DPP - Daily Practice Problems

Chapter-wise Sheets

Date : | Start Time : | End Time :

CHEMISTRY CC17

SYLLABUS : Electrochemistry

Max. Marks : 180 **Marking Scheme :** + 4 for correct & (–1) for incorrect **Time : 60 min.**

INSTRUCTIONS : This Daily Practice Problem Sheet contains 45 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.

1. A gas X at 1 atm is bubbled through a solution containing a mixture of 1 M Y^- and 1 M Z^- at 25°C. If the reduction potential of Z > Y > X, then,
(a) Y will oxidize X and not Z
(b) Y will oxidize Z and not X
(c) Y will oxidize both X and Z
(d) Y will reduce both X and Z

2. On the basis of the following E° values, the strongest oxidizing agent is :
$[Fe(CN)_6]^{4-} \rightarrow [Fe(CN)_6]^{3-} + e^-$; E° = – 0.35 V
$Fe^{2+} \rightarrow Fe^{3+} + e^-$; E° = – 0.77 V
(a) $[Fe(CN)_6]^{4-}$ (b) Fe^{2+}
(c) Fe^{3+} (d) $[Fe(CN)_6]^{3-}$

3. Resistance of a conductivity cell filled with a solution of an electrolyte of concentration 0.1 M is 100 Ω. The conductivity of this solution is 1.29 S m^{-1}. Resistance of the same cell when filled with 0.2 M of the same solution is 520 Ω. The molar conductivity of 0.2 M solution of electrolyte will be
(a) 1.24×10^{-4} S m^2 mol^{-1} (b) 12.4×10^{-4} S m^2 mol^{-1}
(c) 124×10^{-4} S m^2 mol^{-1} (d) 1240×10^{-4} S m^2 mol^{-1}

4. For the electrochemical cell, $M \mid M^+ \parallel X^- \mid X$,
$E^o_{M^+/M} = 0.44V$ and $E^o_{X/X^-} = 0.33V$.
From this data one can deduce that
(a) $M + X \rightarrow M^+ + X^-$ is the spontaneous reaction
(b) $M^+ + X^- \rightarrow M + X$ is the spontaneous reaction
(c) $E_{cell} = 0.77$ V
(d) $E_{cell} = -0.77$ V

5. What will be the emf for the given cell
$Pt \mid H_2(P_1) \mid H^+(aq) \mid\mid H_2(P_2) \mid Pt$
(a) $\frac{RT}{F}\log_e \frac{P_1}{P_2}$ (b) $\frac{RT}{2F}\log_e \frac{P_1}{P_2}$
(c) $\frac{RT}{F}\log_e \frac{P_2}{P_1}$ (d) None of these

RESPONSE GRID	1. ⓐⓑⓒⓓ	2. ⓐⓑⓒⓓ	3. ⓐⓑⓒⓓ	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ

Space for Rough Work

6. What is the standard cell potential E° for an electrochemical cell in which the following reaction takes place spontaneously ?

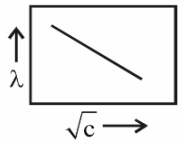
$Cl_2(g) + 2Br^- \rightarrow Br_2(aq) + 2Cl^-, \Delta G° = -50.6$ kJ

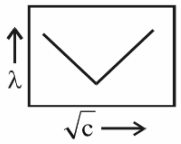
(a) 1.2 V (b) 0.53 V
(c) 0.26 V (d) –0.53 V

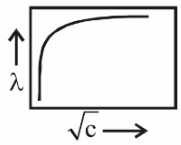
7. The unit of equivalent conductivity is

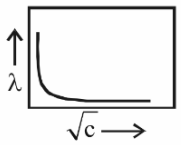
(a) ohm cm
(b) ohm^{-1} cm^2 (g equivalent)$^{-1}$
(c) ohm cm^2 (g equivalent)
(d) S cm^{-2}

8. The variation of equivalent conductance of strong electrolyte with (concentration)$^{1/2}$ is represented by

(a) 

(b) 

