JEE MAIN ANSWER KEY & SOLUTIONS

SUBJECT :- CHEMISTRY
CLASS :- 12th **PAPER CODE :- CWT-2**
CHAPTER :- ELECTROCHEMISTRY

ANSWER KEY

1.	(B)	**2.**	(B)	**3.**	(C)	**4.**	(B)	**5.**	(C)	**6.**	(B)	**7.**	(B)
8.	(C)	**9.**	(A)	**10.**	(A)	**11.**	(C)	**12.**	(C)	**13.**	(A)	**14.**	(B)
15.	(C)	**16.**	(D)	**17.**	(A)	**18.**	(B)	**19.**	(D)	**20.**	(A)	**21.**	0.728
22.	4300	**23.**	500	**24.**	9	**25.**	45	**26.**	32	**27.**	1350	**28.**	60
29.	3	**30.**	1080										

SOLUTIONS

1. (B)

Sol. $\frac{W}{E} = \frac{9.65\times3\times3600}{96500} = 1.08$; $\frac{W}{M} = 0.54$

$[Ni^{2+}] = \frac{2\times0.5-0.54}{0.5} = 0.92$ M]

2. (B)

Sol. $2Cl^- \longrightarrow Cl_2 + 2e^-$ $\Delta G_1^o = -2\times F\times(-1.36)$

$2OCl^- + 2H_2O + 4e^- \longrightarrow 2Cl^- + 4OH^-$

$\Delta G_2^o = -4\times F\times(0.94)$

$2OCl^- + 2H_2O + 2e^- \longrightarrow Cl_2(g) + 4OH^-$

$\Delta G_3^o = -2\times F\times E_3^o$

$-2\times F\times E_3^o = -2\times F\times(-1.36) - 4F(0.94)$

$E_3^o = -1.36 + 2\times0.94 = 0.52$ V Ans.]

3. (C)

Sol. $E_{cell} = E_{cell}^0 - \frac{RT}{nF}lnQ$

$H_2 \longrightarrow 2H_2^+ + 2e$

$Cl_2 + 2e \rightarrow 2Cl^-$

$Cl_2 + H_2 \rightarrow 2H^+ + 2Cl^-$

$(E_{cell})_1 = E_{cell}^0 - \frac{0.0591}{2}\log[H^+]_1^2[Cl^-]^2$

If conc. is changed by factor of 10 in both compartments

Change= $-0.0591\log100 = -2\times0.0591 = -0.1182$ Volt]

4. (B)

Sol. $G^* = \frac{l}{a} = \frac{10}{100} = 0.1$; G = 0.0001 S ; V = 100 × 10 = 1000 cm^3 = 1 litre

$\kappa = G\,G^* = 0.\times0.0001 = 10^{-5}$

$\wedge_m = \frac{\kappa\times100}{M} = \frac{(0.1\times0.0001)\times1000}{0.5} = 0.02$ Scm^2mol^{-1} Ans.]

5. (C)

Sol. Let t sec be used

No. of farads = $\frac{4\times t}{96500}$

No. of moles of $H_2O = 2 \Rightarrow \frac{4\times t}{96500} = 2\times2$

$\Rightarrow$ t = 96500 sec.]

6. (B)

Sol. for (A) and (D) E_{cell}^o = – ve$\Rightarrow$ $\Delta G°$ = + ve

for (C) E_{cell}^o = + 0.46

for (B) E_{cell}^o = + 1.56

$\Delta G°$ is most negative for (B)]

7. (B)

Sol. $E^o_{I^-/AgI/Ag} = E^o_{Ag^+/Ag} + \frac{0.059}{1}\log K_{sp}$]

8. (C)

9. (A)

10. (A)

Sol. Before equivalence point NO_3^- is replacing Cl^-. After equivalence point conductance will increase because of increase in conc. of Ag^+ and NO_3^- ions.]

11. (C)

Sol. (A) In dry cell :

$2MnO_2(s) + H_2(g) \rightarrow Mn_2O_3(s) + H_2O(l)$

+4 +3

Reduction of Mn from +4 to +3 state occurs

(B) During discharging

$Pb(s) + PbO_2(s) + 2H_2SO_4(l) \rightarrow 2PbSO_4(s) + 2H_2O(l)$

H_2SO_4 consumed in the reaction thus density decreases.

(C) Anode : $4H_2O + C_2H_6 \rightarrow 2CO_2 + 14H^+ + 14e^-$

Cathode : $4e^- + 4H^+ + O_2 \rightarrow 2H_2O$

permole of e^- only 1 mole of H^+ will produce.

