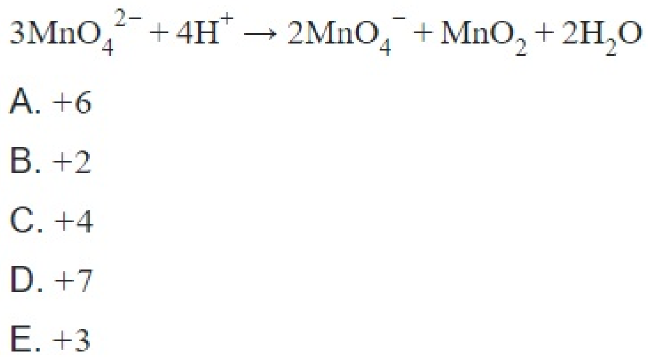
Redox Reactions

Question1

The oxidation states not shown by Mn in given reaction is :



$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

A. +6

B. +2

C. +4

D. +7

E. +3

Choose the most appropriate answer from the options given below :

[NEET 2024 Re]

Options:

A.

D and E only

B.

B and D only

C.

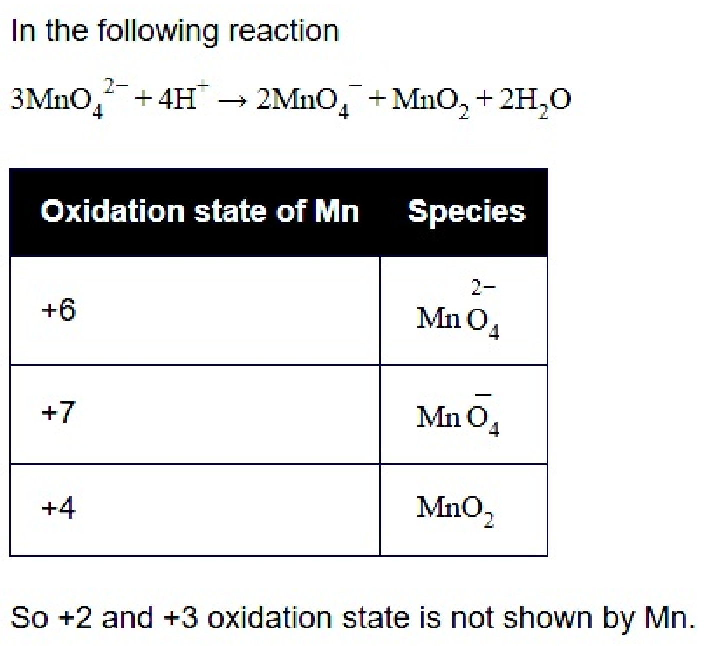
A and B only

D.

B and E only

Answer: D

Solution:



In the following reaction

$$3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$$

Oxidation state of Mn	Species
+6	MnO_4^{2-}
+7	MnO_4^-
+4	MnO_2

So +2 and +3 oxidation state is not shown by Mn.

Question2

Which reaction is NOT a redox reaction?

[NEET 2024]

Options:

A.

$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$

B.

$2KClO_3 + I_2 \longrightarrow 2KIO_3 + Cl_2$

C.

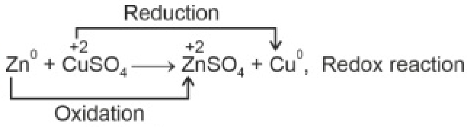
$H_2 + Cl_2 \longrightarrow 2HCl$

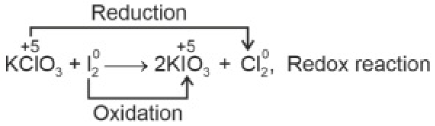
D.

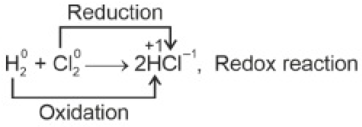
$BaCl_2 + Na_2SO_4 \longrightarrow BaSO_4 + 2NaCl$

Answer: D

Solution:

(1)

$\overset{0}{Zn} + \overset{+2}{Cu}SO_4 \longrightarrow \overset{+2}{Zn}SO_4 + \overset{0}{Cu}$, Redox reaction

(2)

$K\overset{+5}{Cl}O_3 + \overset{0}{I_2} \longrightarrow 2K\overset{+5}{I}O_3 + \overset{0}{Cl_2}$, Redox reaction

(3)

$\overset{0}{H_2} + \overset{0}{Cl_2} \longrightarrow 2\overset{+1}{H}Cl^{-1}$, Redox reaction

(4) $\overset{+2}{Ba}Cl_2^{-1} + \overset{+1}{Na_2}SO_4^{-2} \longrightarrow \overset{+2}{Ba}SO_4 + 2\overset{+1}{Na}Cl^{-1}$

This is not a redox reaction as there is no change in oxidation state.

Question3

On balancing the given redox reaction,

$$aCr_2O_7^{2-} + bSO_3^{2-}(aq) + cH^+(aq) \rightarrow 2aCr^{3+}(aq) + bSO_4^{2-}(aq) + \frac{c}{2}H_2O(l)$$

the coefficients a, b and c are found to be, respectively-

[NEET 2023]

Options:

A.

3,8,1

B.

1,8,3

C.

8,1,3

D.

1,3,8

Answer: D

Solution:

Solution:

Using Ion electron method:

Reduction Half reaction : $Cr_2O_7^{2-} + 6e^- \rightarrow 2Cr^{3+}$

Oxidation Half reaction: $SO_3^{2-} \rightarrow SO_4^{2-} + 2\bar{e} \times 3$

Overall reaction : $Cr_2O_7^{2-} + 3SO_3^{2-} \rightarrow 2Cr^{3+} + 3SO_4^{2-}$

- To balance 'O' atoms, adding H_2O on LHS

$Cr_2O_7^{2-} + 3SO_3^{2-} \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

- To balance ' H ' atoms, adding H^+on RHS

$Cr_2O_7^{2-} + 3SO_3^{2-} + 8H^+ \rightarrow 2Cr^{3+} + 3SO_4^{2-} + 4H_2O$

$\therefore$ $a = 1$

$b = 3$

$c = 8$

Question4

The correct option for a redox couple is :

[NEET 2023 mpr]

Options:

A.

Both are oxidised forms involving same element.

B.

Both are reduced forms involving same element.

C.

Both the reduced and oxidized forms involve same element.

D.

Cathode and anode together.

Answer: C

Solution:

Redox couple is both the reduced and oxidised form involve same element.

Question5

Which of the following reactions is a decomposition redox reaction? [NEET Re-2022]

A. $P_4(s) + 3OH^-(aq) + 3H_2O(l) \rightarrow PH_3(g) + 3H_2PO_2^-(aq)$

B. $2\,Pb(NO_3)_2(s) \rightarrow 2\,PbO(s) + 4NO_2(g) + O_2(g)$

C. $N_2(g) + O_2(g) \rightarrow 2\,NO(g)$

D. $Cl_2(g) + 2OH^-(aq) \rightarrow ClO^-(aq) + Cl^-(aq) + 4H_2O(I)$

Answer: B

Solution:

Solution:

Lead nitrate decomposed to give PbO, NO_2 and O_2. In this Nitrogen atom oxidation state changes from +5 to +4 and oxygen changes from −2 to zero.

Question6

What is the change in oxidation number of carbon in the following reaction?
$CH_4(g) + 4Cl_2(g) \longrightarrow CCl_4(l) + 4HCl(g)$
[2020]

Options:

A. 0 to + 4

B. – 4 to + 4

C. 0 to – 4

D. + 4 to + 4

Answer: B

Solution:

Solution:

(b) $\overset{-4}{C}H_4(g) + 4Cl_2(g) \rightarrow \overset{+4}{C}Cl_4(l) + 4HCl(g)$

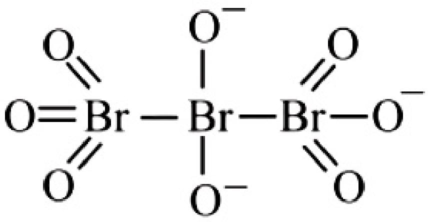
Change in oxidation state of carbon is -4 to $+4$.

Question7

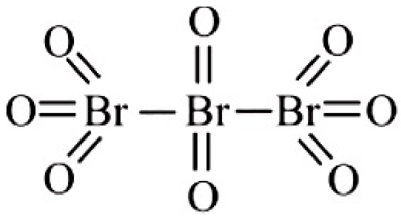
The correct structure of tribromooctaoxide is
(NEET 2019)

Options:

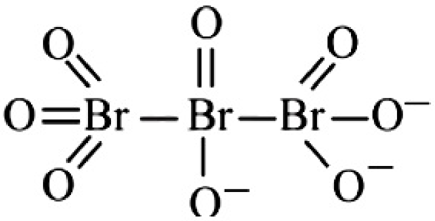
A.



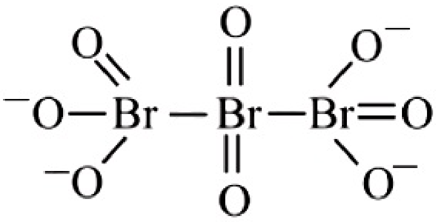
B.



C.



D.