(c) 

(d) 

9. Consider the following cell reaction:

$2Fe(s) + O_2(g) + 4H^+(aq) \rightarrow$

$2Fe^{2+}(aq) + 2H_2O(l); E° = 1.67$ V

At $[Fe^{2+}] = 10^{-3}$ M, $p(O_2) = 0.1$ atm and pH = 3, the cell potential at 25°C is

(a) 1.47 V (b) 1.77 V
(c) 1.87 V (d) 1.57 V

10. The electrical properties and their respective SI units are given below. Identify the wrongly matched pair.

	Electrical property	**SI unit**
(a)	Specific conductance	S m^{-1}
(b)	Conductance	S
(c)	Equivalent conductance	S m^2 g equiv^{-1}
(d)	Cell constant	m

11. Limiting molar conductivity of NH_4OH $\left(\text{i.e., } \Lambda°_{m(NH_4OH)}\right)$ is equal to :

(a) $\Lambda°_{m(NH_4Cl)} + \Lambda°_{m(NaCl)} - \Lambda°_{m(NaOH)}$

(b) $\Lambda°_{m(NaOH)} + \Lambda°_{m(NaCl)} - \Lambda°_{m(NH_4Cl)}$

(c) $\Lambda°_{m(NH_4OH)} + \Lambda°_{m(NH_4Cl)} - \Lambda°_{m(HCl)}$

(d) $\Lambda°_{m(NH_4Cl)} + \Lambda°_{m(NaOH} - \Lambda°_{m(NaCl)}$

12. A lead storage battery containing 5.0 L of (1N) H_2SO_4 solution is operated for 9.65×10^5 s with a steady current of 100 mA. Assuming volume of the solution remaining constant, normality of H_2SO_4 will

(a) remain unchanged (b) increases by 0.20
(c) increase by unity (d) decrease by 0.40

13. The electrode potential $E_{(Zn^{2+}/Zn)}$ of a zinc electrode at 25°C with an aqueous solution of 0.1 M $ZnSO_4$ is $[E°_{(Zn^{2+}/Zn)} = -0.76$ V. Assume $\frac{2.303RT}{F} = 0.06$ at 298 K].

(a) +0.73 (b) –0.79
(c) –0.82 (d) –0.70

14. A battery is constructed of Cr and $Na_2Cr_2O_7$. The unbalanced chemical equation when such a battery discharges is following:

$Na_2Cr_2O_7 + Cr + H^+ \rightarrow Cr^{3+} + H_2O + Na^+$

If one Faraday of electricity is passed through the battery during the charging, the number of moles of Cr^{3+} removed from the solution is

(a) $\frac{4}{3}$ (b) $\frac{1}{3}$
(c) $\frac{3}{3}$ (d) $\frac{2}{3}$

15. Which of the following reaction is possible at anode?

(a) $2Cr^{3+} + 7H_2O \rightarrow Cr_2O_7^{2-} + 14H^+$
(b) $F_2 \rightarrow 2F^-$
(c) $(1/2)O_2 + 2H^+ \rightarrow H_2O$
(d) none of these.

16. In a hydrogen-oxygen fuel cell, combustion of hydrogen occurs to

(a) produce high purity water
(b) create potential difference between two electrodes
(c) generte heat
(d) remove adsorbed oxygen from electron surfaces

RESPONSE GRID					
	6. ⓐⓑⓒⓓ	**7.** ⓐⓑⓒⓓ	**8.** ⓐⓑⓒⓓ	**9.** ⓐⓑⓒⓓ	**10.** ⓐⓑⓒⓓ
	11. ⓐⓑⓒⓓ	**12.** ⓐⓑⓒⓓ	**13.** ⓐⓑⓒⓓ	**14.** ⓐⓑⓒⓓ	**15.** ⓐⓑⓒⓓ
	16. ⓐⓑⓒⓓ				

Space for Rough Work

17. E° for the cell,

$Zn \mid Zn^{2+}(aq) \mid\mid Cu^{2+}(aq) \mid Cu$ is 1.10 V at 25°C. The equilibrium constant for the cell reaction