(D) If fuel cell $\eta = \frac{\Delta G}{\Delta H}$ if $\Delta S > 0$, $\Delta H < 0$

$\Delta G = \Delta H - T\Delta S$

$\Delta G > \Delta H$

and n > 100%]

12. (C)

Sol. $E_{Cell} = E^\circ_{Zn^{2+}/Zn} + E^\circ_{Cl^-/Cl_2(g)}$

= 0.76 + 1.36 = 2.12 V]

13. (A)

Sol. Near one electrode pH increases and near other it decreases. This occur because of following two reactions.

At cathode : $2e^- + 2H_2O\ (l) \longrightarrow 2OH^- + H_2(g)$

At anode : $2H_2O\ (l) \longrightarrow 4e^- + 4H^+ + O_2(g)$

14. (B)

Sol. During electrolysis of Li_2SO_4(aq)

Cathode **Anode**

$2H^+ + 2e^- \rightarrow H_2$ $2OH^- \rightarrow H_2O + \frac{1}{2} O_2 + 2e^-$

pH will remain constant.]

15. (C)

Sol. $\wedge^\circ_{m\,AgCl} = \frac{K \times 1000}{S}$

$135 = \frac{K \times 1000}{10^{-5}}$

$K = 135 \times 10^{-8} = 1.35 \times 10^{-6}\ \Omega^{-1}\ cm^{-1}$]

16. (D)

Sol. $E = E^o - \frac{.06}{2} \log \frac{[Fe^{2+}][Zn^{2+}]}{[Fe^{3+}]^2}$

If conc. of Fe^{2+} increase

E decrease

$\Delta G = -nEE$

Less non PV work will be obtained.

17. (A)

Sol. On increasing concentration number of ion per unit volume increases as a result conductivity increases.

18. (B)

Sol. 'Cs' is used in photoelectric cell as its ionisation energy is lowest

Hence Ans (B)

19. (D)

Sol. Ionic

$C_{NaCl} >> C_{BaSO_4}$ at temp 'T'

20. (A)

Sol. $\wedge_{m1} = \frac{K_1 \times 1000}{M_1} = \frac{K \times 1000}{\frac{10}{0.02}}$

$\wedge_{m2} = \frac{K_2 \times 1000}{\frac{20}{0.80}}$

It is given that $k_1 = k_2$

$K_1 = \frac{\wedge_{m1}}{2}$ $K_2 = \frac{\wedge_{m2}}{4}$

Applying the given condition on conductivity.

$\wedge_{m2} = 2 \wedge_{m1}$

21. 0.728

Sol. $8e^- + 2\ Ph - NO_2 \longrightarrow Ph - N = N - Ph$

$OH^- \longrightarrow \frac{1}{4} O_2 + \frac{1}{2} H_2O + e^-$

$C_{60} + 60\ O_2 \longrightarrow 60\ CO_2$

$\frac{96 \times 10^{-3}}{60 \times 12} \times 60 \times 4 \times \frac{1}{8} \times 182 \Rightarrow 0.728$ gm]

22. 4300

Sol. $0.6 = E^o_{Cell} - 0.06 \log [H+]$

$0.6 = E^o_{Cell} + 0.06\ pH_1$

$0.75 = E^o_{Cell} + 0.06\ pH_2$

$0.15 = 0.06\ (6.8 - pH)$

$2.5 = 6.8 - pH$

$pH = 6.8 - 2.5$

= 4.3 **Ans.**]

23. 500

Sol. $\kappa = \frac{1}{R}\times\frac{\ell}{A} = \frac{1}{50}\times\frac{4}{10} = 8 \times 10^{-3}$ S-cm^{-1}

$\wedge_m = \frac{\kappa\times 1000}{0.1} = 80$ S-cm^{2}mol^{-1}

$\wedge_m^\infty (CH_3COOH) = \wedge_m^\infty (HCl) + \frac{1}{2} Ca(HCOO)_2 - \frac{1}{2}(CaCl_2)$

$= 425 + 115 - 140 = 400$ S-cm^{2}mol^{-1}

$\alpha = \frac{\wedge_m}{\wedge_m^\infty} = 0.2$

$K_a = \frac{0.1\times\alpha^2}{1-\alpha} = \frac{0.1\times 0.04}{0.8} = 5\times 10^{-3}$ M

Ans.]

