GENESIS TUTORIALS

ASSIGNMENT:1- ELECTROCHEMISTRY

1. Consider the following reaction:

$Au + O_2 + 3F_2 \rightarrow [O_2]^+ + [AuF_6]^-$

Which statement is correct about the redox changes in this reaction?

(a) Au is oxidized; O is oxidized; F is reduced

(b) Au is reduced; O is oxidized; F is reduced

(c) Au is oxidized; O does not undergo a redox change; F is reduced

(d) Au is reduced; O is oxidized; F does not undergo a redox change

2. The Daniel cell is

(a) $Pt_I(s)|Zn(s)|Zn^{2+}(aq) \parallel Cu^{2+}(aq)|Cu(s)| Pt_{II}(s)$

(b) $Pt_I(s)|Zn(s)|Zn^{2+}(aq) \parallel Ag^{+}(aq)|Ag(s)| Pt_{II}(s)$

(c) $Pt_I(s)|Fe(s)|Fe^{2+}(aq) \parallel Cu^{2+}(aq)|Cu(s)| Pt_{II}(s)$

(d) $Pt_I(s)|H_2(g)|H_2SO_4\ (aq) \parallel Cu^{2+}(aq)|Cu(s)| Pt_{II}(s)$

3. Given: A. $Fe(OH)_2(s) + 2e^- \rightarrow Fe(s) + 2OH^-(aq)$; E^0 = - 0.877V

B. $Al^{3+}(aq) + 3e^- \rightarrow Al(s)$; E^0= -1.66V

C. $AgBr(aq) + e^- \rightarrow Ag(s) + Br^-(aq)$; E^0 = 0.071V

The overall reaction for the cells in the direction of spontaneous change would be

(a) Cell with A and B : Fe reduced

Cell with A and C : Fe reduced

(b) Cell with A and B : Fe reduced

Cell with A and C : Fe oxidized

(c) Cell with A and B : Fe oxidized

Cell with A and C : Fe oxidized

(d) Cell with A and B : Fe oxidized

Cell with A and C : Fe reduced

4. The cell voltage of Daniel cell [Zn | Zn SO_4 (aq) | | $CuSO_4$ (aq) | Cu] is 1.07 V. If reduction potential of Cu^{2+} | Cu is 0.34 the reduction potential of Zn^{2+} | Zn is –

(a) 1.41 V (b) – 1.41 V (c) 0.73 V (d) – 0.73 V

5. The cell potential for the following electrochemical system at 25 °C is:

Al (s) | Al^{3+} (0.01 M) | | Fe^{2+} (0.1 M) | Fe (s) given that $E^0_{Al^{3+}/Al}$ = -1.66V, $E^0_{Fe^{2+}/Fe}$ = - 0.44V

(a) 1.23 V (b) 1.21 V (c) 1.22 V (d) – 2.10 V

6. A 19th century iron bridge is protected from corrosion by connecting it to a block of metal (sacritificial anode), which is replaced annually. The corrosion of iron, represented by the chemical equation:

$2Fe\ (s) + 2H_2O(l) + O_2\ (g) \rightarrow 2Fe(OH)_2$

Which of the following metals is best suited as sacrificial anode?

(a) Ag : $Ag^+ + e^- \rightarrow Ag(s)$ $E^0 = +0.80V$

(b) Cd : $Cd^{2+} + 2e^- \rightarrow Cd(s)$ $E^0 = -0.40V$

(c) Cu : $Cu^+ + 2e^- \rightarrow Cu(s)$ $E^0 = +0.34V$

(d) Mg : $Mg^{2+} + 2e^- \rightarrow Mg(s)$ $E^0 = -2.36V$

7. Which combination of the following half-cell reactions will produce a cell with the largest potential?

(i) $A + e^- \rightarrow A^-$ E° = - 0.24 V

(ii) $B^- + e^- \rightarrow B^{2-}$ E° = 1.25 V

(iii) $C^- + 2e^- \rightarrow C^{3-}$ E° = - 1.25 V

(iv) $D + 2e^- \rightarrow D^{2-}$ E° = 0.68 V

(v) $E + 4e^- \rightarrow E^{4-}$ E° = 0.38 V

(a) (i) and (ii) (b) (ii) and (iii) (c) (iii) and (iv) (d) (iv) and (v)

