JULIUS CAPUL BSECE 1-1

ASSESSMENT

1. Gold can be plated out of a solution containing Au^{3+} according to the following half-reaction: $Au^{3+}_{(aq)} + 3e^- \rightarrow Au_{(s)}$

What mass of gold (in grams) can be plated by the flow of 0.5A of current for 5 minutes

GIVEN $Au^{3+}_{(aq)} + 3e^- \rightarrow Au_{(s)}$

0.5A, 5min ; $0.5A = 0.5 \frac{C}{s}$; $1 mol\ e^- = 96500 C$

SOLUTION $3 mole\ e^- = 1 mole\ Au$

$0.5 \frac{C}{s} \cdot 5 min \cdot 60 \frac{s}{min} \cdot \frac{1 mol\ e^-}{96500 C} \cdot \frac{1 mol\ Au}{3 mol\ e^-} = \frac{1}{19300} mol\ Au$

$\frac{1}{19300} mol\ Au \cdot 196.97 g/mol = 0.0020 g\ Au$

$= 0.00 g\ Au$

ANSWER

2. Complete and balance the following redox equation using the set of smallest whole-number coefficients.

GIVEN $H^+I^- + H^+N^{5+}O_3^{2-} \rightarrow I_2 + N^{2+}O^{-2}$

SOLUTION

ANODE

$H^+I^- \rightarrow I_2$

$2H^+I^- \rightarrow I_2 + 2H^+ + 2e^-$

CATHODE

$H^+N^{5+}O_3^{2-} \rightarrow N^{2+}O^{2-}$

$H^+N^{5+}O_3^{2-} \rightarrow N^{2+}O^{2-} + 2H_2O$

$H^+N^{5+}O_3^{2-} + 3H^+ \rightarrow N^{2+}O^{2-} + 2H_2O$

$H^+N^{5+}O_3^{2-} + 3H^+ + 3e^- \rightarrow N^{2+}O^{2-} + 2H_2O$

$3(2HI \rightarrow I_2 + 2H^+ + 2e^-)$

$(HNO_3 + 3H^+ + 3e^- \rightarrow NO + 2H_2O)2$

$6HI + 2HNO_3 + 6H^+ + 6e^- \rightarrow 3I_2 + 6H^+ + 6e^- + 2NO + 4H_2O$

$6HI + 2HNO_3 + 6H^+ \rightarrow 3I_2 + 2NO + 4H_2O + 6H^+$

ANSWER $6HI + 2HNO_3 \rightarrow 3I_2 + 2NO + 4H_2O$

3. Given the following notation for an electrochemical cell

$Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Ag^+(aq) \mid Ag(s)$

What is the balanced overall (net) cell reaction

GIVEN $Pt(s) \mid H_2(g) \mid H^+(aq) \parallel Ag^+(aq) \mid Ag(s)$

SOLUTION

ANODE	CATHODE
$H_2 \rightarrow H^+$	$Ag^+ \rightarrow Ag$
$H_2 \rightarrow 2H^+ + 2e^-$	$Ag^+ + e^- \rightarrow Ag$

NET REACTION $H_2 \rightarrow 2H^+ + 2e^-$

$(Ag^+ + e^- \rightarrow Ag)\,2$

$H_2 + 2Ag^+ + 2e^- \rightarrow 2H^+ + 2Ag + 2e^-$

ANSWER $H_{2(g)} + 2Ag^+_{(aq)} \rightarrow 2H^+_{(aq)} + 2Ag_{(s)}$

4. A certain electrochemical cell has for its cell reaction:

$Zn + Hg^{2+}O^{2-} \rightarrow Zn^{2+}O^{2-} + Hg$

Which is the half-reaction occuring at the anode?

ANODE $Zn \rightarrow Zn^{2+}O^{2-}$: $Zn \rightarrow Zn^{2+} + 2e^-$

At the cathode? CATHODE $Hg^{2+}O^{2-} \rightarrow Hg$: $Hg^{2+} + 2e^- \rightarrow Hg$

Write each half-cell reaction and the net reaction with the potential difference for the cell.

ANODE	CATHODE
$Zn \rightarrow Zn^{2+}O^{2-}$	$Hg^{2+}O^{2-} \rightarrow Hg$
$Zn \rightarrow Zn^{2+} + 2e^-$	$Hg^{2+} + 2e^- \rightarrow Hg$
E° -0.76 V	$+0.85$ V

NET REACTION $Zn + HgO \rightarrow ZnO + Hg$

POTENTIAL DIFFERENCE $E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= 0.85V - (-0.76V)$

ANSWER $= 1.61$ V

5. Calculate the value of E°_{cell} for the following reaction:

$2Au(s) + 3Ca^{2+}(aq) \rightarrow 2Au^{3+}(aq) + 3Ca(s)$

ANODE $2Au(s) \rightarrow 2Au^{3+}(aq) + 6e^-$

$Au(s) \rightarrow Au^{3+}(aq) + 3e^-$

$E^\circ_{anode} = 1.50\ V$

CATHODE $3Ca^{2+}(aq) \rightarrow 3Ca(s)$

$3Ca^{2+}(aq) + 6e^- \rightarrow 3Ca(s)$

$Ca^{2+}(aq) + 2e^- \rightarrow Ca(s)$

$E^\circ_{cathode} = -2.87\ V$

$E^\circ_{cell} = E^\circ_{cathode} - E^\circ_{anode}$

$= -2.87V - 1.50V$

$= -4.37V$

6. How many coulombs (C) of electrical charge must pass through an electrolytic cell to reduce $0.44 mol\ Ca^{2+}$ ion to calcium metal?

Half-reaction $Ca^{2+} + 2e^- \rightarrow Ca$

$2 mol\ e^- = 1 mol\ Ca$

SOLUTION $0.44 mol\ Ca^{2+} \cdot \frac{2 mole^-}{1 mol\ Ca^{2+}} \cdot \frac{96500 C}{1 mol\ e^-} = 84920 C$

ANSWER 84 920 C

7. Determine oxidation number of the underlined element:

a. $K\underline{Mn}O_4$

$K^+ Mn^{7+} O_4^{2-}$

$+1 + 7 + (-2(4)) = 0$

b. $Al_2(\underline{S}O_4)_3$

$Al^{3+}_2 (S^{6+} O^{2-}_4)_3$

$+3(2) + (3)(+6) + (-2(4)) = 0$

$+6$

c. $\underline{N}O^{3-}$

$N^{1-} O^{2-}$

$-1 + (-2) = -3$

-1

ANSWERS +7

8. Complete and balance the following redox equation

$Mn^{7+}O^{2-}_4 + H^+ + Br^- \rightarrow Mn^{2+} + Br_2 + H_2O$ (acidic solution)

OXIDATION $2Br^- \rightarrow Br_2 + 2e^-$

REDUCTION $Mn^{7+}O^{2-}_4 + 8H^+ \rightarrow Mn^{2+} + 4H_2O$

$Mn^{7+}O^{2-}_4 + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O^{2-}$

net reaction $5(2Br^- \rightarrow Br_2 + 2e^-)$

$(MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O)2$

$10Br^- + 2MnO_4^- + 16H^+ + 10e^- \rightarrow 5Br_2 + 2Mn^{2+} + 8H_2O + 10e^-$

ANSWER

$10Br^- + 2MnO_4^- + 16H^+ \rightarrow 5Br_2 + 2Mn^{2+} + 8H_2O$