DPP - Daily Practice Problems

Name : _____ Date : _____

Start Time : _____ End Time : _____

CHEMISTRY 34

SYLLABUS : Electrochemistry II : Cell constant and Electrochemical cells, Electrode potential, E_{cell}, Nernst equation and ECS

Max. Marks : 120 **Time : 60 min.**

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 If the half cell reaction $A + e^- \rightarrow A^-$ has a large negative reduction potential, it follows that

(a) A is readily reduced (b) A is readily oxidised

(c) A^- is readily reduced (d) A^- is readily oxidised

Q.2 Which of the following reactions occurs at the cathode of a common dry cell ?

(a) $Mn \rightarrow Mn^{2+} + 2e^-$

(b) $2MnO_2 + Zn^{2+} + 2e^- \rightarrow ZnMn_2O_4$

(c) $2ZnO_2 + Mn^{2+} + 2e^- \rightarrow MnZn_2O_4$

(d) Cu – Zn cell

Q.3 In electrolysis of dilute H_2SO_4 using platinum electrodes

(a) H_2 is evolved at cathode

(b) NH_3 is produced at anode

(c) Cl_2 is obtained at cathode

(d) O_2 is produced

Q.4 Which one is not called a anode reaction from the following?

(a) $Cl^- \rightarrow \frac{1}{2}Cl_2 + e^-$

(b) $Cu \rightarrow Cu^{++} + 2e^-$

(c) $Hg^+ \rightarrow Hg^{++} + e^-$

(d) $Zn^{2+} + 2e^- \rightarrow Zn$

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

Space for Rough Work

Q.5 In a hydrogen – oxygen fuel cell, combustion of hydrogen occurs to
(a) Produce high purity water
(b) Create potential difference between the two electrodes
(c) Generate heat
(d) Remove adsorbed oxygen from electrode surfaces

Q.6 The standard reduction potentials at 298 K for the following half reactions are given against each
$Zn^{2+}(aq.) + 2e \rightleftharpoons Zn(s)$; -0.762
$Cr^{3+}(aq) + 3e \rightleftharpoons Cr(s)$; -0.740
$2H^{+}(aq) + 2e \rightleftharpoons H_2(g)$; 0.00
$Fe^{3+}(aq) + e \rightleftharpoons Fe^{2+}(aq)$; 0.770
Which is the strongest reducing agent?
(a) Zn (s) (b) Cr(s)
(c) H_2 (g) (d) Fe^{2+} (aq)

Q.7 A solution containing one mole per litre of each $Cu(NO_3)_2$, $AgNO_3$, $Hg_2(NO_3)_2$ and $Mg(NO_3)_2$, is being electrolysed by using inert electrodes. The values of standard electrode potentials in volts (reduction potentials) are
$Ag/Ag^{+} = +0.80, 2Hg/Hg_2^{2+} = +0.79, Cu/Cu^{2+} = +0.34$, $Mg/Mg^{2+} = -2.37$ with increasing voltage, the sequence of deposition of metals on the cathode will be
(a) Ag, Hg, Cu, Mg (b) Mg, Cu, Hg, Ag
(c) Ag, Hg, Cu (d) Cu, Hg, Ag

Q.8 Which one of the following reaction is not possible?
(a) $Fe + H_2SO_4 \rightarrow FeSO_4 + H_2$
(b) $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
(c) $2KBr + I_2 \rightarrow 2KI + Br_2$
(d) $CuO + H_2 \rightarrow Cu + H_2O$

Q.9 $2H^{+}(aq) + 2e^{-} \rightarrow H_2(g)$. The standard electrode potential for the above reaction is (in volts)
(a) 0 (b) +1
(c) –1 (d) None of these

Q.10 Reduction potential of four elements P, Q, R, S is – 2.90, + 0.34, + 1.20 and – 0.76. Reactivity decreases in the order
(a) P > Q > R > S (b) Q > P > R > S
(c) R > Q > S > P (d) P > S > Q > R

