CHAPTER 2

Electrochemistry

Electrochemical and Galvanic Cells

1. Given below are half cell reactions: *(2022)*

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

$E^o_{Mn^{2+}/MnO_4^-} = -1.510\,V$

$\frac{1}{2}O_2 + 2H^+ + 2e^- \rightarrow H_2O$

$E_{O_2/H_2O} = +1.223\ V$

Will the permanganate ion, MnO^-_4 liberate O_2 from water in the presence of an acid?

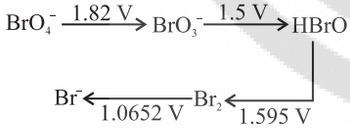
a. No because $E^o_{cell} = -2.733\,V$

b. Yes, because $E^o_{cell} = +0.287\,V$

c. No, because $E^o_{cell} = -0.287\,V$

d. Yes, because $E^o_{cell} = +2.733\ V$

2. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below : *(2018)*



Then the species undergoing disproportionation is

a. BrO_3^-

b. BrO_4^-

c. HBrO

d. Br_2

3. A button cell used in watches functions as following

$Zn(s) + Ag_2O(s) + H_2O(l) \rightleftharpoons 2Ag(s) + Zn^{2+}(aq) + 2OH^-(aq)$. If half cell potentials are

$Zn^{2+}(aq) + 2e^- \rightarrow Zn(s)$; $E^o = -0.76$ V

$Ag_2O(s) + H_2O(l) + 2e^- \rightarrow 2Ag(s) + 2OH^-(aq)$, $E^o = 0.34$ V.

The cell potential will be: *(2013)*

a. 1.10 V

b. 0.42 V

c. 0.84 V

d. 1.34 V

Nernst Equation

4. At 298 K, the standard electrode potentials of Cu^{2+}/Cu, Zn^{2+}/Zn, Fe^{2+}/Fe and Ag^+/Ag are 0.34 V, – 0.76 V, – 0.44 V and 0.80 V, respectively.

On the basis of standard electrode potential, predict which of the following reaction can not occur? *(2022)*

a. $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

b. $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

c. $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

d. $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

5. Find the emf of the cell in which the following reaction takes place at 298 K

$Ni(s) + 2Ag^+(0.001\ M) \rightarrow Ni^{2+}(0.001\ M) + 2Ag(s)$

(Given that $E^\circ_{cell} = 10.5$ V, $\frac{2.303\,RT}{F} = 0.059$ at 298 K) *(2022)*

a. 1.05 V b. 1.0385 V

c. 1.385 V d. 0.9615 V

6. Identify the reaction from following having top position in EMF series (Std. red. potential) according to their electrode potential at 298 K. *(2020-Covid)*

a. $Fe^{2+} + 2e^- \rightarrow Fe(s)$ b. $Au^{3+} + 3e^- \rightarrow Au(s)$

c. $K^+ + 1e^- \rightarrow K(s)$ d. $Mg^{2+} + 2e^- \rightarrow Mg(s)$

7. For a cell involving one electron $E^\circ_{cell} = 0.59$ V at 298 K, the equilibrium constant for the cell reaction is: $\left[\text{Given that } \frac{2.303RT}{F} = 0.059V \text{ at } T = 298K\right]$ *(2019)*

a. 1.0×10^2 b. 1.0×10^5

c. 1.0×10^{10} d. 1.0×10^{30}

8. For the cell reaction

$2Fe^{3+}(aq) + 2I^-(aq) \rightarrow 2Fe^{2+}(aq) + I_2(aq)$

$E^\ominus_{cell} = 0.24$ V at 298 K. The standard Gibbs energy ($\Delta_rG^\ominus$) of the cell reaction is:

[Given that Faraday constant F = 96500 C mol^{-1}] *(2019)*

a. –46.32 kJ mol^{-1} b. –23.16 kJ mol^{-1}

c. 46.32 kJ mol^{-1} d. 23.16 kJ mol^{-1}

9. If the E°cell for a given reaction has a negative value, which of the following gives the correct relationships for the values of $\Delta G°$ and K_{eq}? *(2016 - II)*

a. $\Delta G^0 < 0$; $K_{eq} > 1$ b. $\Delta G^0 < 0$; $K_{eq} < 1$

c. $\Delta G^0 > 0$; $K_{eq} < 1$ d. $\Delta G^0 > 0$; $K_{eq} > 1$

10. The pressure of H_2 required to make the potential of H_{2}- electrode zero in pure water at 298 K is: *(2016 - I)*

a. 10^{-4} atm b. 10^{-14} atm

c. 10^{-12} atm d. 10^{-10} atm

11. The pair of compounds that can exist together is: *(2014)*

a. $HgCl_2$, $SnCl_2$ b. $FeCl_2$, $SnCl_2$

c. $FeCl_3$, KI d. $FeCl_3$, $SnCl_2$

12. A hydrogen gas electrode is made by dipping platinum wire in a solution of HCl of pH = 10 and by passing hydrogen gas around the platinum wire at one atm pressure. The oxidation potential of electrode would be? *(2013)*

