Competition Focus

JEE (Main and Advanced)/Medical Entrance SPECIAL

For complete and exhaustive preparation of this unit for competitive examinations, students are advised to refer to

Pradeep's Objective Chemistry by Dhawan, Kheterpal and Mehta,

available separately for Medical and Engineering entrance examinations.

I. Multiple Choice Questions (with One Correct Answer)

I. Electrolysis and Faraday's laws

1. What current is to be passed for 0·25 s for deposition of a certain weight of metal which is equal to its electrochemical equivalent ?
   (*a*) 4 A (*b*) 100 A
   (*c*) 200 A (*d*) 2 A

2. In an experiment 0·04 F was passed through 400 ml of 1 M solution of NaCl. What would be the pH of the solution after the electrolysis ?
   (*a*) 8 (*b*) 10
   (*c*) 13 (*d*) 6
   (*e*) 9

3. Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milli ampere current. The time required to liberate 0·01 mol of H_2 gas at the cathode is (1 Faraday = 96500 C mol^{-1})
   (*a*) $9{\cdot}65 \times 10^4$ sec (*b*) $19{\cdot}3 \times 10^4$ sec
   (*c*) $28{\cdot}95 \times 10^4$ sec (*d*) $38{\cdot}6 \times 10^4$ sec
   (IIT 2008)

4. Two faradays of electricity are passed through a solution of $CuSO_4$. The mass of copper deposited at the cathode (at. mass of Cu = 63·5 amu)
   (*a*) 2 g (*b*) 127 g
   (*c*) 0 g (*d*) 63·5 g
   (JEE Main 2015)

5. One faraday of electricity is passed through molten Al_2O_3, aqueous solution of $CuSO_4$ and molten NaCl taken in three different electrolytic cells connected in series. The mole ratio of Al, Cu and Na deposited at the respective cathodes is
   (*a*) 2 : 3 : 6 (*b*) 6 : 2 : 3
   (*c*) 6 : 3 : 2 (*d*) 1 : 2 : 3
   (*e*) 3 : 6 : 2 **(Kerala PET 2010)**

6. 9·65 C electric current is passed through fused anhydrous magnesium chloride. The magnesium metal thus obtained is completely converted into a Grignard reagent. The number of moles of the Grignard reagent obtained is
   (*a*) 5×10^{-4} (*b*) 1×10^{-4}
   (*c*) 5×10^{-5} (*d*) 1×10^{-5}
   (Karnataka CET 2010)

7. A current is passed through two cells connected in series. The first cell contains X $(NO_3)_3$ (*aq*) and the second cell contains Y $(NO_3)_2$ (*aq*). The relative atomic masses of X and Y are in the ratio 1 : 2. What is the ratio of the liberated mass of X to that of Y ?
   (*a*) 3 : 2 (*b*) 1 : 2
   (*c*) 1 : 3 (*d*) 3 : 1
   (*e*) 2 : 1

8. A current of 2·0 A passed for 5 hours through a molten metal salt deposits 22·2 g of metal (At wt. = 177). The oxidation state of the metal in the metal salt is
   (*a*) +1 (*b*) +2
   (*c*) +3 (*d*) +4.

ANSWERS

1. (*a*) 2. (*c*) 3. (*b*) 4. (*d*) 5. (*a*) 6. (*c*) 7. (*c*) 8. (*c*)

9. Same quantity of electricity was passed through solutions of salts of elements A, B and C with atomic weights 7, 27 and 48 respectively. The masses of A, B and C deposited were 2·1 g, 2·7 g and 7·2 g respectively. The valencies of A, B and C respectively are
(a) 3, 2 and 1 (b) 1, 2 and 3
(c) 1, 3 and 2 (d) 2, 3 and 2

10. Al_2O_3 is reduced by electrolysis at low potentials and high currents. If $4·0 \times 10^4$ amperes of current is passed through molten Al_2O_3 for 6 hours, what mass of aluminium is produced ? (Assume 100% current efficiency. At. mass of Al = 27 g mol^{-1})
(a) $8·1 \times 10^4$ g (b) $2·4 \times 10^5$ g
(c) $1·3 \times 10^4$ g (d) $9·0 \times 10^3$ g

11. When 0·1 mol MnO_4^{2-} is oxidized, the quantity of electricity required to completely oxidize MnO_4^{2-} to MnO_4^- is
(a) 96500 C (b) 2 × 96500 C
(c) 9650 C (d) 96·50 C
(AIPMT 2014)

