ELECTROCHEMISTRY

Q.1 The standard reduction electrode potential values of elements A, B, C are + 0.68 – 2.50 and – 0.50 V respectively. The order of their reducing power is-

(A) A > B > C (B) A > C > B (C) C > B > A (D) B > C > A

Q.2 How much will potential fo a hydrogen electrode change when its solution initially at pH = 0 is neutralized to pH = 7

(A) Increase by 0.0591 V (B) Decrease by 0.0591 V
(C) Increase by 0.413 V (D) Decrease by 0.413 V

Q.3 Following are some standard reduction potential values for the given half cell :

(i) $A^{++} + 2e^- \rightleftharpoons A$ $E^o = 1.27$ V
(ii) $B^+ + e^- \rightleftharpoons B$ $E^o = -0.7$ V
(iii) $C^{++} + 2e^- \rightleftharpoons C$ $E^o = -0.54$ V
(iv) $D^+ + e^- \rightleftharpoons D$ $E^o = 1.05$ V

The combination of which two half cells will give galvanic cell having maximum possible emf-

(A) (i) and (ii) (B) (i) and (iv) (C) (ii) and (iii) (D) (iii) and (iv)

Q.4 By how much would the oxidising power of the MnO_4^-/Mn^{2+} couple change if the H^+ ions concentration is decreased 100 times ?

(A) Increases by 189 mV (B) Decreases by 189 mV
(C) Will increase by 19 mv (D) Will decrease by 19 mV

Q.5 A solution of sodium sulphate in water is electrolysed using inert electrodes. The products at cathode and anode are respectively-

(A) H_2, O_2 (B) O_2, H_2 (C) O_2, Na (D) O_2, SO_2

Q.6 A solution containing one mole per litre of each $Cu(NO_3)_2$; $AgNO_3$; $Hg_2(NO_3)_2$; $Mg(NO_3)_2$ is being electrolysed using inert electrodes. The values of standard electrode potentials (reduction potentials in volts are $Ag/Ag^+ = 0.80$ V, $2Hg/Hg_2^{++} = 0.79$V, $Cu/Cu^{++} = + 0.24$V, $Mg/Mg^{++} = -2.37$ V. With increasing voltage, the sequence of deposition of metals on the cathode will be-

(A) Ag, Hg, Cu (B) Cu, Hg, Ag
(C) Ag, Hg, Cu, Mg (D) Mg, Cu, Hg, Ag

Q.7 One coulomb of charge passes through solution of $AgNO_3$ and $CuSO_4$ connected in series and the conc. of two solution being in the ratio 1 : 2. The ratio of weight of Ag and Cu deposited on Pt electrode is-

(A) 107.9 : 63.54 (B) 54 : 31.77
(C) 107.9 : 31.77 (D) 54 : 63.54

Q.8 Electrolysis of dil. H_2SO_4 liberates gases at anode and cathode-

(A) O_2 & SO_2 respectively (B) SO_2 & O_2 respectively
(C) O_2 & H_2 respectively (D) H_2 & O_2 respectively

Q.9 For the electrochemical cell M | M^+ || X^-, | X $E^0_{M^+/M}$ = 0.44V, E^0_{X/X^-} = 0.33 V from this data one can deduce that-

(A) $M + X \rightarrow M^+ + X^-$ is spontaneous reaction
(B) $M^+ + X^- \rightarrow M + X$ is spontaneous reaction
(C) E_{cell} = 0.77 V
(D) E_{cell} = – 0.77 V

Q.10 How many coulomb of electricity will be consumed when 100 mA current passes through a solution of $AgNO_3$ for half an hour during electrolysis-

(A) 108 (B) 180 (C) 1800 (D) 18000

ANSWER KEY

Electrochemistry										
Q.No.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
Ans.	D	D	A	B	A	A	C	C	B	B

SOLUTIONS

Ans.1 More is the reduced potential, more is the power to get itself reduced or lesser is reducing power or greater is oxidizing power.
$\therefore$ (D)