Answer: B

Question8

Which of the following reactions are disproportionation reactions?
(i) $2Cu^{+} \longrightarrow Cu^{2+} + Cu^{0}$
(ii) $3MnO_4^{2-} + 4H^{+} \longrightarrow 2MnO_4^{-} + MnO_2 + 2H_2O$
(iii) $2KMnO_4 \xrightarrow{\Delta} K_2MnO_4 + MnO_2 + O_2$
(iv) $2MnO_4^{-} + 3Mn^{2+} + 2H_2O \longrightarrow 5MnO_2 + 4H^{+}$
Select the correct option from the following.
(NEET 2019)

Options:

A. (i) and (iv) only

B. (i) and (ii) only

C. (i), (ii) and (iii)

D. (i), (iii) and (iv)

Answer: B

Solution:

Disproportionation reactions are those in which the same element\/ compound gets oxidized and reduced simultaneously.
$2\mathrm{Cu}^{+} \rightarrow \mathrm{Cu}^{2+} + \mathrm{Cu}^{0}$

$3\mathrm{MnO}_4{}^{2-} + 4\mathrm{H}^{+} \longrightarrow 2\overset{7}{\mathrm{Mn}}\mathrm{O}_4{}^{-} + \overset{+4}{\mathrm{Mn}}\mathrm{O}_2 + 2\mathrm{H}_2\mathrm{O}$

Question9

The oxidation state of Cr in CrO_5 is (Odisha NEET 2019,2014)

Options:

A. -6

B. +12

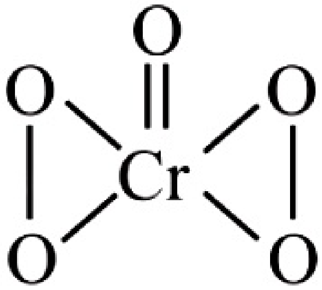
C. +6

D. +4

Answer: C

Solution:

CrO_5 has butterfly structure having two peroxo bonds.



Peroxo oxygen has -1 oxidation state. Let oxidation state ofCr be 'x'
$\mathrm{CrO}_5 : x + 4(-1) + 1(-2) = 0 \Rightarrow x = +6$

Question10

different emf values as shown in the given diagram :

Then the species undergoing disproportionation is
(NEET 2018)

Options:

A. BrO_3^-

B. BrO_4^-

C. Br_2

D. $HBrO$

Answer: D

Solution:

For a reaction to be spontaneous,
E_{cell}° should be positive.
$HBrO \longrightarrow Br_2 \;\; E^{\circ} = 1.595V$, SRP (cathode)
$HBrO \longrightarrow BrO_3^- E^{\circ} = -1.5V$, SOP (anode)
$2HBrO \longrightarrow Br_2 + BrO_3^-$
$E_{cell}^{o} =$ SRP (cathode) - SRP (anode)
$= 1.595 - 1.5 = 0.095V$
$E_{cell}^{\circ} > 0 \Rightarrow \Delta G^{\circ} < 0$ (spontaneous)

Question11

The correct order of N -compounds in its decreasing order of oxidation states is
(NEET 2018)

Options:

A. HNO_3, NO, N_2, NH_4Cl

B. HNO_3, NO, NH_4Cl, N_2

C. HNO_3, NH_4Cl, NO, N_2

D. NH_4Cl, N_2, NO, HNO_3

Answer: A

Solution:

$\overset{+5}{\mathrm{HNO_3}}, \overset{+2}{\mathrm{NO}}, \overset{0}{\mathrm{N_2}}, \overset{-3}{\mathrm{NH_4Cl}}$

Question12

For the redox reaction,
$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$
The correct coefficients of the reactants for the balanced equation are

	MnO^-	$C_2O_4^{2-}$	H^+
(a)	16	5	2
(b)	2	5	16
(c)	2	16	5
(d)	5	16	2

(NEET 2018)

Options:

A. a

B. c

C. d

D. b

Answer: D

Solution:

The correct balanced equation is
$2MnO_4^- + 5C_2O_4^{2-} + 16H^+ \rightarrow 2Mn^{2+} + 10CO_2 + 8H_2O$

Question13

Hot concentrated sulphuric acid is a moderately strong oxidizing agent. Which of the following reactions does not show oxidizing behaviour? (NEET- II 2016)

Options:

A.

$Cu + 2H_2SO_4 \rightarrow CuSO_4 + SO_2 + 2H_2O$

B.

$S + 2H_2SO_4 \rightarrow 3SO_2 + 2H_2O$

C.

$C + 2H_2SO_4 \rightarrow CO_2 + 2SO_2 + 2H_2O$

D.

$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$

Answer: D

Solution:

Solution:
$CaF_2 + H_2SO_4 \rightarrow CaSO_4 + 2HF$
Here, the oxidation state of every atom remains the same so, it is not a redox reaction.

Question14

(I) $H_2O_2 + O_3 \rightarrow H_2O + 2O_2$
(II) $H_2O_2 + Ag_2O \rightarrow 2Ag + H_2O + O_2$
Role of hydrogen peroxide in the above reactions is respectively (2014)

Options:

A. oxidizing in (I) and reducing in (II)

B. reducing in (I) and oxidizing in (II)

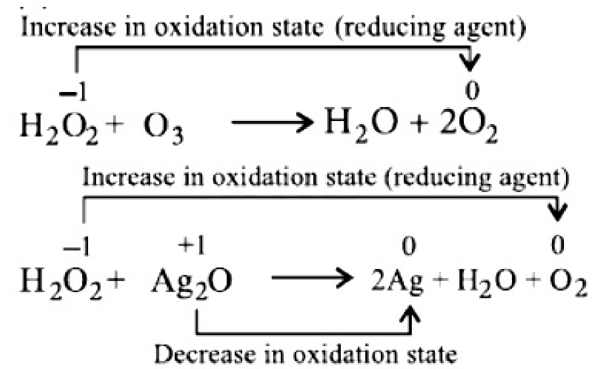
C. reducing in (I) and (II)

D. oxidizing in (I) and (II)

Answer: C

Solution:

Solution:



H_2O_2 acts as reducing agent in all those reaction in which O_2 is evolved

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Question15

The pair of compounds that can exist together is (2014)

Options:

A. $FeCl_3$, $SnCl_2$

B. $HgCl_2$, $SnCl_2$

C. $FeCl_2$, $SnCl_2$

D. $FeCl_3$, KI

Answer: C

Solution:

Solution:
Both $FeCl_2$ and $SnCl_2$ are are reducing agents with low oxidation numbers.

Question16

A mixture of potassium chlorate, oxalic acid and sulphuric acid is heated. During the reaction which element undergoes maximum change in the oxidation number? (2012)

Options:

A. S

B. H

D. C

Answer: C

Solution:

$$\overset{+1}{K}\overset{+5}{Cl}\overset{-2}{O}_3 + (COOH)_2 + H_2\overset{+6}{S}O_4 \rightarrow K_2\overset{+6}{S}O_4 + K\overset{-1}{Cl} + CO_2 + H_2O$$

Maximum change in oxidation number of chlorine, i.e., from +5 to -1.

Question17

In which of the following compounds, nitrogen exhibits highest oxidation state?
(2012)

Options:

A. N_2H_4

B. NH_3

C. N_3H

D. NH_2OH

Answer: C

Solution:

$$N_2H_4 \Rightarrow 2x + 4(+1) = 0 \Rightarrow 2x + 4 = 0 \Rightarrow x = -2$$
$$NH_3 \Rightarrow x + 3(+1) = 0 \Rightarrow x = -3$$
$$N_3H \Rightarrow 3x + 1(+1) = 0 \Rightarrow 3x + 1 = 0 \Rightarrow x = -\frac{1}{3}$$
$$NH_2OH \Rightarrow x + 2 + 1(-2) + 1 = 0 \Rightarrow x + 1 = 0 \Rightarrow x = -1$$

Thus,highest oxidation state is $-\frac{1}{3}$

Question18

When Cl_2 gas reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from
(2012)

A. zero to +1 and zero to -5

B. zero to -1 and zero to +5

C. zero to -1 and zero to +3

D. zero to +1 and zero to -3

Answer: B

Solution:

Solution:

$$\overset{0}{3Cl_2} + \underset{\text{(hot and conc.)}}{6NaOH} \rightarrow 5Na\overset{-1}{Cl} + Na\overset{+5}{Cl}O_3 + 3H_2O$$

This is an example of disproportionation reaction and oxidation state of chlorine changes from 0 to -1 and +5.

Question19

Oxidation numbers of P in PO_4^{3-}, of S in SO_4^{2-} and that of Cr in $Cr_2O_7^{2-}$are respectively
(2009)

Options:

A. +3,+6 and +5

B. +5,+3 and +6

C. +3,+6 and +6

D. +5,+6 and +6

Answer: D

Solution:

Let oxidation number of P in PO_4^{3-} be x
$\therefore x + 4(-2) = -3 \qquad \Rightarrow x = +5$
Let oxidation number of S in SO_4^{2-} be y
$\therefore y + 4(-2) = -2 \qquad \Rightarrow y = +6$
Let oxidation numbers of Cr in $Cr_2O_7^{2-}$ be z.
$\therefore 2z + 7(-2) = -2 \qquad \Rightarrow z = +6$

Question20

Number of moles of MnO_4^- required to oxidize one mole of ferrous oxalate completely in acidic medium will be

Options:

A. 7.5 moles

B. 0.2 moles

C. 0.6 moles

D. 0.4 moles

Answer: D

Solution:

$[5e + MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O \qquad ......(i)] \times 2$
$[C_2O_4^{2-} \rightarrow 2e + 2CO_2 \qquad (ii)] \times 5$
$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} \rightarrow 2Mn^{2+} + 10CO_2$
2 moles of MnO_4^- required to oxidise 5 moles of oxalate
∴ no.of moles of MnO_4^- required to oxidise 1 mole of oxalate = 2/5 = 0.4

Question21

Which is the best description of the behaviour of bromine in the reaction given below? $H_2O + Br_2 \rightarrow HOBr + HBr$
(2004)

Options:

A. Proton acceptor only

B. Both oxidised and reduced

C. Oxidised only

D. Reduced only

Answer: B

Solution:

Solution:
$H_2O + \overset{0}{Br_2} \rightarrow HO\overset{+1}{Br} + H\overset{-1}{Br}$
In the above reaction the oxidation number of Br_2 increases from zero (in Br_2) to +1 (in HOBr) and decreases from zero (in Br_2) to -1 (in HBr).
Thus, Br_2 is oxidised as well as reduced and hence it is a redox reaction.