$Zn + Cu^{2+}(aq) \rightleftharpoons Cu + Zn^{2+}(aq)$

is of the order of

(a) 10^{-37} (b) 10^{37}

(c) 10^{-17} (d) 10^{17}

18. The correct order of $E^{\circ}_{M^{2+}/M}$ values with negative sign for the four successive elements Cr, Mn, Fe and Co is

(a) Mn > Cr > Fe > Co (b) Cr < Fe > Mn > Co

(c) Fe > Mn > Cr > Co (d) Cr > Mn > Fe > Co

19. For a spontaneous reaction the ΔG, equilibrium constant (K) and E^{o}_{Cell} will be respectively

(a) –ve, >1, –ve (b) –ve, <1, –ve

(c) +ve, >1, –ve (d) –ve, >1, +ve

20. If the E°_{cell} for a given reaction has a negative value, then which of the following gives the correct relationships for the values of ΔG° and K_{eq} ?

(a) $\Delta G^{\circ} > 0\,; K_{eq} > 1$ (b) $\Delta G^{\circ} < 0\,; K_{eq} > 1$

(c) $\Delta G^{\circ} < 0\,; K_{eq} < 1$ (d) $\Delta G^{\circ} > 0\,; K_{eq} < 1$

21. Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$, Given that $\Lambda^{\circ}_{Al^{3+}}$ and $\Lambda^{\circ}_{SO_4^{2-}}$ are the equivalent conductances at infinite dilution of the respective ions?

(a) $\frac{1}{3}\Lambda^{\circ}_{Al^{3+}} + \frac{1}{2}\Lambda^{\circ}_{SO_4^{2-}}$ (b) $2\Lambda^{\circ}_{Al^{3+}} + 3\Lambda^{\circ}_{SO_4^{2-}}$

(c) $\Lambda^{\circ}_{Al^{3+}} + \Lambda^{\circ}_{SO_4^{2-}}$ (d) $\left(\Lambda^{\circ}_{Al^{3+}} + \Lambda^{\circ}_{SO_4^{2-}}\right) \times 6$

22. Given : $E^{o}_{Cr^{3+}/Cr} = -0.74$ V; $E^{o}_{MnO_4^{-}/Mn^{2+}} = 1.51$ V

$E^{o}_{Cr_2O_7^{2-}/Cr^{3+}} = 1.33$ V; $E^{o}_{Cl/Cl^{-}} = 1.36$ V

Based on the data given above, strongest oxidising agent will be :

(a) Cl (b) Cr^{3+}

(c) Mn^{2+} (d) MnO_4^{-}

23. The standard electrode potentials $\left(E^{o}_{M^{+}/M}\right)$ of four metals A, B, C and D are – 1.2 V, 0.6 V, 0.85 V and – 0.76 V, respectively. The sequence of deposition of metals on applying potential is:

(a) A, C, B, D (b) B, D, C, A

(c) C, B, D, A (d) D, A, B, C

24. Which of the following statements is correct?

(a) Oxidation number of oxygen in KO_2 is +1

(b) The specific conductance of an electrolyte solution decreases with increase in dilution

(c) Sn^{2+} oxidises Fe^{3+}

(d) $Zn/ZnSO_4$ is a reference electrode

25. Molar ionic conductivities of a two-bivalent electrolytes x^{2+} and y^{2-} are 57 and 73 respectively. The molar conductivity of the solution formed by them will be

(a) 130 S cm^2 mol^{-1} (b) 65 S cm^2 mol^{-1}

(c) 260 S cm^2 mol^{-1} (d) 187 S cm^2 mol^{-1}

26. The cell, $Zn \mid Zn^{2+}(1\ M) \mid\mid Cu^{2+}(1\ M) \mid Cu$ ($E^{\circ}_{cell} = 1.10$ V) was allowed to be completely discharged at 298 K. The relative concentration of Zn^{2+} to Cu^{2+} $\left(\frac{[Zn^{2+}]}{[Cu^{2+}]}\right)$ is

(a) 9.65×10^4 (b) antilog (24.08)

(c) 37.3 (d) $10^{37.3}$.