8. What is the standard cell potential for the reaction below?

$Mg(s) + Br_2(\ell) \rightarrow Mg^{2+}{}_{(aq)} + 2\ Br^-{}_{(aq)}$

The standard reduction potential is – 2.37 V for the Mg^{2+}/ Mg half-cell and + 1.09 V for the Br_2 / Br^- half cell

(a) + 1.28 V (b) – 1.28 V (c) + 3.46 V (d) – 3.46 V

9. The equilibrium constant for an electrochemical reaction

$$2Fe^{3+} + Sn^{2+} \rightleftharpoons 2Fe^{2+} + Sn^{4+}$$

$[E^0\left(\frac{Fe^{3+}}{Fe^{2+}}\right) = 0.75\ V,\ E^0\left(\frac{Sn^{4+}}{Sn^{2+}}\right) = 0.15\ V,\ E^0\left(\frac{2.303\ RT}{F}\right) = \ = 0.06\ V]$

(a) 10^{10} (b) 10^{20} (c) 10^{30} (d) 10^{40}

10. The electrochemical cell potential (E), after the reactants and products reach equilibrium, is (E^0 is the standard cell potential and n is the number of electrons involved)

(a) $E = E^0 + \frac{nF}{RT}$ (b) $E = E^0 - \frac{RT}{nF}$ (c) $E = E^0$ (d) $E = 0$

11. The EMF of the concentration cell

$$Cu(s)\ |\ Cu^{2+}\ (0.012\ M)\ \|\ Cu^{2+}\ (1.2\ M)\ |\ Cu(s)\ \text{is} -$$

(a) 0.001 V (b) 0.025 V (c) 0.059 V (d) 0.118 V

12. The amount of copper (atomic weight 63.6 g mol^{-1}) deposited on passing a current of 2 ampere through a solution of copper sulfate for 965 seconds is –

(a) 636 g (b) 63.6g (c) 6.36 g (d) 0.636 g

13. A current equivalent to 0.1 faraday of charge is passed through a solution of $CuSO_4$ to deposit pure copper at the cathode. The weight of copper deposited is:

(a) 6.4 g (b) 12.8 g (c) 3.2 g (d) 1.6 g

14. How many faradays are required to reduce one mole of $M_nO_4^-$ to M_n^{2+}?

(a) 1 (b) 2 (c) 3 (d) 5

15. Passage of 30 A current for 70.2 minutes correspond to:

(a) 1.31 C (b) 1.31 F (c) 2100 C (d) 2100 F

16. The temperature derivative of electrochemical cell potential E at constant pressure, $\left(\frac{\partial E}{\partial T}\right)_p$ is given by

(a) $-\frac{\Delta S}{nF}$ (b) $\frac{\Delta S}{nF}$ (c) $\frac{\Delta S}{nFT}$ (d) $-\frac{\Delta S}{nFT}$

17. The standard cell potential for he reaction,

$$Zn(s) + Cu^{2+}(aq) \rightleftharpoons Zn^{2+}(aq) + Cu(s)$$

is + 1.10 V. The Gibbs free energy change during the reaction is (F = 96500 coulomb mol^{-1})

(a) -21.2 kJ mol^{-1} (b) +212 kJ mol^{-1} (c) -212 kJ mol^{-1} (d) -212 J mol^{-1}

18. The standard free energy of the reaction:

$$AgBr(s) \rightarrow Ag^{+}(aq) + Br^{-}(aq)$$

is closest to

($E°(AgBr/Ag, Br^{-}) = +0.07$ V, $E°(Ag^{+}/Ag) = 0.80$ V; F = 96500 C mol^{-1})

(a) 7 $kJmol^{-1}$ (b) 70 $Jmol^{-1}$ (c) 70 $kJmol^{-1}$ (d) 7 $Jmol^{-1}$