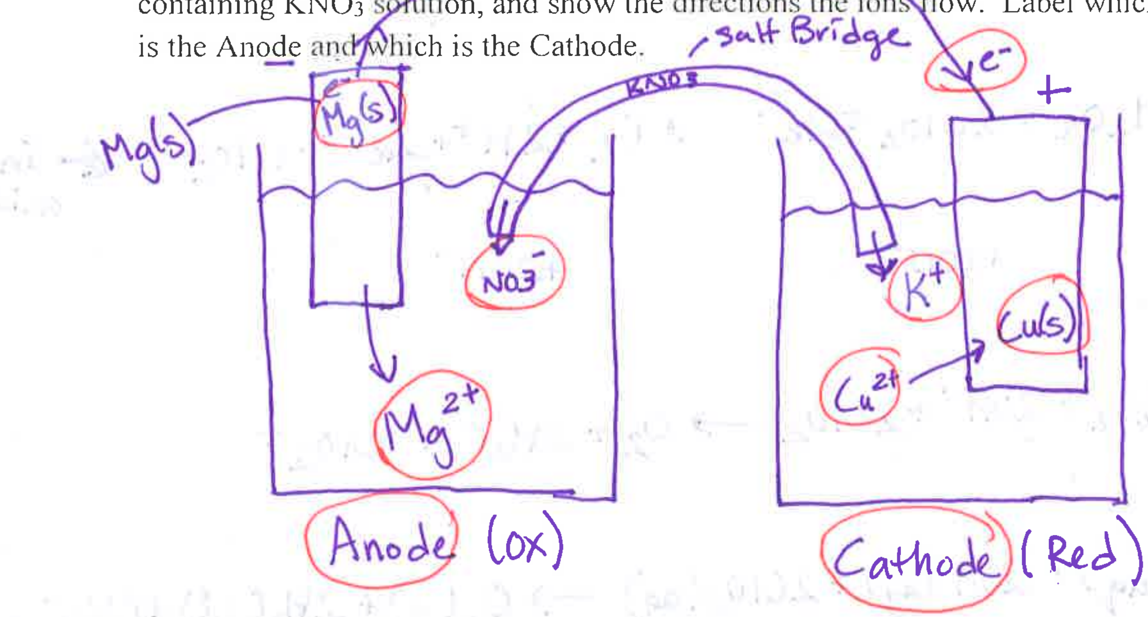
b) (4 Points) What is $\Delta G°$ for the reaction above?

$$\Delta G = -\underset{2}{n}\,\underset{96{,}485\ C/mole^-}{F}\,E^\circ_{cell}$$

$$\Delta G = -525\,kJ \quad or \quad -5.25 \times 10^5\,J$$

c) (2 Points) Based on your answer, is the reaction spontaneous? yes!

d) (6 Points) Draw the galvanic cell below. Indicate the direction of e- flow, the positions of each Reactant and Product ($Mg(s)$, Mg^{2+}, $Cu(s)$ and Cu^{2+}). Use a salt bridge containing KNO_3 solution, and show the directions the ions flow. Label which half-cell is the Anode and which is the Cathode.



e) (5 Points) Now, assume that the concentrations in the cells are $[Cu^{2+}] = .0600M$ and $[Mg^{2+}] = 1.25M$. What is the value of cell potential (E) in this instance?

$$Q = \frac{[Mg^{2+}]}{[Cu^{2+}]} = \frac{1.25}{.0600} = 20.833$$

$$E = 2.72 - \frac{0.0592}{2} \log(20.833)$$

$$\boxed{= 2.68V}$$

2. (6 Points) Balance the following redox reaction if it occurs in BASIC solution.

$$H_2O_2(aq) + ClO_2(aq) \rightarrow ClO_2^-(aq) + O_2(g)$$

$+1\ -1 \quad +4\ -2 \quad +3\ -2 \quad 0$

RIG

OIL

$$H_2O_2 \rightarrow O_2 + 2H^+ + 2e^- \qquad 2\times[ClO_2 + e^- \rightarrow ClO_2^-]$$

$$H_2O_2 + 2ClO_2 + \cancel{2e^-} \rightarrow O_2 + 2H^+ + \cancel{2e^-} + ClO_2^-$$ ← In acid

$+2OH^- \qquad +2OH^-$

either! → $H_2O_2 + 2OH^- + 2ClO_2 \rightarrow O_2 + 2H_2O + ClO_2^-$

→ $H_2O_2(aq) + 2OH^-(aq) + 2ClO_2(aq) \rightarrow O_2(g) + 2H_2O(l) + ClO_2^-(aq)$