FH_Chem1C_Sum09_LabQuiz2 Name KEY

Read the questions carefully to understand what is being asked before answering. Use the reverse side of your answer paper as scratch. You can use periodic table and important constants charts. (Tot pts = 64 + 36 = 100)

SHORT ANSWER. When appropriate show the set up and the units before showing the calculation.

1) In a voltaic cell lab experiment the E_{red} of a Zn electrode was found to be -1.018 V relative to Cu, which acted as a refenece cell. In this configuration, write which metal electrode acted as (A) the cathode and which one acted as (B) the anode? (4 pts) 1) _____

(A) Cu acted as cathode.

(B) Zn acted as anode.

Relative to Cu electrode, Zn has a negative −1.018V potential. So Cu has more ⊕ive reduction potential. So Cu will be preferentially reduced, which would make a cathode. And Zn will be the anode.

2) In a voltaic cell lab experiment the E_{red} of an Al electrode was found to be -0.515 V relative to Cu, which acted as a refenece cell. Explain what would be the E_{cell}. (4 pts.) 2) +0.515 V

$E_{cell} = E_{red}(\text{cathode}) - E_{red}(\text{anode})$

$= 0 - (-0.515\,V)$

$= +0.515\,V$

Al is being oxidized in the voltaic cell so $E_{cell} = +0.515\,V$

3) In a voltaic cell lab experiment the E_{red} of a Mg electrode was found to be - 1.32 V relative to Cu, which acted as a refenece cell. If E_{red} of Cu against a standard hydrogen electrode (SHE) is + 0.34 V, then calculate the E_{red} of Mg against a standard hydrogen electrode (SHE). (4 pts.) 3) -0.98 V

Mg electrode's potential of −1.32 V is compared to Cu as reference, as 0. But Cu is already up +0.34 V against SHE. So Mg should be above that value when compared with SHE

E_{red} of Mg against SHE $= -1.32 + (+0.34)$

$= -0.98\,V$

4) In a voltaic cell lab experiment the E_{red} of a Mg electrode was found to be – 1.32 V relative to Cu, which acted as a refenece cell. Also the E_{red} of a silver (Ag) electrode was found to be +0.388 V relative to Cu. If you make a galvanic cell with two half cells with Mg/Mg2+ and Ag/Ag+ half cells (black probe on Mg and red probe on Ag), then (1) identify which electrode would be the anode and (2)then calculate the the E_{cell}. (6 pts.) 4) _____

(1) Mg electrode would be anode ∵ Between Mg & Ag, Ag has more ⊕ive red potential

(2) $E_{cell} = E_{red}(\text{cathode}) - E_{red}(\text{anode})$

$= +0.388 - (-1.32)$

$= +1.708\ V$

5) In the copper (Cu^{2+}) ammonia complex formation experiment, the voltage of the cell, E_{cell} before and after addition of ammonia were + 0.52 V and + 0.81 V respectively (black probe on Cu and red probe on Ag). If the concentration of Ag+ ion in the Ag half cell was 0.1M, then calculate the concentration of free Cu^{2+} left in the complex solution at 298K. (10 pts.) 5) 1.55×10^{-12} M

$2Ag^+_{(aq)} + Cu_{(s)} \rightarrow 2Ag_{(s)} + Cu^{2+}_{(aq)}$

$E_{cell} = E^\circ_{cell} - \frac{RT}{nF} \ln Q$

$0.81 = 0.52 - \frac{8.3145 \times 298}{2 \times 96480} \times \ln Q$

$Q = 1.55 \times 10^{-10}$

$\frac{[Cu^{2+}]}{[Ag^+]^2} = 1.55 \times 10^{-10}$

$[Cu^{2+}] = 1.55 \times 10^{-10} (0.1)^2 = 1.55 \times 10^{-12}\ M$

6) Balance the following redox reaction with correct coefficients (in **basic** medium) (10 pts.) 6) _____

$\overset{-2}{CN^-}(aq) + H_2O(l) + \overset{+7}{MnO_4^-}(aq) \longrightarrow \overset{+3}{CNO^-}(aq) + \overset{+4}{MnO_2}(s) + OH^-(aq)$

Oxidation: $(H_2O + CN^- \rightarrow CNO^- + 2H^+ + 2e^-) \times 3$

Reduction: $(4H^+ + MnO_4^- + 3e^- \rightarrow MnO_2 + 2H_2O) \times 2$

$3H_2O + 3CN^- \rightarrow 3CNO^- + 6H^+ + 6e^-$

$8H^+ + 2MnO_4^- + 6e^- \rightarrow 2MnO_2 + 4H_2O$

$3CN^- + 2MnO_4^- + 2H^+ \rightarrow 3CNO^- + 2MnO_2 + H_2O$

$+ 2OH^-$ $\quad + 2OH^-$

$2H_2O$

$3CN^-_{(aq)} + H_2O_{(l)} + 2MnO_4^-{}_{(aq)} \rightarrow 3CNO^-_{(aq)} + 2MnO_{2(s)} + 2OH^-_{(aq)}$