Question22

The oxidation states of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order
(2003)

Options:

A. $S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$

B. $SO_3^{2-} < S_2O_4^{2-} < S_2O_6^{2-}$

C. $S_2O_4^{2-} < S_2O_6^{2-} < SO_3^{2-}$

D. $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

Answer: A

Solution:

SO_3^{2-} : $x + (-2)3 = -2$
or $x - 6 = -2$ or $x = +4$
$S_2O_4^{2-}$: $2x + (-2)4 = -2$
or $2x - 8 = -2$ or $2x = +6 \quad \therefore x = +3$
$S_2O_6^{2-}$: $2x + (-2)6 = -2$
or, $2x - 12 = -2$ or $2x = +10 \therefore x = +5$
Oxidation states follow the order :
$S_2O_4^{2-} < SO_3^{2-} < S_2O_6^{2-}$

Question23

Oxidation state of Fe in Fe_3O_4 is
(1999)

Options:

A. $\frac{5}{4}$

B. $\frac{4}{5}$

C. $\frac{3}{2}$

D. $\frac{8}{3}$

Answer: D

$Fe_3O_4 \rightarrow 3x + 4(-2) = 0 \Rightarrow x = +\frac{8}{3}$

Question24

Which of the following is redox reaction? (1997)

Options:

A. Evaporation of H_2O

B. Both oxidation and reduction

C. H_2SO_4 with $NaOH$

D. In atmosphere O_3 from O_2 by lighting

Answer: B

Solution:

Solution:
Redox reactions are those chemical reactions which involve transfer of electrons from one chemical species to another.

Question25

The oxide, which cannot act as a reducing agent is (1995)

Options:

A. CO_2

B. ClO_2

C. NO_2

D. SO_2

Answer: A

Solution:

Solution:
since carbon is in maximum state of +4, therefore carbon dioxide (CO_2) cannot act as a reducing agent.

Question26

Which substance is serving as a reducing agent in the following reaction?
$14H^{+} + Cr_2O_7^{2-} + 3Ni \rightarrow 7H_2O + 2Cr^{3+} + 3Ni^{2+}$
(1994)

Options:

A. H^{+}

B. $Cr_2O_7^{2-}$

C. H_2O

D. Ni

Answer: D

Solution:

Solution:
since the oxidation number of Ni increases from 0 to 2, therefore it acts as a reducing agent.

Question27

The oxidation state of I in $H_4IO_6^{-}$ is
(1994)

Options:

A. +1

B. -1

C. +7

D. +5

Answer: C

Solution:

Let $x =$ Oxidation state of I. Since oxidation state of $H = +1$ and oxidation state of $O = -2$, therefore for $H_4IO_6^{-}$, we get
$(4 \times 1) + x + (6 \times -2) = -1$
or $x = +7$

Electrochemistry

Question1

From the following select the one which is not an example of corrosion.

[NEET 2024 Re]

Options:

A.

Rusting of iron object

B.

Production of hydrogen by electrolysis of water

C.

Tarnishing of silver

D.

Development of green coating on copper and bronze ornaments

Answer: B

Solution:

Corrosion slowly coats the surfaces of metallic objects with oxides or other salts of the metal. The rusting of iron, tarnishing of silver, development of green coating on copper and bronze are some of the examples of corrosion.

- Production of H_2 by electrolysis of water is an example of electrolytic cell.

Question2

The standard cell potential of the following cell $Zn|Zn^{2+}(aq)|Fe^{2+}(aq)|Fe$ is 0.32 V . Calculate the standard Gibbs energy change for the reaction :

$$Zn(s) + Fe^{2+}(aq) \longrightarrow Zn^{2*}(aq) + Fe(s)$$

(Given : $1F = 96487C$)

[NEET 2024 Re]

Options:

A

$-61.75 \text{ kJ mol}^{-1}$

B.

$+5.006 \text{ kJ mol}^{-1}$

C.

$-5.006 \text{ kJ mol}^{-1}$

D.

$+61.75 \text{ kJ mol}^{-1}$

Answer: A

Solution:

$$\Delta_r G^{\ominus} = -nFE_{\text{cell}}^{\ominus}$$

For the given reaction, $n = 2$

$$\therefore \Delta_r G^{\ominus} = -2 \times 96487 \times 0.32$$

$$= -61751.68 \text{J mol}^{-1}$$

$$= -61.751 \text{ kJ mol}^{-1}$$

Question3

Match List I with List II.

	List I (Conversion)		List II (Number of Faraday required)
A.	1 mol of H_2O to O_2	I.	3F
B.	1 mol of MnO_4^- to Mn^{2+}	II.	2F
C.	1.5 mol of Ca from molten $CaCl_2$	III.	1F
D.	1 mol of FeO to Fe_2O_3	IV.	5F

Choose the correct answer from the options given below:

[NEET 2024]

Options:

A.

A-II, B-IV, C-I, D-III

B.

A-III, B-IV, C-I, D-II

C.

A-II, B-III, C-I, D-IV

D.

A-III, B-IV, C-II, D-I

Answer: A

Solution:

$4OH^- \longrightarrow 2H_2O + O_2 + 4e^-$

for 2 mole of $H_2O = 4F$ charge is required for 1 mole of $H_2O = \frac{4F}{2} = 2F$ required

$\overset{+7}{MnO_4^-} \longrightarrow \overset{2+}{Mn^{+2}}$

for 1 mole MnO_4^- $5F$ charge is required

$Ca^{2+} \xrightarrow{+2e^-} Ca$

For 1 mole Ca^{2+} ion required $= 2F$

1.5 mole Ca^{2+} ion required $= \frac{2}{1} \times 1.5 = 3F$

$\overset{+2}{FeO} \longrightarrow \overset{+3}{Fe_2O_3}$

for 1 mole FeO, 1F charge is required.

Question4

Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is

(Given : Molar mass of Cu : $63 gmol^{-1}$, $1F = 96487C$)

[NEET 2024]

Options:

A.

3.15g

B.

0.315g

C.

31.5g

D.

0.0315g

Answer: B

$Cu^{2+}(aq) + 2e^- \longrightarrow Cu(s)$

$$\text{Mass of Cu deposited } (w) = \frac{M \times i \times t}{nF}$$

$$= \frac{63 \times 9.6487 \times 100}{2 \times 96487}$$

$$= 0.315g$$

Question5

The conductivity of centimolar solution of KCl at 25°C is 0.0210ohm^{-1}cm^{-1} and the resistance of the cell containing the solution at 25°C is 60ohm. The value of cell constant is

[NEET 2023]

Options:

A.

3.28cm^{-1}

B.

1.26cm^{-1}

C.

3.34cm^{-1}

D.

1.34cm^{-1}

Answer: B

Solution:

Conductivity = conductance × cell constant

$$k = GG^*$$

$$= \frac{1}{R} G^*$$

$$G^* = k \times R = 0.0210 \times 60 = 1.26\text{cm}^{-1}$$

Question6

Given below are two statements: one is labelled as Assertion A and the other is labelled as Reason R
Assertion A : In equation $\Delta_r G = -nFE_{cell}$ value of $\Delta_r G$ depends on n.

Reasons R : Ecell is an intensive property and Δ_rG is an extensive property.
In the light of the above statements, choose the correct answer from the options given below

[NEET 2023]

Options:

A.

Both **A** and **R** are true and **R** is NOT the correct explanation of **A**

B.

A is true but **R** is false

C.

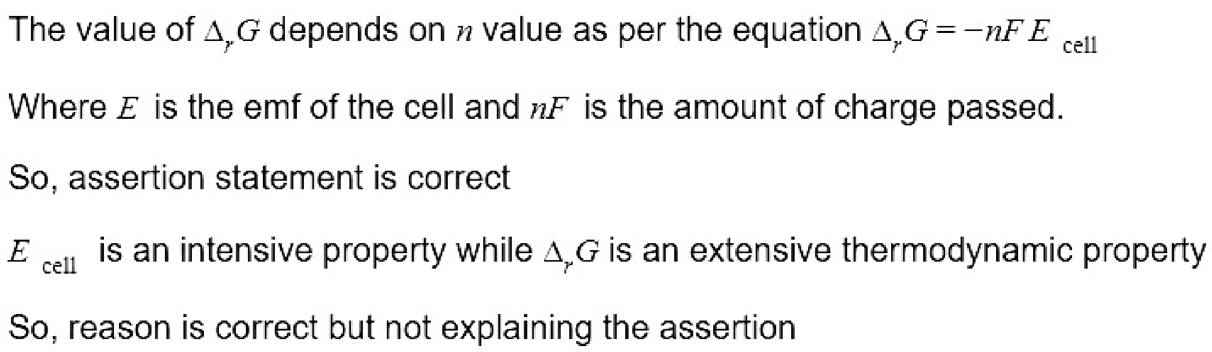
A is false but **R** is true

D.