Q.11 The reaction is spontaneous if the cell potential is
(a) positive (b) negative (c) zero (d) infinite

Q.12 Standard reduction potentials at 25°C of $Li^{+}|Li$, $Ba^{2+}|Ba$, $Na^{+}|Na$ and $Mg^{2+}|Mg$ are –3.05, –2.90, – 2.71 and – 2.37 volt respectively. Which one of the following is the strongest oxidising agent?
(a) Na^{+} (b) Li^{+} (c) Ba^{2+} (d) Mg^{2+}

Q.13 Which of the following displaces Br_2 from an aqueous solution containing bromide ions ?
(a) Cl_2 (b) Cl^{-} (c) I_2 (d) I_3^{-}

Q.14 The E° for half cells Fe/Fe^{2+} and Cu/Cu^{2+} are – 0.44 V and + 0.32 V respectively. Then
(a) Cu^{2+} oxidises Fe (b) Cu^{2+} oxidises Fe^{2+}
(c) Cu oxidises Fe^{2+} (d) Cu reduces Fe^{2+}

Q.15 What is E° for electrode represented by Pt, O_2 (1 atm) / $2H^{+}$ (1m)?
(a) Unpredictable (b) Zero
(c) 0.018V (d) 0.118V

Q.16 The cell potential of a cell in operation is
(a) zero (b) positive
(c) negative (d) None of the above

Q.17 The electrode potentials for
$Cu^{2+}(aq) + e^{-} \longrightarrow Cu^{+}(aq)$
and $Cu^{+}(aq) + e^{-} \longrightarrow Cu(s)$
are + 0.15 V and + 0.50, respectively. The value of $E^{\circ}_{Cu^{2+}/Cu}$ will be :
(a) 0.500V (b) 0.325V
(c) 0.650V (d) 0.150V

Q.18 Standard reduction electrode potentials of three metals A, B and C are respectively + 0.5V, – 3.0V and – 1.2 V. The reducing powers of these metals are
(a) B > C > A (b) A > B > C
(c) C > B > A (d) A > C > B

Q.19 Adding powdered lead and iron to a solution that is 1.0 *M* in both Pb^{2+} and Fe^{2+} ions, would result a reaction, in which
(a) More iron and Pb^{2+} ions are formed
(b) More lead and Fe^{2+} ions are formed
(c) Concentration of both Pb^{2+} and Fe^{2+} ions increases
(d) There is no net change

RESPONSE GRID					
5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ	9. ⓐⓑⓒⓓ
10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ	14. ⓐⓑⓒⓓ
15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	18. ⓐⓑⓒⓓ	19. ⓐⓑⓒⓓ

Space for Rough Work

Q.20 Which of the following condition will increase the voltage of the cell, represented by the equation?
$Cu(s) + 2Ag^+(aq) \rightarrow Cu^{2+}(aq) + 2Ag(s)$
(a) Increase in the concentration of Ag^+ ion
(b) Increase in the concentration of Cu^+ ion
(c) Increase in the dimension of silver electrode
(d) Increase in the dimension of copper electrode

Q.21 What is wrongly stated about electrochemical series?
(a) It is the representation of elements in order of increasing or decreasing standard electrode reduction potential.
(b) It does not compare the relative reactivity of metals.
(c) It compares relative strength of oxidising agents.
(d) H_2 is centrally placed element

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :
(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct
(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 Which of the following are correct ?
Given, the half cell emf's

$E^{\bullet}_{Cu^{2+}|Cu} = 0.337,\ E^{\circ}_{Cu^{+}|Cu} = 0.521$

(1) Cu^+ disproportionates.
(2) Cu and Cu^{2+} comproportionates (reverse of disproportionation) into Cu^+.
(3) $E^{\bullet}_{Cu|Cu^{2+}} + E^{\circ}_{Cu^{+}|Cu}$ is positive.
(4) All of these