27. Which of the following statements is true for an electrochemical cell?

(a) Reduction occurs at H_2 electrode

(b) H_2 is cathode and Cu is anode

(c) H_2 is anode and Cu is cathode

(d) Oxidation occurs at Cu electrode

28. Given

$Fe^{3+}(aq) + e^{-} \rightarrow Fe^{2+}(aq)$; $E^{o} = +0.77$ V

$Al^{3+}(aq) + 3e^{-} \rightarrow Al(s)$; $E^{o} = -1.66$ V

$Br_2(aq) + 2e^{-} \rightarrow 2Br^{-}$; $E^{o} = +1.09$ V

Considering the electrode potentials, which of the following represents the correct order of reducing power?

(a) $Fe^{2+} < Al < Br^{-}$ (b) $Br^{-} < Fe^{2+} < Al$

(c) $Al < Br^{-} < Fe^{2+}$ (d) $Al < Fe^{2+} < Br^{-}$

29. Standard free energies of formation (in kJ/mol) at 298 K are –237.2, –394.4 and –8.2 for $H_2O(l)$, $CO_2(g)$ and pentane (g), respectively. The value E°_{cell} for the pentane-oxygen fuel cell is :

(a) 1.968 V (b) 2.0968 V (c) 1.0968 V (d) 0.0968 V

30. Given $E^{o}_{Cr^{3+}/Cr} = -0.72$ V, $E^{o}_{Fe^{2+}/Fe} = -0.42$ V. The potential for the cell

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

(a) 0.26 V (b) 0.336 V (c) –0.339 V (d) 0.26 V

RESPONSE GRID					
	17. (a)(b)(c)(d)	18. (a)(b)(c)(d)	19. (a)(b)(c)(d)	20. (a)(b)(c)(d)	21. (a)(b)(c)(d)
	22. (a)(b)(c)(d)	23. (a)(b)(c)(d)	24. (a)(b)(c)(d)	25. (a)(b)(c)(d)	26. (a)(b)(c)(d)
	27. (a)(b)(c)(d)	28. (a)(b)(c)(d)	29. (a)(b)(c)(d)	30. (a)(b)(c)(d)	

Space for Rough Work

31. Electrolysis of dilute aqueous NaCl solution was carried out by passing 10 milli ampere current. The time required to liberate 0.01 mole of H_2 gas at the cathode is
(1 Faraday = 96500 C mol^{-1})
(a) 9.65×10^4 sec (b) 19.3×10^4 sec
(c) 28.95×10^4 sec (d) 38.6×10^4 sec

32. Which of the following reaction occurs at the cathode during the charging of lead storage battery?
(a) $Pb^{2+} + 2e^- \longrightarrow Pb$
(b) $Pb^{2+} + SO_4^{2-} \longrightarrow PbSO_4$
(c) $Pb \longrightarrow Pb^{2+} + 2e^-$
(d) $PbSO_4 + 2H_2O \longrightarrow 2PbO_2 + 4H^+ + SO_4^{2-} + 2e^-$

33. Conductance of 0.1 M KCl (conductivity = X $ohm^{-1}cm^{-1}$) filled in a conductivity cell is Y ohm^{-1}. If the conductance of 0.1 M NaOH filled in the same cell is Z ohm^{-1}, the molar conductance of NaOH will be
(a) $10^3 \frac{XZ}{Y}$ (b) $10^4 \frac{XZ}{Y}$
(d) $10\frac{XZ}{Y}$ (d) $0.1\frac{XZ}{Y}$

34. How much charge is required, when 1 mole of $Cr_2O_7^{2-}$ reduce to form 1 mole of Cr^{3+}?
(a) 6F (b) 3F
(c) 1F (d) 2F