Both **A** and **R** are true and **R** is the correct explanation of **A**

Answer: A

Solution:



The value of Δ_rG depends on n value as per the equation $\Delta_rG = -nFE_{\text{cell}}$

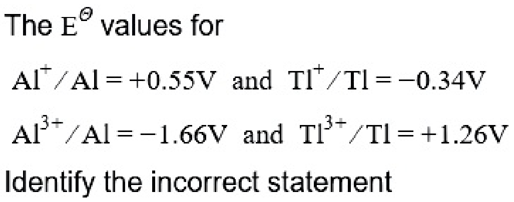
Where E is the emf of the cell and nF is the amount of charge passed.

So, assertion statement is correct

E_{cell} is an intensive property while Δ_rG is an extensive thermodynamic property

So, reason is correct but not explaining the assertion

Question7



The $E^{\ominus}$ values for

$Al^{+}/Al = +0.55V$ and $Tl^{+}/Tl = -0.34V$

$Al^{3+}/Al = -1.66V$ and $Tl^{3+}/Tl = +1.26V$

Identify the incorrect statement

[NEET 2023]

Options:

A.

Al is more electropositive than Tl

Tl^{3+} is a good reducing agent than Tl^{1+}

C.

Al^{+} is unstable in solution

D.

Tl can be easily oxidised to Tl^{+} than Tl^{3+}

Answer: B

Solution:

Tl^{+3} act as an oxidising agent not reducing agent.

Question8

Molar conductance of an electrolyte increase with dilution according to the equation:

$$\Lambda_m = \Lambda_m^{\circ} - A\sqrt{c}$$

Which of the following statements are true?
(A) This equation applies to both strong and weak electrolytes.
(B) Value of the constant A depends upon the nature of the solvent.
(C) Value of constant A is same for both $BaCl_2$ and $MgSO_4$
(D) Value of constant A is same for both $BaCl_2$ and $Mg(OH)_2$
Choose the most appropriate answer from the options given below:

[NEET 2023 mpr]

Options:

A.

(A) and (B) only

B.

(A), (B) and (C) only

C.

(B) and (C) only

D.

(B) and (D) only

Answer: D

Solution:

B and D statement are correct.

Question9

The correct value of cell potential in volt for the reaction that occurs when the following two half cells are connected, is

$$Fe_{(aq)}^{2+} + 2e^{-} \rightarrow Fe(s),\ E^{\circ} = -0.44V$$

$$Cr_2O_7^{2-}(aq) + 14H^{+} + 6e^{-} \rightarrow 2Cr^{3+} + 7H_2O,$$

$$E^{\circ} = +1.33V$$

[NEET 2023 mpr]

Options:

A.

+1.77V

B.

+2.65V

C.

+0.01V

D.

+0.89V

Answer: A

Solution:

$$E_{cell}^{\circ} = E_C^{\circ} - E_A^{\circ}$$

$$= (1.33) - (-0.44)$$

$$= +1.77V$$

Question10

At 298K, the standard electrode potentials of Cu^{2+}/Cu, Zn^{2+}/Zn, Fe^{2+}/Fe and Ag^{+}/Ag are $0.34V$, $-0.76V$, $-0.44V$ and $0.80V$, respectively. On the basis of standard electrode potential, predict which of the following reaction cannot occur? [NEET-2022]

Options:

A. $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

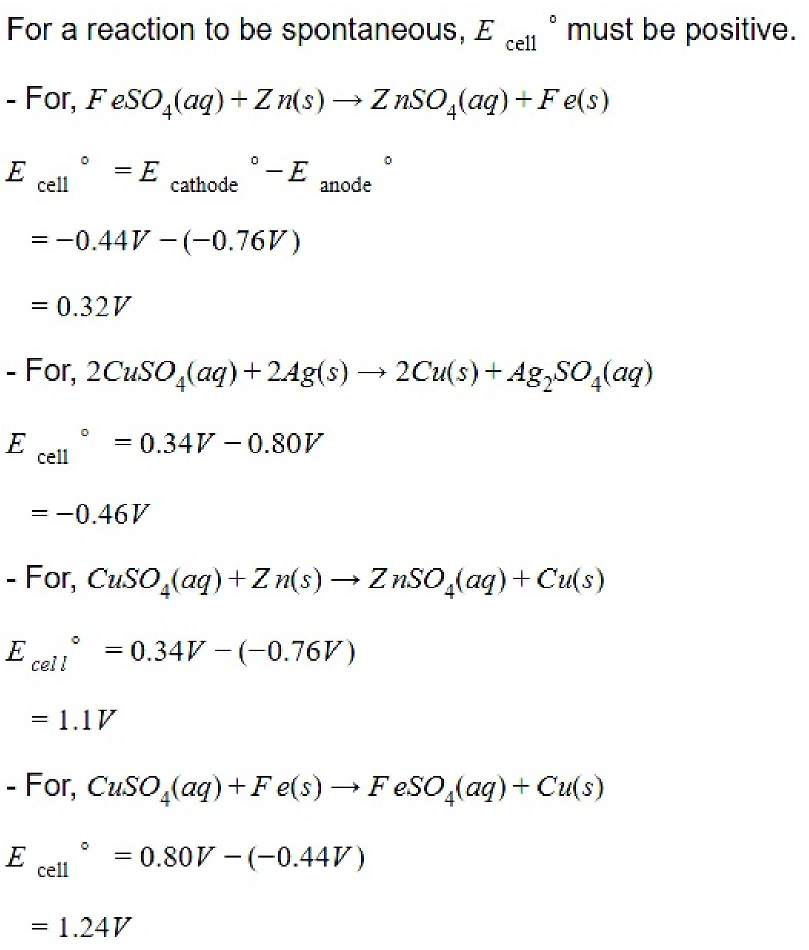
B. $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

C. $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

D. $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

Answer: D

Solution:



For a reaction to be spontaneous, E_{cell}° must be positive.

- For, $FeSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Fe(s)$

$E_{\text{cell}}^{\circ} = E_{\text{cathode}}^{\circ} - E_{\text{anode}}^{\circ}$

$= -0.44V - (-0.76V)$

$= 0.32V$

- For, $2CuSO_4(aq) + 2Ag(s) \rightarrow 2Cu(s) + Ag_2SO_4(aq)$

$E_{\text{cell}}^{\circ} = 0.34V - 0.80V$

$= -0.46V$

- For, $CuSO_4(aq) + Zn(s) \rightarrow ZnSO_4(aq) + Cu(s)$

$E_{cell}^{\circ} = 0.34V - (-0.76V)$

$= 1.1V$

- For, $CuSO_4(aq) + Fe(s) \rightarrow FeSO_4(aq) + Cu(s)$

$E_{\text{cell}}^{\circ} = 0.80V - (-0.44V)$

$= 1.24V$

Question11

Find the emf of the cell in which the following reaction takes place at 298K
$Ni(s) + 2Ag^{+}(0.001M) \rightarrow Ni^{2+}(0.001M) + 2Ag(s)$
(Given that $E_{\text{cell}}^{\circ} = 10.5V$, $\frac{2.303RT}{F} = 0.059$ at 298K)
[NEET-2022]

Options:

A. 1.0385V

B. 1.385V

C. 0.9615V

D. 1.05V

E. None of above

Answer: E

Solution:

Solution

$Ni(s) + 2Ag^{+}(0.001M) \rightarrow Ni^{2+}(0.001M) + 2Ag(s)$

$E_{\text{cell}}{}^{\circ} = 10.5V$

$$E_{\text{cell}} = E_{\text{cell}}{}^{\circ} - \frac{0.059}{n}\log\frac{[Ni^{2+}]}{[Ag^{+}]^{2}}$$

$$= 10.5 - \frac{0.059}{2}\log\frac{(10^{-3})}{(10^{-3})^{2}}$$

$$\Rightarrow 10.5 - \frac{0.059}{2}\log(10)^{3}$$

$$\Rightarrow 10.5 - 0.0295 \times 3$$

$$= 10.5 - 0.0885$$

$$= 10.4115V$$

Question12

Two half cell reactions are given below.