12. The weight of silver (at. wt. = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be
(a) 5·4 g (b) 10·8 g
(c) 54·0 g (d) 108·0 g
(AIPMT 2014)

13. 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
(a) 55 minutes (b) 110 minutes
(c) 220 minutes (d) 330 minutes
(NEET Phase II 2016)

14. The number of electrons delivered at the cathode during electrolysis by a current of 1 amphere in 60 seconds is (charge on the electron = $1·60 \times 10^{-19}$ C)
(a) 6×10^{23} (b) 6×10^{20}
(c) $3·75 \times 10^{20}$ (d) $7·48 \times 10^{23}$
(NEET Phase II 2016)

II. Conductance and specific, equivalent and molar conductivities

15. The resistance of a 0·10 M weak acid HA in a conductivity cell is $2·0 \times 10^3$ ohm. The cell constant of the cell is 0·78 cm^{-1} and $\wedge_0$ of the acid is 390 S cm^2 mol^{-1}.
Consider the following statements :
1. pH of the acid solution = 3
2. pK_a of the acid = 5
3. Degree of dissociation of the acid = 0·01
Which of the statements given above are correct ?
(a) 1 and 2 only (b) 1 and 3 only
(c) 2 and 3 only (d) 1, 2 and 3
(IAS Prelim 2010)

16. An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to
(a) Increase in number of ions
(b) Increase in ionic mobility of ions
(c) 100% ionisation of electrolyte at normal dilution
(d) Increase in both, *i.e.*, number of ions and ionic mobility of ions
(AIPMT Prelim 2010 ; AIIMS 2014)

17. The sequence of ionic mobility in the aqueous solution is
(a) $K^+ > Na^+ > Rb^+ > Cs^+$
(b) $Cs^+ > Rb^+ > K^+ > Na^+$
(c) $Rb^+ > K^+ > Cs^+ > Na^+$
(d) $Na^+ > K^+ > Rb^+ > Cs^+$ (AIPMT 2008)

18. The equivalent conductance of NaCl at concentration C and at infinite dilution are λ_c and λ_∞ respectively. The correct relationship between λ_c and λ_∞ is given by (where the constant B is positive)
(a) $\lambda_c = \lambda_\infty + (B)\sqrt{C}$ (b) $\lambda_c = \lambda_\infty + (B)\,C$
(c) $\lambda_c = \lambda_\infty - (B)\,C$ (d) $\lambda_c = \lambda_\infty - (B)\sqrt{C}$
(JEE Main 2014)

19. 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^2 mol^{-1} is
(a) 5×10^2 (b) 5×10^{-4}
(c) 5×10^{-3} (d) 5×10^3
(JEE Main 2014)

20. The molar conductivity of a 0·5 mol/dm^3 solution of $AgNO_3$ with electrolytic conductivity of $5·76 \times 10^{-3}$ S cm^{-1} at 298 K is
(a) 2·88 S cm^2/mol (b) 11·52 S cm^2/mol
(c) 0·086 S cm^2/mol (d) 28·8 S cm^2/mol
(NEET Phase II 2016)

ANSWERS
9. (c) **10.** (a) **11.** (c) **12.** (d) **13.** (b) **14.** (c) **15.** (d) **16.** (b) **17.** (b) **18.** (d) **19.** (b) **20.** (b)

III. Kohlrausch's law and its applications

21. The limiting molar conductivities of HCl, CH_3COONa and NaCl are respectively 425, 90 and 125 mho cm^2 mol^{-1} at 25°C. The molar conductivity of 0·1 M CH_3COOH solution is 7·8 mho cm^2 mol^{-1} at the same temperature. The degree of dissociation of 0·1 M acetic acid solution at the same temperature is

(*a*) 0·10 (*b*) 0·02
(*c*) 0·15 (*d*) 0·03
(*e*) 0·20

(Kerala PET 2011, AIPMT Prelim 2012)

22. Ionic mobility of Ag^+ is ($\lambda_{Ag^+} = 5\times10^{-4}$ ohm^{-1} cm^2 eq^{-1})

(*a*) $5·2 \times 10^{-9}$ (*b*) $2·4 \times 10^{-9}$
(*c*) $1·52 \times 10^{-9}$ (*d*) $8·25 \times 10^{-9}$

23. Degree of dissociation of pure water is $1·9 \times 10^{-9}$. Molar ionic conductances of H^+ and OH^- ions at infinite dilution are 200 S cm^2 mol^{-1} and 350 S cm^2 mol^{-1} respectively. Molar conductance of water is