Ans.2 $H^+ + e^- \rightleftharpoons \frac{1}{2}H_2(g)$,

$[E = E^0 - \frac{0.0591}{n} \log Q]$

$$= 0.0 - \frac{0.0591}{n} \log \frac{\frac{P_1}{H_2^2}}{[H^+]} = \frac{0.591}{1}\log\frac{1}{10^{-7}}$$

$$= -0.0591 \times 7 \times \log 10 = -0.413 \text{ V}$$

$\therefore$ (D)

Ans.3 Since all the values are standard reduction potential and so the two half cells having maximum and minimum reduction potential values will give a cell of maximum possible emf.

$E^o_{cell} = E^o_{RP(cathode)} - E^o_{RP(anode)}$

$\therefore$ (A)

Ans.4 $MnO_4^- + 5e^- + 8H^+ \longrightarrow Mn^{2+} + 4H_2O$

According to Nernst equation,

$$E_{red} = E^o_{red} - \frac{0.059}{5}\log\left[\frac{[Mn^{2+}]}{[MnO_4^-][H^+]^8}\right]$$

Let $[H^+]_{initial} = X$

$$E_{red(initial)} = E^o_{red}\frac{-0.059}{5}\log\left[\frac{[Mn^{2+}]}{[MnO_4^-][H^+]^8}\right]$$

$$[H^+]_{final} = \frac{X}{100} = \frac{X}{10^2}$$

$$E_{red(final)} = E^o_{red}\frac{-0.059}{5}\log\frac{[Mn^{2+}]\times 10^{16}}{[MnO_4^-]\times[X]^8}$$

$$E_{red(final)} = -E_{red(initial)} = \frac{-0.059}{5}\log 10^{16} = -0.1891 \text{ V}$$

This E_{red} decreases by 0.189 V. The tendency of the half cell to get reduced is its oxidising power. Hence the oxidising power decreases by 0.189 V.

$\therefore$ (B)

Ans.5 Na^+ ions are not reduced at cathode and SO_4^{2-} ions are not oxidized at anode

Cathode : $2H_2(I) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$

Anode : $2H_2O(I) + 2e^- \longrightarrow H_2(g) + 2OH^-(aq)$

$\therefore$ (A)

Ans.6 Greater the value of standard reduction potential, greater will be it's tendency to undergo reduction. So the sequence of deposition of metals on cathode will be Ag, Hg, Cu. Here, magnesium will not be deposited because it's standard reduction potential is negative, so it has stronge tendency to undergo oxidation. Therefore, on electrolysis of $Mg(NO_3)_2$ solution, H_2 gas will be evolved at cathode.

$\therefore$ (A)

Ans.7 Faraday's IInd Law $\frac{W}{E}$ = Constant

So, $\frac{W_{Ag}}{E_{Ag}} = \frac{W_{Cu}}{E_{Cu}}$ $\left(Ag^+ + e^- \rightarrow Ag,\ E_{Ag} = \frac{M}{1}\right)$

$\therefore$ $\frac{W_{Ag}}{W_{Cu}} = \frac{E_{Ag}}{E_{Cu}} = \frac{107.9}{63.54/2}$ $\left(Cu^{+2} + 2e^- \rightarrow Cu,\ E_{Cu} = \frac{M}{2}\right)$

$= \frac{107.9}{31.77}$

$\therefore$ (C)

Ans.8 At anode : $2H_2O \rightarrow O_2 + 4H^+ + 4e^-$

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

$\therefore$ (C)

Ans.9 E^o_{RP} for M > ΔE_{RP} for X

$\therefore M^+ + X^- \longrightarrow M + X$ (spontaneous),

$E^o_{cell} = -0.33 + 0.44 = 0.11$ V

$\therefore$ (B)

Ans.10 Charge passed during electrolysis = i × t

$= (100 \times 10^{-3}) \times (\frac{1}{2} \times 60 \times 60)$

$= 180$ C

$\therefore$ (B)