$Co^{3+} + e^{-} \rightarrow Co^{2+}$, $E^{o}_{Co^{2+}}$ / $Co^{3+} = -1.81V$

$2Al^{3+} + 6e^{-} \rightarrow 2\,Al(s)$, $E^{o}_{Al\,/\,Al^{3+}} = +1.66V$

The standard EMF of a cell with feasible redox reaction will be : [NEET Re-2022]

Options:

A. −3.47V

B. +7.09V

C. +0.15V

D. +3.47V

Answer: D

Solution:

$$E^0_{Cell} = \left(E^0_c - E^0_a\right)_{RP}$$

$$= 1.81 - (-1.66)$$

$$= 1.81 + 1.66$$

$$= 3.47V$$

Question13

Standard electrode potential for the cell with cell reaction
$Zn(s) + Cu^{2+}(aq) \rightarrow Zn^{2+}(aq) + Cu(s)$
is 1.1V. Calculate the standard Gibbs energy change for the cell reaction.
(Given F = $96487Cmol^{-1}$)
[NEET Re-2022]

Options:

A. $-200.27Jmol^{-1}$

B. $-200.27\,kJ\,mol^{-1}$

C. $-212.27\,kJ\,mol^{-1}$

D. $-212.27Jmol^{-1}$

Answer: C

Solution:

$$Zn(s) + Cu^{+2}(aq) \longrightarrow Zn^{+2}(aq) + Cu(s)\,v$$

$$E^{\circ}_{cell} = 1.1V$$

$$n = 2$$

$$\Delta G^{\circ} = -nFE^{\circ}_{cell}$$

$$= -2 \times 96487 \times 1.1$$

$$= -212.27\,kJ$$

Question14

The molar conductance of $NaCl$, HCl and CH_3COONa at infinite dilution are 126.45, 426.16 and 91.0Scm^2mol^{-1} respectively. The molar conductance of CH_3COOH at infinite dilution is. Choose the right

[NEET 2021]

Options:

A. 201.28 $S\ cm^2\ mol^{-1}$

B. 390.71 $S\ cm^2\ mol^{-1}$

C. 698.28 $S\ cm^2\ mol^{-1}$

D. 540.48 $S\ cm^2\ mol^{-1}$

Answer: B

Solution:

According to Kohlrausch law of independent migration of ions.

$$\Lambda^\circ_m(CH_3COOH) = \Lambda^\circ_m(CH_3COONa) + \Lambda^\circ_m(HCl) - \Lambda^\circ_m(NaCl)$$
$$= 91.0\ S\ cm^2\ mol^{-1} + 426.16\ S\ cm^2\ mol^{-1} - 126.45\ S\ cm^2\ mol^{-1}$$
$$= 390.71\ S\ cm^2\ mol^{-1}$$

Question15

The molar conductivity of 0.007 M acetic acid is 20 $S\ cm^2\ mol^{-1}$. What is the dissociation constant of acetic acid? Choose the correct option.

$$\left[\begin{array}{c} \Lambda_{H^+}{}^\circ = 350 S\ cm^2\ mol^{-1} \\ \Lambda_{CH_3COO^-} = 50\ S\ cm^2\ mol^{-1} \end{array}\right]$$

[NEET 2021]

Options:

A. $1.75 \times 10^{-4}\ mol\ L^{-1}$

B. $2.50 \times 10^{-4}\ mol\ L^{-1}$

C. $1.75 \times 10^{-4}\ mol\ L^{-1}$

D. $2.50 \times 10^{-4}\ mol\ L^{-1}$

Answer: C

Solution:

$\Lambda_m = 20\ S\ cm^2\ mol^{-1}$.

$$\Lambda^\circ_{m\ CH_3COOH} = \Lambda^\circ_{m\ CH_3COO^-} + \Lambda^\circ_{m\ H^+}$$
$$= 50 + 350 = 400\ S\ cm^2\ mol^{-1}$$

$\alpha = \frac{\Lambda_m}{\backslash\Lambda^\circ_m} = \frac{20}{400} = \frac{1}{20}$

$K_a = \frac{C\alpha^2}{1-\alpha} \simeq C\alpha^2 = 7 \times 10^{-3} \times \left(\frac{1}{20}\right)^2$

$= 7 \times 10^{-3} \times \frac{1}{4} \times 10^{-2}$

$= 1.75 \times 10^{-5}$ mol L^{-1}

Question16

On electrolysis of dil. sulphuric acid using Platinum (Pt) electrode, the product obtained at anode will be
(2020)

Options:

A. Oxygen gas

B. H_2S gas

C. SO_2 gas

D. Hydrogen gas

Answer: A

Solution:

Solution:
During the electrolysis of dil. sulphuric acid using Pt electrodes following reaction occurs
At cathode :$4H^+(aq) + 4e^- \longrightarrow 2H_2(g)$
At anode :$2H_2O(l) \longrightarrow O_2(g) + 4H^+(aq) + 4e^-$

Question17

The number of Faradays(F) required to produce 20g of calcium from molten $CaCl_2$ (Atomic mass of Ca = 40gmol^{-1}) is:
(2020)

Options:

A. 2

B. 3

C. 4

D. 1

Answer: D

Solution:

1 equivalent of any substance is deposited by $1F$ of charge. 20g calcium contains,

Number of equivalents $= \frac{\text{Given mass}}{\text{Equivalent mass}}$

(Equivalent mass of Ca $= \frac{\text{Atomic mass}}{\text{Valency}} = \frac{40}{2} = 20\Big)$

$= \frac{20}{20} = 1$

So, 1 Faraday of charge is required to deposit 1 equivalent of Ca.

Question18

For the cell reaction:

$2Fe^{3+}{}_{(aq)} + 2I^{-}{}_{(aq)} \rightarrow 2Fe^{2+}{}_{(aq)} + I_{2(aq)} E^{\ominus}{}_{cell} = 0.24V$ at 298K.

The standard Gibbs energy $\left(\Delta_r G^{\ominus}\right)$ of the cell reaction is

[Given that Faraday constant, $F = 96500 C\, mol^{-1}$]

(NEET 2019)

Options:

A. $23.16\, kJ\, mol^{-1}$

B. $-46.32\, kJ\, mol^{-1}$

C. $-23.16\, kJ\, mol^{-1}$

D. $46.32\, kJ\, mol^{-1}$

Answer: B

Solution:

$$\Delta G^{\ominus} = -nFE^{\ominus}{}_{cell}$$
$$= 2 \times 96500 \times 0.24 J\, mol^{-1}$$
$$= -46320 J\, mol^{-1}$$
$$= -46.32 kJ\, mol^{-1}$$

Question19

For a cell involving one electron, $E°_{cell} = 0.59V$ at 298K, the equilibrium constant for the cell reaction is

[Given that $\frac{2.303\, RT}{F} = 0.059V$ at $T = 298K$]

(NEET 2019)

Options:

A. 1.0×10^{30}

B. 1.0×10^{2}

C. 1.0×10^{5}

D. 1.0×10^{10}

Answer: D

Solution:

According to Nernst equation, $E_{cell} = E°_{cell} - \frac{0.059}{n} \log Q_c$

At equilibrium $E_{cell} = 0$,

$\therefore Q_c = K_c$

$E°_{cell} = \frac{0.059}{n} \log K_c$

$\Rightarrow 0.59 = \frac{0.059}{1} \log K_c$

$K_c =$ antilog $10 \Rightarrow K_c = 1 \times 10^{10}$

Question20

Following limiting molar conductivities are given as :

$\lambda°m(H_2SO_4) = x \text{ S cm}^2 \text{ mol}^{-1}$

$\lambda°m(K_2SO_4) = y \text{ S cm}^2 \text{ mol}^{-1}$

$\lambda°m(CH_3COOK) = z \text{ S cm}^2 \text{ mol}^{-1}$

$\lambda°m(\text{in S cm}^2\text{mol}^{-1})$

for CH_3COOH will be

(Odisha NEET 2019)

Options:

A. $x - y + 2z$

B. $x + y - z$

C. $x - y + z$

D. $\frac{(x-y)}{2} + z$

Answer: D

Solution:

According to Kohlrausch's law,
Λ°_m for $CH_3COOH = \lambda^\circ_{CH_3COO^-} + \lambda^\circ_{H^+}$
λ° for $H_2SO_4 = 2\lambda^\circ_{H^+} + \lambda^\circ_{SO_4^{2-}} = x\ S\ cm^2\ mol^{-1}$ ...(i)
λ° for $K_2SO_4 = 2\lambda^\circ_{K^+} + \lambda^\circ_{SO_4^{2-}} = y\ S\ cm^2\ mol^{-1}$ ...(ii)
λ° for $CH_3COOH = \lambda^\circ_{CH_3COO^-} + \lambda^\circ_{K^+} = z\ S\ cm^2\ mol^{-1}$ ...(iii)
On adding equation (i) and $2\times$ (iii) and subtracting (ii), we get
$2\lambda^\circ_{H^+} + \lambda^\circ_{SO_4^{2-}} + 2\lambda^\circ_{CH_3COO^-} + 2\lambda^\circ_{K^+} - 2\lambda^\circ_{K^+} - 2\lambda^\circ_{SO_4^{2-}} = x + 2z - y$
$\Rightarrow \lambda^\circ_{H^+} + \lambda^\circ_{CH_3COO^-} = \frac{(x-y)}{2} + z$

Question21

The standard electrode potential (E°) values of Al^{3+} / Al, Ag^+ / Ag, K^+ / K and Cr^{3+} / Cr are $-1.66V$, $0.80V$, $-2.93V$ and $-0.74V$ respectively. The correct decreasing order of reducing power of the metal is
(Odisha NEET 2019)

Options:

A. Ag > Cr > Al > K

B. K > Al > Cr > Ag

C. K > Al > Ag > Cr

D. Al > K > Ag > Cr

Answer: B

Solution:

Solution:
Reducing power of metal $\propto \frac{1}{SRP}$
K > Al > Cr > Ag

Question22

In the electrochemical cell :
$Zn \mid ZnSO_4(0.01M) \| CuSO_4(1.0M) \mid Cu$ the emf of this Daniell cell is E_1. When the concentration of $ZnSO_4$ is changed to 1.0M and that of $CuSO_4$ changed to 0.01M, the emf changes to E_2. From the followings, which one is the relationship between E_1 and E_2? (Given, $\frac{RT}{F} = 0.059$)
(NEET 2017, 2003)