35. In electrolysis of dilute H_2SO_4 using platinum electrodes
(a) H_2 is evolved at cathode
(b) NH_2 is produced at anode
(c) Cl_2 is obtained at cathode
(d) O_2 is produced

36. The resistance of 0.1 N solution of a salt is found to be 2.5×10^3 ohm. The equivalent conductance of the solution is (cell constant = 1.15 cm^{-1})
(a) 4.6 (b) 5.6 (c) 6.6 (d) 7.6

37. The highest electrical conductivity of the following aqueous solutions is of
(a) 0.1 M difluoroacetic acid
(b) 0.1 M fluoroacetic acid
(c) 0.1 M chloroacetic acid
(d) 0.1 M acetic acid

38. When during electrolysis of a solution of $AgNO_3$ 9650 coulombs of charge pass through the electroplating bath, the mass of silver deposited on the cathode will be
(a) 10.8 g (b) 21.6 g (c) 108 g (d) 1.08 g

39. The reduction potential of hydrogen half-cell will be negative if:
(a) $p(H_2) = 1$ atm and $[H^+] = 2.0$ M
(b) $p(H_2) = 1$ atm and $[H^+] = 1.0$ M
(c) $p(H_2) = 2$ atm and $[H^+] = 1.0$ M
(d) $p(H_2) = 2$ atm and $[H^+] = 2.0$ M

40. When electric current is passed through acidified water, 112 mL of hydrogen gas at STP collected at the cathode in 965 seconds. The current passed in amperes is
(a) 1.0 (b) 0.5 (c) 0.1 (d) 2.0

41. An electrolytic cell contains a solution of Ag_2SO_4 and has platinum electrodes. A current is passed until 1.6 g of O_2 has been liberated at anode. The amount of silver deposited at cathode would be
(a) 107.88 g (b) 1.6 g
(c) 0.8 g (d) 21.60 g

42. Which of the following pair(s) is/are incorrectly matched?
(i) R (resistance) – ohm (Ω)
(ii) ρ (resistivity) – ohm metre (Ωm)
(iii) G (conductance) – seimens or ohm (S)
(iv) κ (conductivity) – seimens $metre^{-1}$ (Sm^{-1})
(a) (i), (ii) and (iii) (b) (ii) and (iii)
(c) (i), (ii) and (iv) (d) (iii) only

43. 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 cathode is
(a) 2 : 3 : 6 (b) 6 : 2 : 3
(c) 6 : 3 : 2 (d) 1 : 2 : 3

44. If ρ is the resistance in ohm of a centimeter cube, generally called the specific resistance of the substance constituting the conductor, the resistance r of the layer containing "a" cubes is given by
(a) $\frac{1}{r} = \frac{1}{\rho} + \frac{1}{\rho} + ...$ (b) $\frac{1}{r} = \frac{1}{\rho a} + \frac{1}{\rho a} + ...$
(c) $r = a/\rho$ (d) $r = \rho + \rho + ...$

45. Which of the following statements is wrong ?
(a) Electrolysis of an aqueous sodium hydroxide solution liberates H_2 gas at the cathode and O_2 gas at the anode.
(b) Electrolysis of dil. H_2SO_4 liberates H_2(g) at cathode and O_2 (g) at the anode
(c) $\Delta G° = nFE°$ for a spontaneous reaction
(d) $E = E° - \frac{0.059}{n}\log Q$, Where Q = reaction quotient.

RESPONSE GRID				
31. ⓐⓑⓒⓓ	32. ⓐⓑⓒⓓ	33. ⓐⓑⓒⓓ	34. ⓐⓑⓒⓓ	35. ⓐⓑⓒⓓ
36. ⓐⓑⓒⓓ	37. ⓐⓑⓒⓓ	38. ⓐⓑⓒⓓ	39. ⓐⓑⓒⓓ	40. ⓐⓑⓒⓓ
41. ⓐⓑⓒⓓ	42. ⓐⓑⓒⓓ	43. ⓐⓑⓒⓓ	44. ⓐⓑⓒⓓ	45. ⓐⓑⓒⓓ

Space for Rough Work