Q.23 The standard redox potentials E° of the following systems are:

	System	E° (volts)
(i)	$MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$	1.51
(ii)	$Sn^{2+} \rightarrow Sn^{4+} + 2e^-$	−0.15
(iii)	$Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$	1.33
(iv)	$Ce^{3+} \rightarrow Ce^{4+} + e^-$	−1.61

The oxidising power of the various species are related as
(1) $MnO_4^- > Sn^{4+}$ (2) $Ce^{4+} > Sn^{4+}$
(3) $Ce^{4+} > MnO_4^-$ (4) $Cr_2O_7^{2-} > MnO_4^-$

Q.24 Which of the following statements are true for the electrochemical Daniel cell ?
(1) Electrons flow from copper electrode to zinc electrode
(2) Current flows from zinc electrode to copper electrode
(3) Cations move toward copper electrode which is cathode
(4) Cations move toward zinc electrode

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follows :

Tollen's reagent is used for detection of aldehydes. When NH_4OH is added in glucose with $AgNO_3$ solution, then gluconic acid is formed.

$Ag^+ + e^- \longrightarrow Ag;\ E^\circ_{red} = +0.800V$

$C_6H_{12}O_6 + H_2O \longrightarrow \underset{\text{Gluconic acid}}{C_6H_{12}O_7} + 2H^+ + 2e^-;\ E^\circ_{ox} = -0.05V$

$[Ag(NH_3)_2]^+ + e^- \longrightarrow Ag + 2NH_3;\ E^\circ_{red} = 0.373V$

Given $\frac{2.303RT}{F} = 0.0591$ and $\left(\frac{F}{RT}\right) = 38.92V^{-1}$

Q.25 Calculate (lnK) for

$C_6H_{12}O_6 + 2Ag^+ + H_2O \longrightarrow C_6H_{12}O_7 + 2H^+ + 2Ag$

(a) 66.13 (b) 58.38
(c) 28.30 (d) 46.29

Q.26 On adding NH_3, pH of the solution increases to 11 then, identify the effect on potential of half-cell
(a) E_{ox} increased from E°_{ox} by 0.65 V
(b) E_{ox} decreased from E°_{ox} by 0.65 V
(c) E_{red} increased from E°_{red} by 0.65 V
(d) E_{red} decreased from E°_{red} by 0.65 V

Q.27 NH_3 is used in this reaction rather than any other base. Select the correct statement out of the following
(a) $[Ag(NH_3)_2]^+$ is a weaker oxidizing agent than Ag^+
(b) to dissolve the insoluble silver oxide formed under the reaction conditions
(c) Ag precipitates gluconic acid as its silver salt
(d) NH_3 changes the standard reduction potential of $[Ag(NH_3)_2]^+$

RESPONSE GRID					
	20. ⓐⓑⓒⓓ	21. ⓐⓑⓒⓓ	22. ⓐⓑⓒⓓ	23. ⓐⓑⓒⓓ	24. ⓐⓑⓒⓓ
	25. ⓐⓑⓒⓓ	26. ⓐⓑⓒⓓ	27. ⓐⓑⓒⓓ		

Space for Rough Work

DIRECTIONS (Q.28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

Q.28 Statement-1: A negative value of standard reduction potential means that reduction take place on this electrode with reference to standard hydrogen electrode.
Statement-2 : The standard electrode potential of a half cell has a fixed value.

Q.29 Statement-1 : $Ni/Ni^{2+}(1.0M)||Au^{3+}(1.0M)|Au$, for this cell emf is 1.75V, if $E^{\bullet}_{Au^{3+}/Au} = 1.50$ and $E^{o}_{Ni^{2+}/Ni} = 0.25$ V
Statement-2 : Emf of the cell $= E^{\bullet}_{cathode} - E^{o}_{anode}$.