Options:

A. $E_1 < E_2$

B. $E_1 > E_2$

C. $E_2 = 0 \neq E_1$

D. $E_1 = E_2$

Answer: B

Solution:

$$E_{cell} = E°_{cell} - \frac{0.059}{n} \log \frac{[Zn^{2+}]}{[Cu^{2+}]}$$

$$E_1 = E° - \frac{0.059}{2} \log \frac{0.01}{1}$$

$$E_1 = E° - \frac{0.059}{2}(-2) \quad = E° + 0.059$$

$$E_2 = E° - \frac{0.059}{2} \log \frac{1}{0.01} \quad = E° - 0.059$$

Hence, $E_1 > E_2$

Question23

The molar conductivity of a 0.5 mol / dm^3 solution of $AgNO_3$ with electrolytic conductivity of $5.76 \times 10^{-3} Scm^{-1}$ at 298K (NEET-II 2016)

Options:

A. $2.88 Scm^2 / mol$

B. $11.52 Scm^2 / mol$

C. $0.086 Scm^2 / mol$

D. $28.8 Scm^2 / mol$

Answer: B

Solution:

Solution:

$$\Lambda_m = \frac{\kappa \times 1000}{\text{Molarity(M)}} = \frac{5.76 \times 10^{-3} Scm^{-1} \times 1000}{0.5\,mol\,cm^{-3}} = 11.52 Scm^2 / mol$$

Question24

produce 0.10 mol of chlorine gas using a current of 3 amperes is (NEET-II 2016)

Options:

A. 55 minutes

B. 110 minutes

C. 220 minutes

D. 330 minutes.

Answer: B

Solution:

During the electrolysis of molten sodium chloride,
At cathode : $2Na^+ + 2e^- \rightarrow 2\,Na$
At anode : $2Cl^- \rightarrow Cl_2 + 2e^-$

Net reaction: $2Na^+ + 2Cl^- \rightarrow 2\,Na + Cl_2$

According to Faraday's first law of electrolysis, $w = Z \times I \times t$

$$\Rightarrow w = \frac{E}{96500} \times I \times t$$

No. of moles of Cl_2 gas × Mol. wt. of Cl_2 gas $= \dfrac{\text{Eq. wt. of } Cl_2 \text{ gas} \times I \times t}{96500}$

$$\Rightarrow 0.10 \times 71 = \frac{35.5 \times 3 \times t}{96500}$$

$$t = \frac{0.10 \times 71 \times 96500}{35.5 \times 3} = 6433.33\,\text{sec} \approx 110\,\text{min}$$

Question25

If the E°_{cell} for a given reaction has a negative value, which of the following gives the correct relationships for the values of ΔG° and K_{eq}? (NEET-II 2016, 2011)

Options:

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. $\Delta G^\circ < 0; K_{eq} < 1$

Answer: A

$\Delta G° = -nFE°_{cell}$
If $E°_{cell} = -ve$ then $\Delta G° = +ve$ i.e.; $\Delta G° > 0$.
$\Delta G° = -nRT \log K_{eq}$
For $\Delta G° = +ve$, $K_{eq} = -ve$ i.e., $K_{eq} < 1$

Question26

The number of electrons delivered at the cathode during electrolysis by a current of 1 ampere in 60 seconds is (charge on electron $= 1.60 \times 10^{-19} C$)
(NEET-II 2016)

Options:

A. 6×10^{23}

B. 6×10^{20}

C. 3.75×10^{20}

D. 7.48×10^{23}

Answer: C

Solution:

$Q = I \times t = 1 \times 60 = 60C$
Now, $1.60 \times 10^{-19} C \equiv 1$ electron
$$\therefore 60C \equiv \frac{60}{1.6 \times 10^{-19}} = 37.5 \times 10^{19} = 3.75 \times 10^{20} \text{ electrons}$$

Question27

Zinc can be coated on iron to produce galvanized iron but the reverse is not possible. It is because
(NEET-II 2016)

Options:

A. zinc is lighter than iron

B. zinc has lower melting point than iron

C. zinc has lower negative electrode potential than iron

D. zinc has higher negative electrode potential than iron.

Solution:

Reduction potential values of $E_{Zn^{2+}/Zn} = -0.76V$ and $E°_{Fe^{2+}/Fe} = -0.44V$
Thus, due to higher negative electrode potential value of zinc than iron, iron cannot be coated on zinc.

Question28

The pressure of H_2 required to make the potential of H_2 electrode zero in pure water at 298K is
(NEET-I 2016)

Options:

A. 10^{-10} atm

B. 10^{-4} atm

C. 10^{-14} atm

D. 10^{-12} atm.

Answer: C

Solution:

pH = 7 for water.

$-\log[H^+] = 7 \Rightarrow [H^+] = 10^{-7}$

$2H^+_{(aq)} + 2e^- \rightarrow H_{2(g)}$

$$E_{cell} = E°_{cell} - \frac{0.0591}{2}\log\frac{p_{H_2}}{[H^+]^2}$$

$$0 = 0 - \frac{0.0591}{2}\log\frac{p_{H_2}}{(10^{-7})^2}$$

$$\log\frac{p_{H_2}}{(10^{-7})^2} = 0 \Rightarrow \frac{p_{H_2}}{(10^{-7})^2} = 1$$

$p_{H_2} = 10^{-14}$ atm

Question29

A device that converts energy of combustion of fuels like hydrogen and methane, directly into electrical energy is known as
(2015 Cancelled)

Options:

B. Ni-Cd cell

C. fuel cell

D. electrolytic cell

Answer: C

Question30

When 0.1 mol MnO_4^{2-} is oxidised the quantity of electricity required tom completely oxidise MnO_4^{2} to MnO_4^{-} is
(2014)

Options:

A. 96500 C

B. 2×96500 C

C. 9650 C

D. 96.50 C

Answer: C

Solution:

The oxidation reaction is

$$\overset{+6}{M}nO_4^{2-} \rightarrow \overset{+7}{M}nO_4^{-} + e^{-}$$

0.1 mol 0.1 mol

$Q = 0.1 \times F = 0.1 \times 96500C = 9650C$

Question31

The weight of silver (at. wt. = 108) displaced by a quantity of electricity which displaces 5600 mL of O_2 at STP will be
(2014)

Options:

A. 5.4 g

B. 10.8 g

C. 54.0 g

D. 108.0 g

Answer: D

Solution:

According to Faraday's second law,

$$\frac{W_{Ag}}{E_{Ag}} = \frac{W_{O_2}}{E_{O_2}} \text{ or } \frac{W_{Ag}}{108} = \frac{\frac{5600}{22400} \times 32}{8}$$

$$\text{or } \frac{W_{Ag}}{108} = \frac{8}{8} \Rightarrow W_{Ag} = 108\text{g}$$

Question32

At 25°C molar conductance of 0.1 molar aqueous solution of ammonium hydroxide is 9.54ohm^{-1}cm^{2}mol^{-1} and at infinite dilution its molar conductance is 238ohm^{-1}cm^{2}mol^{-1}.The degree of ionisation of ammonium hydroxide at the same concentration and temperature is (2013 NEET)

Options:

A. 4.008 %

B. 40.800 %

C. 2.080 %

D. 20.800 %

Answer: A

Solution:

Solution:
Degree of dissociations

$$(\alpha) = \frac{\text{Molar conductivity at conc . c}(\Lambda_m{}^c)}{\text{Molar conductivity at infinite dilution}(\Lambda_m{}^\infty)}$$

$$\alpha = \frac{9.54\Omega^{-1}\text{cm}^2\text{mol}^{-1}}{238\Omega^{-1}\text{cm}^2\text{mol}^{-1}} = 0.04008 = 4.008\%$$

Question33

$Zn_{(s)} + Ag_2O_{(s)} + H_2O_{(l)} \rightleftharpoons 2Ag_{(s)} + Zn_{(aq)}^{2+} + 2OH_{(aq)}^{-}$
If half cell potentials are
$Zn_{(aq)}^{2+} + 2e^- \rightarrow Zn_{(s)}; E^\circ = -0.76V$
$Ag_2O_{(s)} + H_2O_{(l)} + 2e^- \rightarrow 2Ag_{(s)} + 2OH_{(aq)}^{-} . E^\circ = 0.34V$

The cell potential will be
(2013 NEET)

Options:

A. 0.84 V

B. 1.34 V

C. 1.10 V

D. 0.42 V

Answer: C

Solution:

$E^\circ_{cell} = E^\circ_{O.P} + E^\circ_{R.P} = 0.76 + 0.34 = 1.10V$

Question34

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 electrode would be?
(2013 NEET)

Options:

A. 0.118 V

B. 1.18 V

C. 0.059 V

D. 0.59 V

Answer: D

Solution:

$\underset{atm}{H_2} \rightarrow \underset{10^{-10}}{2H^+} + 2e^-$

$$E_{\frac{H_2}{H^+}} = 0 - \frac{0.059}{2}\log\frac{(10^{-10})^2}{1}$$

$$E_{\frac{H_2}{H^+}} = +0.59V$$

Question35

Consider the half-cell reduction reaction
$Mn^{2+} + 2e^- \rightarrow Mn, E° = -1.18V$
$Mn^{2+} \rightarrow Mn^{3+} + e^-, E° = -1.51V$
The E° for the reaction
$3Mn^{2+} \rightarrow Mn^0 + 2Mn^{3+}$
and possibility of the forward reaction are respectively
(Karnataka NEET 2013)

Options:

A. −4.18V and yes

B. +0.33V and yes

C. +2.69V and no

D. −2.69V and no.

Answer: D

Solution:

$Mn^{2+} + 2e^- \rightarrow Mn, E° = -1.18V$
$2Mn^{2+} \rightarrow 2Mn^{3+} + 2e^-, E° = -1.51V$
For the cell,
$3Mn^{2+} \rightarrow Mn + 2 \rightarrow Mn^{3+}; E° = -2.69V$
since the E° value is negative, so the process is non-spontaneous.

