PHYSICAL / INORGANIC CHEMISTRY

DPP
DAILY PRACTICE PROBLEMS

DPP No. 32

Total Marks : 33

Max. Time : 36 min.

Topic : Electro Chemistry

Type of Questions		M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.3	(3 marks, 3 min.)	[9, 9]
Subjective Questions ('–1' negative marking) Q.4 to Q.6	(4 marks, 5 min.)	[12, 15]
Comprehension ('–1' negative marking) Q.7 to Q.10	(3 marks, 3 min.)	[12, 12]

1. Aqueous solution of Na_2SO_4 containing a small amount of HPh (Phenolphthalein) is electrolysed using Pt-electrodes. The colour of the solution after some time will :

(A) remain colourless (B) change from pink to colourless

(C) change from colourless to pink (D) remain pink

2. For the electrolytic production of $NaClO_4$ from $NaClO_3$ as per the equation, $NaClO_3 + H_2O \longrightarrow NaClO_4 + H_2$, how many faradays of electricity will be required to produce 0.5 mole of $NaClO_4$, assuming 60% efficiency?

(A) 0.835 F (B) 1.67 F (C) 3.34 F (D) 1.6 F

3. Identify the true and false statement and answer in given options

1. During electrolysis of 1M NaCl solution Cl_2 does not form at the anode.
2. For a concentration cell with its reaction at equilibrium both E_{cell} and E°_{cell} are zero.
3. The hybridisation of $[Cr(H_2O)_6]^{+++}$ is sp^3d^2.

(A) F T F (B) T T T (C) F F F (D) F T T

4. A current of 0.2 A is passed for 10 minutes through 0.05 dm^3 of 0.1 M NaCl. If only chlorine is produced at anode and water is reduced to H_2 at cathode, what is the OH^- concentration in the solution after electrolysis?

5. Find the thickness of the electro deposited silver if the surface area over which deposition occurred was 100 cm^2 and a current of 0.2 A flowed for 1hr with the cathodic efficiency of 80%. Density of Ag = 10 g/cc (Ag = 108).

6. A 300 mL solution of NaCl was electrolysed for 6.00 min. If the pH of the final solution was 12.24, calculate the average current used.

Comprehension # (Q.7 to Q.10)

If an electrolytic solution consists of more than two ions and electrolysis is done, it is observed that all the ions are not discharge at the electrodes simultaneously but certain ions are liberate at the electrodes in perferential discharge theory. It states that if more than one type of ions are attracted towards a particular electrode, then the one discharged is the ion which required least energy. The potential at which the ion is discharge or deposited on the apropriate electrode is termed as discharge or depositon potential (E). If current of 1 ampere is passed through an aqueous (1 litre) electrolytic solution having $[Zn^{2+}] = [Cu^{2+}] = [Mn^{2+}] = 0.03$ M. The standard electrode potential, $E^0_{Cu^{2+}/Cu} = 0.34$ V, $E^0_{Zn/Zn^{2+}} = 0.762$ V and $E^0_{Mn/Mn^{2+}} = 1.8$ V are observed and 1 Faraday = 96500 coulomb.

7. Which of the following metal is almost first deposited at cathode ?

(A) Cu (B) Zn (C) Mn (D) All of these.

8. What would be the approximate concentration of metal ions Cu^{2+}, Zn^{2+} and Mn^{2+} after 96.5 min respectively?

(A) 0.01 M , 0.03 M, 0.001 M (B) 0.01 M, 0.03 M, 0.03 M

(C) 0 M, 0.03 M, 0.03 M (D) 0.003 M, 0.03 M, 0 M.

9. After 106.5 minute the metal deposited is approximately ?

(A) 0.012 mole of Cu (B) 0.03 mole of Zn (C) 0.03 mole of Mn (D) 0.003 mole of Zn

10. If current efficiency is 50%, what volume of O_2 gas evolved at NTP after 96.5 minutes ?

(A) 332 mL (B) 168 mL (C) 84 mL (D) 42 mL

Answer Key

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1.	(A)	**2.**	(B)	**3.**	(A)	**4.**	0.02486 Molar.		
5.	6.4×10^{-4} cm	**6.**	1.4 A.	**7.**	(A)	**8.**	(C)	**9.**	(D)
10.	(B)								

Hints & Solutions

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1. Remains colourless since solution is almost neutral & Hph shows pink colour only in basic medium.

Cathode : $2H_2O + 2e \longrightarrow H_2 + 2OH^-$.

Anode : $2H_2O \longrightarrow O_2 + 4H^+ + 4e^-$.

both OH^- equivalent = H^+ equivalent.

2. $NaCl O_3 + H_2O \longrightarrow NaClO_4 + H_2$

At cathode : $2H^+ + 2e^- \longrightarrow H_2$

For 1 mole of $NaClO_4$ and H_2 we require 2 F of charge

For 0.5 mole of $NaClO_4$ we require 1 F of charge

$\therefore$ Electricity required = 1×100/60 = 1.67F.

4. The number of Faradays = $\frac{600 \times 0.2}{96500} = 1.243 \times 10^{-3}$.

At the cathode, reaction is

$$H_2O + e^- \longrightarrow \frac{1}{2} H_2 + OH^-$$

1.243×10^{-3} mol of OH^- are produced.

The concentration = $1.243 \times 10^{-3} / 0.05 = 0.02486$ Molar.

5. $th \times Area \times density = \frac{108 \times 0.2 \times 0.8 \times 3600}{96500}$;

$$th = \frac{108 \times 0.2 \times 0.8 \times 3600}{96500 \times 100 \times 10} \text{ cm} = 6.4 \times 10^{-4} \text{ cm}$$

6. Anode : $2Cl^- \longrightarrow Cl_2(g) + 2e^-$ $\quad E^\circ = -1.36$ V

Cathods : $2H_2O + 2e^- \longrightarrow H_2(g) + 2OH^-$ $\quad E^\circ = -0.83$ V

pH = 12.24 $\Rightarrow [OH^-] = 0.0174$M

Moles of $OH^- = 0.3 \times 0.0174 = 5.213 \times 10^{-3}$ moles

= Moles of e^-

Total charge = $5.213 \times 10^{-3} \times 96500 = 503.1$ C.

$It = 503.1 \quad \Rightarrow \quad I = \frac{503.1}{360} = 1.4$ A.

7. The reduction potential of $Cu^{2+} > Zn^{2+} > Mn^{2+}$.

8. Since, no. of Faraday used

= No of equivalent deposited = (n-factor) × mole deposited

$$\therefore \text{ mole deposited } = \frac{\text{no. of Faraday used}}{\text{n-factor}} = \frac{i \times t}{96500} \times \frac{1}{n} = \frac{1 \times 96.5 \times 60}{96500 \times 2} = 30 \times 10^{-3} = 0.03.$$

9. If time for the deposition of Zn be t

$\therefore \quad t = 106.5 - 96.5 = 10$ minute.

$$\therefore \text{ mole deposited } = \frac{1 \times 10 \times 60}{96500} \times \frac{1}{2} = 0.0031.$$

10. No.of equivalent of O_2 evolved = no.of Faraday used

$$= \frac{\left(\frac{50}{100}\right) i.t}{96500} = \frac{0.5 i.t}{96500} \quad \therefore \quad \text{mole of } O_2 = \frac{0.5 \times 1 \times 96.5 \times 60}{96500} \times \frac{1}{4} = \frac{0.03}{4}$$

$$\therefore \quad \text{volume at NTP} = \frac{0.03}{4} \times 22.4 = 0.168 \text{ L} = 168 \text{ mL}.$$