Q.30 Statement-1 : Emf and potential difference are not same for cell.
Statement-2 : Both gives the difference in electrode potential under any condition.

RESPONSE GRID	28. ⓐ ⓑ ⓒ ⓓ	29. ⓐ ⓑ ⓒ ⓓ	30. ⓐ ⓑ ⓒ ⓓ

DAILY PRACTICE PROBLEM SHEET 34 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	36	Qualifying Score	56
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

Space for Rough Work

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

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1. **(d)** Since E^{o}_{A/A^-} has large negative value, the tendency of A to be reduced to A^- is very small. In other words tendency of A^- to be oxidized to A is very large.

2. **(b)** In common dry cell.

Anode : $Zn \rightarrow Zn^{++} + 2e^-$

Cathode : $2MnO_2 + Zn^{++} + 2e^- \rightarrow ZnMn_2O_4$.

3. **(a)** When platinum electrodes are dipped in dilute solution H_2SO_4 then H_2 is evolved at cathode.

4. **(d)** $\overset{\text{Reduction}}{\overbrace{Zn^{2+} + 2e^- \longrightarrow Zn}}$. It shows reduction reaction.

5. **(b)** In hydrogen–oxygen fuel cell, following reactions take place to create potential difference between the two electrodes.

$$2H_2(g) + 4OH^-(aq) \rightarrow 4H_2O(l) + 4e^-$$

$$O_2(g) + 2H_2O(l) + 4e^- \rightarrow 4OH^-(aq)$$

$$\text{Overall reaction} = 2H_2(g) + O_2(g) \rightarrow 2H_2O(l)$$

the net reaction is the same as burning (combustion) of hydrogen to form water.

6. **(a)** More negative is the reduction potential, higher will be the reducing property, i.e. the power to give up electrons.

7. **(c)** A cation having highest reduction potential will be reduced first and so on. However, Mg^{2+} in aqueous solution will not be reduced

$\left(E^{o}_{Mg^{2+}/Mg} < E_{H_2O/\frac{1}{2}H_2+OH^-}\right)$. Instead water would be reduced in preference.

8. **(c)** According to electrochemical series.

9. **(a)** Standard electrode potential of hydrogen is zero.

10. **(d)** Reducing power i.e. the tendency to lose electrons increases as the reduction potential decreases.

11. **(a)** EMF = [s.r.p. of cathode– s.r.p of anode] where s.r.p = Standard reduction potential

If EMF is positive then the reaction is spontaneous

12. **(d)** The oxidizing character i.e. acceptance of electrons increases with the reduction potential.

13. **(a)** According to electrochemical series.

14. **(a)** Fe is more electropositive than copper. Hence, Cu^{2+} can oxidise Fe.

15. **(b)** $E^{\bullet} = 0$ because hydrogen has zero potential.

16. **(b)** Cell potential of the cell is positive.

17. **(b)** $Cu^{2+} + 1e^- \rightarrow Cu^+$

$E^{o}_1 = 0.15V; \Delta G^{o}_1 = -n_1E^{o}_1F$

$Cu^+ + 1e^- \rightarrow Cu \quad E^{o}_2 = 0.50V; \Delta G^{o}_2 = -n_2E^{o}_2F$

$Cu^{2+} + 2e^- \rightarrow Cu \quad \Delta G^{\circ} = \Delta G^{\circ}_1 + \Delta G^{\circ}_2$

$-nE^{\circ}F = -1\, n_1 E_1^{\bullet} F + (-1) n_2 E_2^{\bullet} F$

$-nE^{\bullet}F = -1\,(n_1 E_1^{\circ} F + n_2 E_2^{\circ} F)$

$$E^{\circ} = \frac{n_1E_1^{\circ} + n_2E_2^{\circ}}{n} = \frac{0.15\times1 + 0.50\times1}{2}$$

$\Rightarrow 0.325$

18. **(a)** More is reduction potential, more is the power to get itself reduced or lesser is reducing power or greater is oxidising power.