Question36

How many grams of cobalt metal will be deposited when a solution of cobalt(II) chloride is electrolyzed with a current of 10 amperes for 109 minutes? (1 Faraday = 96, 500C; Atomic mass of Co = 59u)
(Karnataka NEET 2013)

Options:

A. 4.0

B. 20.0

C. 40.0

D. 0.66

Answer: B

Solution:

$$W = \frac{I\,tE}{96500} = \frac{10 \times 109 \times 60 \times 59}{96500 \times 2} = 19.99 \approx 20g$$

Question37

Limiting molar conductivity of NH_4OH [i,.e. $\Lambda^\circ_{m[NH_4OH]}$] is equal to (2012)

Options:

A.

$\Lambda^\circ_{m(NH_4Cl)} + \Lambda^\circ_{m(NaCl)} - \Lambda^\circ_{m(NaOH)}$

B.

$\Lambda^\circ_{m(NaOH)} + \Lambda^\circ_{m(NaCl)} - \Lambda^\circ_{m(NH_4Cl)}$

C.

$\Lambda^\circ_{m(NH_4OH)} + \Lambda^\circ_{m(NH_4Cl)} - \Lambda^\circ_{m(HCl)}$

D.

$\Lambda^\circ_{m(NH_4Cl)} + \Lambda^\circ_{m(NaOH)} - \Lambda^\circ_{m(NaCl)}$

Answer: D

Question38

Standard reduction potentials of the half reactions are given below :$F_{2(g)} + 2e^- \rightarrow 2F^-_{(aq)}$; $E^\circ = +2.85V$
$Cl_{2(g)} + 2e^- \rightarrow 2Cl^-_{(aq)}$; $E^\circ = +1.36V$

$Br_{2(l)} + 2e^{-} \rightarrow 2Br_{(aq)}^{-}$; $E° = +1.06V$
$I_{2(s)} + 2e^{-} \rightarrow 2I_{(aq)}^{-}$; $E° = +0.53V$
The strongest oxidising and reducing agents respectively are
(2012 Mains)

Options:

A. F_2 and I^-

B. Br_2 and Cl^-

C. Cl_2 and Br^-

D. Cl_2 and I_2

Answer: A

Solution:

Solution:
More negative the value of reduction potential, stronger will be the reducing agent thus I^- is strongest reducing agent
More positive value of reduction potential shows good oxidising properties thus strongest oxidising agent is F_2

Question39

Molar conductivities ($\Lambda°_m$) at infinite dilution of NaCl, HCl and CH_3COONa are 126.4,425.9 and 91.0Scm^2mol^{-1} receptively ($\Lambda°_m$) for CH_3COOH will be
(2012 Mains, 1997)

Options:

A. $425.5Scm^2mol^{-1}$

B. $180.5Scm^2mol^{-1}$

C. $290.8Scm^2mol^{-1}$

D. $390.5Scm^2mol^{-1}$

Answer: D

Solution:

$\Lambda°_{NaCl} = 126.4Scm^2mol^{-1}$
$\Lambda°_{HCl} = 425.9Scm^2mol^{-1}$

$\Lambda^\circ_{CH_3CCOONa} = 91.0 \mathrm{Scm^2 mol^{-1}}$
$\Lambda^\circ_{CH_3COOH} = \Lambda^\circ_{CH_3COONa} + \Lambda^\circ_{HCl} - \Lambda^\circ_{NaCl}$

$= 91.0 + 425.9 - 126.4$
$= 390.5 \mathrm{Scm^2 mol^{-1}}$

Question40

The Gibb's energy for the decomposition of Al_2O_3 at 500°C is as follows $\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$, $\Delta_r G = +960\,\mathrm{kJ\,mol^{-1}}$.
The potential difference needed for the electrolytic reduction of aluminium oxide (Al_2O_3) at 500°C is at least
(Mains 2013)

Options:

A. 4.5V

B. 3.0V

C. 2.5V

D. 5.0V

Answer: C

Solution:

$\Delta G^\circ = -nFE^\circ$
$F = 96500, \Delta G^\circ = +960 \times 10^3 \mathrm{J / mol}$
$\frac{2}{3}Al_2O_3 \rightarrow \frac{4}{3}Al + O_2$
Total number of Al atoms in $Al_2O_3 = \frac{2}{3} \times 2 = \frac{4}{3}$
$Al^{3+} + 3e^- \rightarrow Al$
As $3e^-$ change occur for each Al-atom
$\therefore$ Total $n = \frac{4}{3} \times 3 = 4$
$E^\circ = -\Delta G^\circ nF = -\frac{960 \times 1000}{4 \times 96500}$
$\Rightarrow E^\circ = -2.48 \approx -2.5V$

Question41

Standard electrode potential of three metals X, Y and Z are 1.2 V, + 0.5 V and - 3.0 V respectively. The reducing power of these metals will be (2011)

A. Y > Z > X

B. Y > X > Z

C. Z > X > Y

D. X > Y > Z

Answer: C

Solution:

As the electrode potential drops, reducing power increases.
So, $Z(-3.0V) > X(-1.2V) > Y(+0.5V)$

Question42

The electrode potentials for $Cu_{(aq)}^{2+} + e^- \rightarrow Cu_{(aq)}^{+}$ and $Cu_{(aq)}^{+} + e^- \rightarrow Cu_{(s)}$ are $+ 0.15$ V and $+ 0.50$ V respectively.The value of $E°_{Cu^{2+}/Cu}$ will be

(2011)

Options:

A. 0.500 V

B. 0.325 V

C. 0.650 V

D. 0.150 V

Answer: B

Solution:

$Cu_{(aq)}^{2+} + e^- \rightarrow Cu_{(aq)}^{+}$; $E_1° = 0.15V$
$Cu_{(aq)}^{+} + e^- \rightarrow Cu_{(s)}$; $E_2° = 0.50V$
$Cu^{2+} + 2e^- \rightarrow Cu$
Now, $\Delta G° = \Delta G°_1 + \Delta G_2°$
or, $-nFE° = -n_1FE_1° - n_2FE_2°$
or

$$E° = \frac{n_1E_1° + n_2E_2}{n} = \frac{1 \times 0.15 + 1 \times 0.50}{2} = 0.325V$$

Question43

Standard electrode potential for Sn^{4+}/Sn^{2+} couple is $+ 0.15$ V and that

for the Cr^{3+} / Cr couple is - 0.74 V. These two couples in their standard state are connected to make a cell. The cell potential will be (2011)

Options:

A. + 1.19 V

B. + 0.89 V

C. + 0.18 V

D. + 1.83 V

Answer: B

Solution:

$$E°_{cell} = E°_{cathode} - E°_{anode}$$
$$= 0.15 - (-0.74) = 0.15 + 0.74 = 0.89V$$

Question44

A solution contains Fe^{2+}, Fe^{3+} and I^- ions.This solution was treated with iodine at 35°C.E° for Fe^{3+} / Fe^{2+} is $+0.77V$ and E° for $I_2 / 2I^- = 0.536V$.The favorable redox reaction is (2011 Mains)

Options:

A. I_2 will be reduced to I

B. there will be no redox reaction

C. I^- will be oxidised to I_2

D. Fe^{2+} will be oxidised to Fe^{3+}

Answer: C

Solution:

Since the reduction potential of $\frac{Fe^{3+}}{Fe^{2+}}$ is greater than that of $\frac{I_2}{I^-}$, Fe^{3+} will be reduced and i^- will be oxidised.

$$2Fe^{3+} + 2I^- \rightarrow 2Fe^{2+} + I_2$$

Question45

For the reduction of silver ions with copper metal, the standard cell potential was found to be + 0.46 V at 25°C. The value of standard Gibb's energy, $\Delta G°$ will be ($F = 96500 \mathrm{C mol}^{-1}$)
(2010)

Options:

A. - 89.0 kJ

B. - 89.0 J

C. -44.5 KJ

D. - 98.0 kJ

Answer: A

Solution:

The cell reaction can be written as
$\mathrm{Cu} + 2\mathrm{Ag}^{+} \rightarrow \mathrm{Cu}^{2+} + 2\mathrm{Ag}$
We know $\Delta G° = -nFE°_{cell}$
$= -2 \times 96500 \times 0.46 = -88780\mathrm{J}$
$= -88.780\mathrm{kJ} = -89\mathrm{kJ}$

Question46

An increase in equivalent conductance of a strong electrolyte with dilution is mainly due to
(2010)

Options:

A. increase in ionic mobility of ions

B. 100% ionisation of electrolyte at normal dilution

C. increase in both i.e., number of ions and ionic mobility of ions

D. increase in number of ions

Answer: A

Solution:

Strong electrolytes arc completely ionised at all concentrations. On increasing dilution the no. of ions remains the same but the ionic mobility increases and the equivalent conduction increases.