a. 0.059 V b. 0.59 V

c. 0.118 V d. 1.18 V

Conductance of Electrolytic Solutions

13. The molar conductance of NaCl, HCl and CH_3COONa at infinite dilution are 126.45, 426.16 and 91.0 S cm^2 mol^{-1} respectively. The molar conductance of CH_3COOH at infinite dilution is. Choose the right option for your answer. *(2021)*

a. 390.71 S cm^2 mol^{-1} b. 698.28 S cm^2 mol^{-1}

c. 540.48 S cm^2 mol^{-1} d. 201.28 S cm^2 mol^{-1}

14. The molar conductivity of 0.007 M acetic acid is 20 S cm^2 mol^{-1}. What is the dissociation constant of acetic acid? Choose the correct option. *(2021)*

$$\begin{bmatrix} \Lambda^{\circ}_{H^+} = 350\ S\ cm^2 mol^{-1} \\ \Lambda^{\circ}_{CH_3COO^-} = 50\ S\ cm^2 mol^{-1} \end{bmatrix}$$

a. 2.50×10^{-4} mol L^{-1} b. 1.75×10^{-5} mol L^{-1}

c. 2.50×10^{-5} mol L^{-1} d. 1.75×10^{-4} mol L^{-1}

15. The molar conductivity of a 0.5 mol dm^{-3} solution of $AgNO_3$ with electrolytic conductivity of 5.76×10^{-3} S cm^{-1} at 298 K is: *(2016 - II)*

a. 0.086 S cm^2 mol^{-1} b. 28.8 S cm^2 mol^{-1}

c. 2.88 S cm^2 mol^{-1} d. 11.52 S cm^2 mol^{-1}

16. At 25°C, molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is 9.54 ohm^{-1} cm^2mol^{-1} and at infinite dilution its molar conductance is 238 ohm^{-1} cm^2mol^{-1}. The degree of ionisation of ammonium hydroxide at the same concentration and temperature is: *(2013)*

a. 2.080 % b. 20.800 %

c. 4.008 % d. 40.800 %

Electrolytic Cells and Electrolysis

17. On electrolysis of dil sulphuric acid using Platinum (Pt) electrode, the product obtained at anode will be: *(2020)*

a. Oxygen gas b. H_2S gas

c. SO_2 gas d. Hydrogen gas

18. The number of Faradays (F) required to produce 20 g of calcium from molten $CaCl_2$ (Atomic mass of Ca = 40 g mol^{-1}) is: *(2020)*

a. 2 b. 3

c. 4 d. 1

19. During the electrolysis of molten sodium chloride, the time required to produce 0.10 mol of chlorine gas using a current of 3 amperes is: *(2016 - II)*

a. 220 minutes b. 330 minutes

c. 55 minutes d. 110 minutes

20. The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is: (charge on electron = 1.60×10^{-19} C) *(2016 - II)*

a. 3.75×10^{20} b. 7.48×10^{23}

c. 6×10^{23} d. 6×10^{20}

21. When 0.1 mol MnO_4^{2-} is oxidised, the quantity of electricity required to completely oxidise MnO_4^{2-} to MnO_4^- is: *(2014)*

a. 96500 C b. 2×96500 C

c. 9650 C d. 96.50 C

22. The weight of silver (atomic weight = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be: *(2014)*

a. 10.8 g b. 54.0 g

c. 108.0 g d. 5.4 g

Batteries, Fuel Cells and Corrosion

23. In a typical fuel cell, the reactants (R) and product (P) are *(2020-Covid)*

a. R = $H_{2(g)}$, $O_{2(g)}$; P = $H_2O_{(\ell)}$

b. R = $H_{2(g)}$, $O_{2(g)}$, $Cl_{2(g)}$; P = $HClO_{4(aq)}$

c. R = $H_{2(g)}$, $N_{2(g)}$; P = $NH_{3(aq)}$

d. R = $H_{2(g)}$, $O_{2(g)}$; P = $H_2O_{2(\ell)}$

24. Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because: *(2016 - II)*

a. Zinc has lower negative electrode potential than iron

b. Zinc has higher negative electrode potential than iron

c. Zinc is lighter than iron

d. Zinc has lower melting point than iron

25. A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as: *(2015)*

a. Electrolytic cell b. Dynamo

c. Ni-Cd cell d. Fuel cell

Answer Key

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
b	c	a	a	None	b	c	a	c	b	b	b	a	b	d	c	a
18	19	20	21	22	23	24	25									
d	d	a	c	c	a	b	d									