19. **(b)**

20. **(a)** Increase in the concentration of Ag^+ ion increases the voltage of the cell.

21. **(b)** Electrochemical series compare the relative reactivity of metals.

22. **(d)** The disproportionation of Cu can be written as

$2Cu^+ \longrightarrow Cu + Cu^{2+}$

$2Cu^+ + 2e \longrightarrow 2Cu\,; \quad E^{\circ}_{Cu^+/Cu} = 0.521$

$\Rightarrow \Delta G^{\circ}_1 = -2F(0.521)$

$Cu - 2e \dashrightarrow Cu^{2+}; \quad E_{Cu|Cu^{2+}} = -0.337$

$\Rightarrow \Delta G^{\bullet}_2 = -2F(-0.337)$

$2Cu^+ \longrightarrow Cu^{2+} + Cu\,; \Delta G^{\circ} = \Delta G^{\circ}_1 + \Delta G^{\circ}_2$

Thus ΔG for disproportionation of Cu^+ is positive, hence Cu^+ disproportionates spontaneously and comproportion of Cu and Cu^{2+} into Cu^+ is non-spontaneous.

Also $E^{\circ}_{Cu|Cu^{2+}} + E^{\bullet}_{Cu|Cu} = -0.337 + 0.521 = 0.184 > 0$

23. **(a)** The standard reduction potential P should be high for a species to be a good oxidising agent.

24. **(a)** In Daniel cell copper rod acts as cathode hence cations move towards copper electrode and reduction take place on copper rod.

25. (b) In the given reaction, Ag ions are reduced to Ag and glucose is oxidised to gluconic acid as per the given reactions,

$Ag^+ + e^- \longrightarrow Ag;\ E^\circ_{red} = +0.800V$ and

$C_6H_{12}O_6 + H_2O \longrightarrow \underset{\text{Gluconic acid}}{C_6H_{12}O_7} + 2H^+ + 2e^-;$

$E^\circ_{ox} = -0.05V$

Hence, $E^\circ_{cell} = 0.8 - 0.05 = 0.75V$

$\Delta G^\bullet_{cell} = -nFE = -2F \times 0.75 = -RT\ln K$

$\Rightarrow \ln K = \frac{2F}{RT}(0.75) = 2 \times 38.92 \times 0.75 = 58.38$

26. (a) For the reaction,

$C_6H_{12}O_6 + H_2O \longrightarrow \underset{\text{Gluconic acid}}{C_6H_{12}O_7} + 2H^+ + 2e^-$

$E = E^\circ - \frac{0.0591}{n}\ln\frac{[P]}{[R]} = E^\circ - \frac{0.0591}{2}\ln[H^+]^2$

$E - E^\circ = -\frac{0.0591}{2} \times 2\ln(-pH) = 0.0591 \times 11 = 0.65$

So, $E_{oxidation}$ increases over $E^\circ_{oxidation}$ by 0.65 V.

27. (b) During Tollen's test, oxidation of silver ion requires an alkaline medium. Under these conditions it forms insoluble silver oxide, hence to dissolve this oxide a complexing agent, ammonia is added, which brings silver ion as diamminosilver (I) ion, $[Ag(NH_3)_2]^+$ which is a soluble complex.

28. (c) A negative value of standard reduction potential means that oxidation takes place on this electrode with reference to SHE.

29. (a) Both statement-1 and statement-2 are true and statement-2 is the correct explanation of statement-1

$E^\circ_{Au^{3+}/Au} - E^\circ_{Ni/Ni^{2+}} = 1.50 - (-0.25) = 1.75V$

30. (d) Statement-1 is true and statement-2 is false. Potential difference is the difference between the electrode potential of the two electrodes of the cell when cell is under operation while emf is the potential difference generated by a cell when there is zero electron flow.