24. 9

Sol. $\wedge_N = \frac{\wedge_m}{n_f} \Rightarrow \wedge_m = 200 \times 2 = 400\ \Omega^{-1}$ cm^2 mol^{-1}

$400 = \frac{4\times 10^{-5}\times 1000}{S} \Rightarrow S = \frac{4\times 10^{-2}}{400} \Rightarrow 1 \times 10^{-4}$

$K_{sp(BaSO_4)} = 1 \times 10^{-8}$ M^2

(x + y) = 9 **Ans.**

25. 45

Sol. $p_v = \frac{l}{A}$ $\qquad \wedge_m = \frac{k\times 1000}{C}$

$\frac{100\times 4}{2} = p$ $\qquad \wedge_m = \frac{1}{200}\times\frac{1000}{0.1}$

$\frac{1}{p} = k\frac{1}{200}$ $\qquad \wedge_m = 50$

$\frac{\wedge_m}{\wedge_m^\infty} = \frac{50}{400} = \frac{1}{8}$

$CH_3COOH \rightleftharpoons CH_3COO^- + H^\oplus$

$1-\alpha \qquad \alpha \qquad \alpha$

$1+\alpha = \frac{9}{8}$

$\Delta T_b = K_b \times m \times i$

$= 0.5 \times 0.1 \times \frac{9}{8} \times 800 = 45$]

26. 32

Sol. $\frac{1}{2} H_2(g) \rightarrow H^+(aq) + e^-$

$Ag^+(aq) + e^- \rightarrow Ag(s)$

$\frac{1}{2} H_2(g) + Ag^+(aq) \rightarrow H^+(aq) + Ag(s)$

$E_{cell} = E^o_{cell} - \frac{0.06}{1}\log\frac{[H^+]}{[Ag^+](P_{H_2})^{1/2}}$

$= 0.8 - 0.06 \log\frac{0.2}{2\times 10^{-9}}$

$= 0.8 - 0.06 \log 10^8$

$= 0.32$]

27. 1350

Sol. i = 0.5 Amp

Current efficiency = $\frac{1000}{12}\%$

t = 9.65 hr = 9.65 × 3600 sec.

$w = \frac{Eit}{96500} = \frac{9\times\frac{\frac{1000}{12}}{100}\times 1\times 0.5\times 9.65\times 3600}{96500}$

$\because E_{Al} = 9$

$= \frac{9\times 5\times 9.65\times 3}{965} = 1.35$ g = 1350 mg]

28. 60

Sol. Initially 0.1 M

$Cr^{3+} \xrightarrow{\text{electrolysis}} Cr$

Finally 0.08 M

Number of moles of Cr^{3+} reduced = $M_1V_1 - M_2V_1$

$= 0.1 \times 1 - 0.08 \times 1$

$= 0.02$ mole

Number of equivalent of Cr^{3+} reduced = 0.02 × 3 equ.

$\therefore 0.02 \times 3 = \frac{i.t}{96500}$

i.t = 0.02 × 3 × 96500

$t = \frac{0.02\times 3\times 96500}{96.5} = 60$ sec.]

29. 3

Sol. $Cd + 2H^+ \longrightarrow Cd^{+2} + H_2$

$$E = E^\circ - \frac{0.06}{n} \log \frac{[Cd^{+2}][H_2]}{[Cd][H^+]^2}$$

$$= 0.39 - \frac{0.06}{2} \log \frac{\left[\frac{K_{sp}}{[OH^-]^2} \times 1\right]}{[H^+]^2}$$

$$= 0.39 - 0.03 \log \frac{K_{sp}}{(K_w)^2}$$

$E = 0$

$$\therefore 0.39 = 0.03 \log \frac{K_{sp}}{K_w^{\,2}}$$

$$13 = \log \frac{K_{sp}}{K_w^{\,2}}$$

$13 = \log K_{sp} - \log K_w^{\,2}$

$13 = \log K_{sp} + 28$

$\log K_{sp} = -15$

$$\frac{1}{5}\frac{1}{\log K_{sp}} = \frac{1}{5} \times 15 = 3$$

30. 1080

Sol. $2CH_3COO^- \longrightarrow (n_f = 2)\ C_2H_6 + (n_f = 1)\ 2CO_2 + 2e^-$

Number of equivalents deposited

$$= \frac{it}{96500} = \frac{2 \times 965 \times 60 \times 60}{96500} = 72$$

$$\text{Moles of } C_2H_6 = \frac{72}{2} = 36$$

$$\text{Moles of } CO_2 = \frac{72}{1} = 72$$

Total moles = 36 + 72 = 108

Total volume

$$= \frac{nRT}{P} = \frac{108 \times 0.0821 \times \frac{10}{0.0821}}{1} = 1080 \text{ L}$$