(*a*) $3·8 \times 10^{-7}$ S cm^2 mol^{-1}
(*b*) $5·7 \times 10^{-7}$ S cm^2 mol^{-1}
(*c*) $9·5 \times 10^{-7}$ S cm^2 mol^{-1}
(*d*) $1·045 \times 10^{-6}$ S cm^2 mol^{-1}

24. Λ°_{eq} for $BaCl_2$, H_2SO_4 and HCl are x_1, x_2 and x_3 S cm^2 eq^{-1} respectively. If conductivity of saturated $BaSO_4$ solution is y S cm^{-1}, then K_{sp} for $BaSO_4$ is

(*a*) $\dfrac{10^6\, y^2}{2(x_1 + x_2 - 2x_3)}$ (*b*) $\dfrac{10^9\, y^3}{8(x_1 + x_2 - 2x_3)^3}$

(*c*) $\dfrac{10^3\, y}{2(x_1 + x_2 - 2x_3)}$ (*d*) $\dfrac{10^6\, y^2}{4(x_1 + x_2 - 2x_3)^2}$

25. Equivalent conductivity at infinite dilution for sodium potassium oxalate, $(COO^-)_2Na^+K^+$, will be (given, molar conductivities of oxalate, K^+ and Na^+ ions at infinite dilution are 148·2, 50·1, 73·5 S cm^2 mol^{-1} respectively)

(*a*) 271·8 S cm^2 eq^{-1} (*b*) 67·95 S cm^2 eq^{-1}
(*c*) 543·6 S cm^2 eq^{-1} (*d*) 135·9 S cm^2 eq^{-1}

(West Bengal JEE Engg. 2013)

IV. Galvanic cells

26. The reaction taking place in the cell

Pt | H_2 (*g*) | HCl (1·0 M) | AgCl | Ag is 1 atm

(*a*) $AgCl + (1/2)\,H_2 \longrightarrow Ag + H^+ + Cl^-$
(*b*) $Ag + H^+ + Cl^- \longrightarrow AgCl + (1/2)\,H_2$
(*c*) $2\,Ag^+ + H_2 \longrightarrow 2\,Ag + 2\,H^+$
(*d*) $2\,Ag + 2\,H^+ \longrightarrow 2\,Ag^+ + H_2$

(IAS Prelim 2010)

V. Electrode potential, cell potential, electrochemical series and its applications

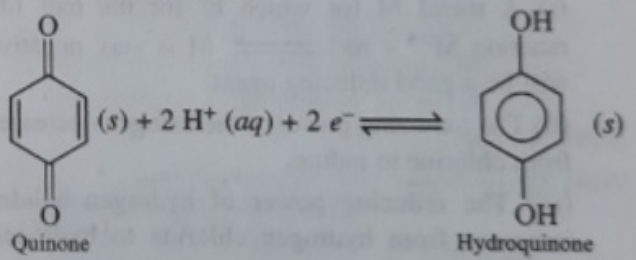
27. When measured against a standard calomel electrode, an electrode is found to have a standard reduction potential of 0·100 V. If standard reduction potential of calomel electrode is + 0·244 V and it acts as anode, the standard electrode potential of the same electrode against standard hydrogen electrode will be

(*a*) – 0·144 V (*b*) + 0·100 V
(*c*) – 0·344 V (*d*) – 0·100 V

28. Which has maximum potential for the half cell reaction : $2\,H^+ + 2e^- \longrightarrow H_2$?

(*a*) 1·0 M HCl (*b*) 1·0 M NaOH
(*c*) Pure water
(*d*) A solution with pH = 4

29. Quinhydrone electrode is sometimes used to find the pH of a solution. It is based on the following electrode reaction :



Its standard electrode potential is 0·70 V. If in a particular solution, the electrode potential is found to be 0·58 V, the pH of the solution is

(*a*) 2 (*b*) 4
(*c*) 6 (*d*) 8

30. Given $E^\circ_{Cr^{3+}/Cr} = -0·74$ V,

$E^\circ_{MnO_4^-/Mn^{2+}} = 1·51$ V

$E^\circ_{CrO_7^{2-}/Cr^{3+}} = 1·33$ V, $E^\circ_{Cl/Cl^-} = 1·36$ V

Based on the data given above, strongest oxidizing agent will be

ANSWERS

21. (*b*) **22.** (*a*) **23.** (*d*) **24.** (*d*) **25.** (*d*) **26.** (*a*) **27.** (*b*) **28.** (*a*) **29.** (*a*)