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Chapter End Test

Date : _____ Duration: 30 mins Max. Marks : 25	Chemistry Topic : Electrochemistry	BATCH XII

Disclaimer: The objective is to test the understanding of the children. For long question is to write coherently in more than one paragraph.

General instruction:

1. This paper consist of two Sections. Students has to attempt both sections.
2. Section – A is objective carry 1 mark each.
3. Section – B is subjective.

[Section – A]

1. A current of 20A passed for 5 hours through a molten metal salt deposits 222 g of metal (at mass = 177). The oxidation state of the metal salt is

(a) +1 (b) +2
(c) +3 (d) +4

2. The quantity of charge required to obtain one mole of Al from Al_2O_3 is

(a) 1F (b) 2F
(c) 3F (d) 6F

3. Resistance of 0.2 M solution of an electrolyte is 50 Ω. The specific conductance of the solution is 1.4 S m^{-1}. The resistance of 0.5 M solution of the same electrolyte is 280 Ω. The molar conductivity of 0.5 M solution of the electrolyte in S m^2mol^{-1} is

(a) 5×10^2 (b) 5×10^{-4}
(c) 5×10^{-3} (d) 5×10^3

4. An electrochemical cell can behave like an electrolytic cell when

(a) $E_{cell} = 0$ (b) $E_{cell} > E_{ext}$
(c) $E_{ext} > E_{cell}$ (d) $E_{cell} = E_{ext}$

5. $Cr_2O_7^{2-} + I^- \rightarrow I_2 + Cr^{3+}$

$E^0_{cell} = 0.79$ V, $E^0_{Cr_2O_7^{2-}} = 1.33$ V, $E^0_{I_2} = ?$

(a) 0.54 V (b) –0.054 V
(c) +0.18 V (d) –0.18 V

6. The standard reduction potentials for Zn^{2+}/Zn, Ni^{2+}/Ni and Fe^{2+}/Fe are –0.76, –0.23 and –0.44 V respectively. The reaction $X + Y^{2+} \rightarrow X^{2+} + Y$ will be spontaneous when

(a) X = Zn, Y = Ni (b) X = Ni, Y = Fe
(c) X = Ni, Y = Zn (d) X = Fe, Y = Zn

7. Given at 25°C,

$\left[Ag(NH_3)_2\right]^+ + e^- \rightarrow Ag + 2NH_3;\ E^0 = 0.02$ V

$Ag^+ + e^- \rightarrow Ag;\ E^0 = 0.80$ V

The value of equilibrium constant of the reaction

$\left[Ag(NH_3)\right]^+ \rightleftharpoons Ag^+ + 2NH_3$ will be

(a) 6.3×10^{-8} (b) 3.6×10^{-10}
(c) 3.6×10^{-12} (d) 6.3×10^{-14}

8. The cell constant of a conductivity cell
(a) changes with change of electrolyte
(b) changes with change of concentration of electrolyte
(c) remains constant for a cell
(d) changes with temperature of electrolyte

9. Conductivity of 0.01 M NaCl solution is 0.00147 cm^{-1}. What happens to this conductivity if extra 100 ml of H_2O will be added to the above solution?
(a) Increases (b) Decreases
(c) Remain unchanged (d) First increases and then decreases

10. A current of 0.5 A is passed for 30 minutes through a voltmeter containing $CuSO_4$ solution. The weight of Cu deposited will be
(a) 3.18 g (b) 0.318 g
(c) 0.296 g (d) 0.150 g

11. 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 the electrode would be
(a) 0.059 V (b) 0.59 V
(c) 0.118 V (d) 1.18 V

12. Among the following cells
Leclanche cell (I), Nickel – cadmium cell (II), Lead storage battery (III), Mercury cell (IV), primary cells are
(a) I and II (b) I and III
(c) II and III (d) I and IV

13. Units of conductivity is
(a) S m^{-1} (b) m^{-1}
(c) S m^2mol^{-1} (d) S cm^2mol^{-1}

14. Electrode potential of any electrode depends on
(a) nature of the metal (b) temperature of the solution
(c) molarity of the solution (d) all of these

15. Which has the highest oxidizing power?
(a) I_2 (b) Br_2
(c) F_2 (d) Cl_2

[Section – B]

16. How does the mercury cell work?

OR

What type of cell is a lead storage battery? Write the anode and the cathode reaction during discharging.

17. Conductivity of 0.00241 M acetic acid is 7.896×10^{-5} S cm^{-1}. Calculate its molar conductivity. If Λ_m^0 of acetic acid is 390.5 S cm^2mol^{-1}, what is its dissociation constant?

18. (a) Calculate the cell potential of the following cell at 25°C:

$$Cr(S)\,|\,Cr^{3+}(0.1\ M)\,\|\,Fe^{2+}(0.01\ M)\,|\,Fe$$

Given

$$E^0_{Cr^{3+}|Cr} = -0.74\ V,\ E^0_{Fe^{2+}|Fe} = -0.44\ V$$

(b) Name the type of cell that was used in Apollo space programme for providing electrical power, also mention the advantage of using this type of cell.
(c) How much charge is required for conversion of 1 mol of Zn^{2+} to Zn?

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Hints/Solutions to Chapter End Test

Date : _____ Duration: 30 mins Max. Marks : 25	Chemistry Topic : Electrochemistry	BATCH XII

1. (c)
2. (c)
3. (b)
4. (c)
5. (a)
6. (a)
7. (d)
8. (c)
9. (b)
10. (c)
11. (b)
12. (d)
13. (a)
14. (d)
15. (c)

16. Refer notes.

17. $\Lambda_m^c = \frac{K \times 1000}{C} = \frac{7.896 \times 10^{-5} \times 1000}{0.00241} = 32.76 \text{ S cm}^2$

$\alpha = \frac{\Lambda_m^c}{\Lambda_m^\infty} = \frac{32.76}{390.5} = 8.4 \times 10^{-2}$

$K_a = \frac{C\alpha^2}{1-\alpha} = \frac{0.00241 \times \left(8.4 \times 10^{-2}\right)^2}{1 - 0.084} = 1.86 \times 10^{-5}$

18. (a) $2Cr + 3Fe^{2+} \rightarrow 2Cr^{2+} + 3Fe$

$E^0_{cell} = E^0_{Fe^{2+}Fe} - E^0_{Cr^{3+}Cr}$

$= -0.44 - (-0.74) = 0.30$ V

$$E_{cell} = E^0_{cell} - \frac{0.0591}{6} \log \frac{\left[Cr^{3+}\right]^2}{\left[Fe^{2+}\right]^3}$$

$$= 0.30 - \frac{0.0591}{6} \log \frac{(0.1)^2}{(0.01)^3}$$

$= 0.30 - 0.00985 \log 10^4$

$= 0.30 - 0.00985 \times 4 \log 10$

$= 0.30 - 0.00985 \times 4$

$= 0.30 - 0.0394$

$E_{cell} = 0.2606$ V

(b) Fuel cell and refer notes

(c) 2F

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