$2\,Ag^+_{(aq)} + Cu_{(s)} \rightarrow 2\,Ag_{(s)} + Cu^{2+}_{(aq)}$

7) In an experiment to determine the K_{sp} of AgCl, a voltaic cell was constructed with a copper electrode dipped in 1 M $CuSO_4$ solution and a silver electrode dipped in a 1 M KCl solution and they were separated by a porous medium. The black probe was on copper electrode (anode) and the red probe was on silver electrode (cathode). The observed potential E_{cell} was 0.52 V. Two drops of 0.1 M $AgNO_3$ solution was then added into the KCl solution and the potential (E_{cell}) measured after equilibrium was stabilized to be – 0.04 V. Calculate the concentration of Ag^+ ion in the solution. (10 pts) 7) 3.39×10^{-10} M

$$E_{cell} = E^\circ_{cell} - \frac{RT}{nF}\ln Q \qquad Q = \frac{[Cu^{2+}]}{[Ag^+]^2}$$

$$-0.04 = 0.52 - \frac{8.3145\times298}{2\times96480}\ln Q$$

$$Q = 8.72\times10^{18}$$

$$\frac{[Cu^{2+}]}{[Ag^+]^2} = 8.72\times10^{18}$$

$$\frac{1}{[Ag^+]^2} = 8.72\times10^{18}$$

$$[Ag^+] = 3.39\times10^{-10}\ M$$

8) In the reaction $3\,\overset{2+}{Pb}O(s) + 2\,NH_3\,(aq) \dashrightarrow \overset{0}{N_2}\,(g) + 3\,\overset{0}{Pb}(s) + 3\,H_2O(l)$, identify the oxidising agent and the reducing agent and then calculate the equivalent weights of both of them (in g/mol of electrons). (2+2+3+3 = 10 pts) 8) _____

Oxidizing agent: $PbO_{(s)}$

Reducing agent: $NH_{3(aq)}$

Equivalent weight of $PbO = \frac{223\ g/mol}{2\ mol\ \bar{e}} = 111.5\ g/mol\ \bar{e}$

Equivalent weight of $NH_3 = \frac{17\ g/mol}{3\ mol\ \bar{e}} = 5.67\ g/mol\ \bar{e}$

9) **Fill out the blanks**: One of the confirmatory tests for calcium and barium is the flame test, where calcium produces ___brick-red___ color and barium produces ___apple-green___ color to the flame . (4 pts.) 9) _____

10) **Fill out the blank:** Color of the precipitate formed from Ni^{+2} solutions with dimethylglyoxime (DMG) in ammonia solution is ___cherry-red___ (2 pts.) 10) _____

MULTIPLE CHOICE. Select the one alternative that best completes the statement or answers the question (4 pts each).

11) The equivqlent mass of metal was found to be 56.2 g/mol. The identity of the metal is 11) A

A) Cd B) Sc C) Ag D) Fe

12) Color of the solution formed from Fe^{3+} solutions with Potassium thiocyanate (KSCN) solution is _____ 12) C

A) Blue B) Purple C) Red D) Black

13) Ba^{2+} ions with potassium chromate solution gives _____ colored precipitate of formula _____ 13) B

* $BaCrO_4$ * (CANCELLED)

A) Red B) Yellow C) Green D) White

14) Pb^{2+} ions with potassium iodide solution gives _____ 14) C

A) yellow solution B) gray ppt. C) yellow ppt. D) brown ppt.

15) Color of the precipitate formed from Cu^{+2} solutions with potassium ferrocyanide is _____ 15) D

A) White B) Light blue C) Grey D) Maroon

16) You have only one Gr. B cation. You added 6M NaOH solution to strong alkalinity and H_2O_2. but there was no ppt. You heated the solution for 10 minutes in a boiling water bath. To a small amount of this solution you added 3% H_2O_2 and then acidified with 6M HCl, But the test failed convincingly for a blue purple flash of color. The Gr. B cation you have is: 16) D

A) Mn^{2+} B) Bi^{2+} C) Fe^{3+} D) Al^{3+}

17) When temperature is increased in the following reaction, which is in equilibrium: $COCl_2(g) <=> CO(g) + Cl_2(g)$ $\Delta H=10$ KJ 17) A

The equilibrium moves to the:

A) Right B) Left C) Left or Right D) No effect

18) If H_2 is now removed from the equilibrium reaction: $H_2(g) + 2ICl(g) <=> I_2(g) + 2HCl(g)$, then the equilibrium will shift to: 18) C

A) Left or Right B) Right C) Left D) No Effect

19) When volume is increased of the reaction which is in equilibrium: $CH_3OH(g) <=> CO(g) + 2H_2(g)$ $\Delta H=10$ KJ; The equilibrium moves to the: 19) B

A) Left B) Right C) Left or Right D) No effect

20) When catalyst is added to the following reaction at equlibrium, $NO_3(g) + NO(g) <=> 2NO_2(g)$ $\Delta H=10$KJ; The equilibrium moves to the: 20) D

A) Left B) Right C) Left or Right D) No effect