Question47

Which of the following expressions correctly represents the equivalent conductance at infinite dilution of $Al_2(SO_4)_3$.Given that $\Lambda°_{Al^{3+}}$ and $\Lambda°_{SO_4^{2-}}$are the equivalent conductance's at infinite dilution of the respective ions?
(2010 Mains)

Options:

A. $2\Lambda°_{Al^{3+}} + 3\Lambda°_{SO_4^{2-}}$

B. $\Lambda°_{Al^{3+}} + \Lambda°_{SO_4^{2-}}$

C. $\left(\Lambda°_{Al^{3+}} + \Lambda°_{SO_4^{2-}}\right) \times 6$

D. $\frac{1}{3}\Lambda°_{Al^{3+}} + \frac{1}{2}\Lambda°_{SO_4^{2-}}$

Answer: B

Solution:

Solution:
At infinite dilution, when dissociation is complete, each ion makes a definite contribution towards molar conductance of the electrolyte irrespective of the nature of the other ion with which it is associated.
Hence $\Lambda°_{Al_2(SO_4)_2} = \Lambda°_{Al^{3+}} + \Lambda°_{SO_4^{2-}}$

Question48

Consider the following relations for emf of an electrochemical cell
(i) EMF of cell = (Oxidation potential of anode) - (Reduction potential of cathode)
(ii) EMF of cell = (Oxidation potential of anode) + (Reduction potential of cathode)
(iii) EMF of cell = (Reductional potential of anode) + (Reduction potential of cathode)
(iv) EMF of cell = (Oxidation potential of anode) - (Oxidation potential of cathode)
Which of the above relations are correct?
(2010 Mains)

Options:

A. (iii) and (i)

B. (i) and (ii)

C. (iii) and (iv)

D. (ii) and (iv)

Answer: D

Solution:

EMF of a cell = Reduction potential of cathode - Reduction potential of anode
= Reduction potential of cathode + Oxidation potential of anode
= Oxidation potential of anode - Oxidation potential of cathode

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Question49

Given
(i) $Cu^{2+} + 2e^{-} \rightarrow Cu$, $E° = 0.337V$
(ii) $Cu^{2+} + e \rightarrow Cu^{+}$, $E° = 0.153V$
Electrode potential, E° for the reaction,
$Cu^{+} + e^{-} \rightarrow Cu$ will be
(2009)

Options:

A. 0.90 V

B. 0.30 V

C. 0.38 V

D. 0.52 V

Answer: D

Solution:

Given
$Cu^{2+} + 2e^{-} \rightarrow Cu$, $E°_1 = 0.337V$
$Cu^{2+} + e \rightarrow Cu^{+}$, $E°_2 = 0.153V$
The required equation is
$Cu^{2+} + e^{-} \rightarrow Cu$; $E°_3 = ?$
Applying,
$\Delta G° = -nF E°$, $\Delta G°_3 = \Delta G°_1 - \Delta G_2°$
$-(n_3 F E_3°) = -(nF E°_1) - (-n_2 F E_2°)$

or $E°_3 = 2 \times E_1° - E_2°$
or $E_3° = (2 \times 0.337) - 0.153 = 0.52V$

Question50

Al_2O_3 is reduced by electrolysis at low potentials and high currents.If 4.0×10^4 amperes of current passed through molten Al_2O_3 for 6 hours,What mass of aluminium is produced ?
(Assume 100% current efficiency,at mass of Al $= 27gmol^{-1}$)
(2009)

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Options:

A. $8.1 \times 10^4 g$

B. $2.4 \times 10^5 g$

C. $1.3 \times 10^4 g$

D. $9.0 \times 10^3 g$

Answer: A

Solution:

Applying $E = Z \times 96500$

$\frac{27}{3} = Z \times 96500 \Rightarrow Z = \frac{9}{96500}$

Now applying the formula. $W = Z \times I \times t$

$W = \frac{9}{96500} \times 4 \times 10^4 \times 6 \times 60 \times 60 = 8.1 \times 10^4 g$

Question51

The equivalent conductance of M/32 solution of a weak monobasic acid is $8.0 mhocm^2$ and at infinite dilution is $400 mhocm^2$.The dissociation constant of this acid is
(2009)

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Options:

A. 1.25×10^{-6}

B. 6.25×10^{-4}

C. 1.25×10^{-4}

D. 1.25×10^{-5}

Answer: D

Given $\Lambda = 8 \mathrm{mho cm}^2$
$\Lambda_\infty = 400 \mathrm{mho cm}^2$
Degree of dissociation,
$\alpha = \frac{\Lambda}{\Lambda_\infty} \Rightarrow \alpha = \frac{8}{400} = 2 \times 10^{-2}$

Dissociation constant, $K = C\alpha^2$
Given $C = \frac{M}{32}$
$\therefore K = \frac{1}{32} \times 2 \times 10^{-2} \times 2 \times 10^{-2}$
$K = 1.25 \times 10^{-5}$

Question52

On the basis of the following E° values, the strongest oxidizing agent is
$[Fe(CN)_6]^{4-} \rightarrow [Fe(CN)_6]^{3-} + e^-; E° = -0.35V$
$Fe^{2+} \rightarrow Fe^{3+} + e^-; E° = -0.77V$
(2008)

Options:

A. Fe^{3+}

B. $[Fe(CN)_6]^{3-}$

C. $[Fe(CN)_6]^{4-}$

D. Fe^{2+}

Answer: A

Solution:

$[Fe(CN)_6]^{3-} \rightarrow [Fe(CN)_6]^{4-} + e^-; E° = +0.35V$
$Fe^{3+} \rightarrow Fe^{2+}; E° = -0.77V$

Higher the +ve reduction potential, stronger will be the oxidising agent. Oxidising agent oxidises other compounds and gets itself reduced easily.

Question53

Kohlrausch's law states that at
(2008)

A. infinite dilution, each ion makes definite contribution to conductance of an electrolyte whatever be the nature of the other ion of the electrolyte

B. infinite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

C. finite dilution, each ion makes definite contribution to equivalent conductance of an electrolyte, whatever be the nature of the other ion of the electrolyte

D. infinite dilution each ion makes definite contribution to equivalent conductance of an electrolyte depending on the nature of the other ion of the electrolyte

Answer: A

Solution:

At infinite dilution, when dissociation is complete each ion makes a definite contribution towards molar conductance of the electrolyte irrespective of the nature of the other ion with which it is associated and that the molar conductance of any electrolyte at infinite dilution is given by the sum of the contributions of two ions. This is called Kohlrausch’s law.
$\Lambda_m^\infty = \lambda_+^\infty + \lambda_-^\infty$
λ_+^∞ and λ_-^∞ are molar ionic conductance at infinite dilution for cations and anion respectively.

Question54

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 of E°_{cell} for the pentane-oxygen fuel cell is (2008)

Options:

A. 1.0968 V

B. 0.0968 V

C. 1.968 V

D. 2.0968 V

Answer: A

Solution:

$C_5H_{12(g)} + O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(l)}$
$\Delta G^\circ = [(-394.4 \times 5) + (-237.2 \times 6)] - [(-8.2) + (8 \times 0)]$
$= -3387$ kJ
Note that the standard free energy change of elementary substances is taken as zero.
For the fuel cell, the complete cell reaction is :
$C_5H_{12(g)} + 8O_{2(g)} \rightarrow 5CO_{2(g)} + 6H_2O_{(l)}$
Which is the combination of the following two half reactions:
$C_5H_{12(g)} + 10H_2O_{(l)} \rightarrow 5CO_{2(g)} + 32H^+ + 32e$and

Therefore, the number of electrons exchanged is 32 here, means n = 32. This is the trickiest part of the problem.
$\Delta G^\circ = nFE^\circ$
$-3387 \times 10^3 J = -32 \times 96500 \frac{J}{Volt} \times E^\circ$
Then $E^\circ = 1.0968V$

Question55

The equilibrium constant of the reaction: $Cu_{(s)} + 2Ag_{(aq)}^{+} \rightarrow Cu_{(aq)}^{2+} + 2Ag_{(s)}, E^\circ = 0.46V$ at 298K is (2007)

Options:

A. 2.0×10^{10}

B. 4.0×10^{10}

C. 4.0×10^{15}

D. 2.4×10^{10}

Answer: C

Solution:

For a cell reaction in equilibrium at 298 K,
$E^\circ_{cell} = \frac{0.0591}{n} \mathrm{loh} K_c$
Where K_c = equilibrium constant, n = number of electrons involved in the electrochemical cell reaction
Given $E^\circ_{cell} = 0.46V, n = 2$
$\therefore 0.46 = \frac{0.0591}{2} \times \log K_c$
or $\log K_c = \frac{2 \times 0.46}{0.0591} = 15.57$
or $K_c = 3.7 \times 10^{15} = 4 \times 10^{15}$

Question56

The efficiency of a fuel is given by (2007)

Options:

A. $\Delta G/\Delta S$

B. $\Delta G/\Delta H$

D. $\Delta H/\Delta G$

Answer: B

Solution:

The thermal efficiency,η of a fuel conversion device is the amount of useful energy produced relative to the change in enthalpy, ΔH between the product and feed streams

$\eta = \frac{\text{useful energy}}{\Delta H}$

In an ideal case of an electrochemical convertor, such as a fuel cell, the change in Gibb's free energy, ΔG of the reaction is available as useful electric energy at that temperature of the conversion.

Hence $\eta_{ideal} = \frac{\Delta G}{\Delta H}$

Question57

A hypothetical electrochemical cell is shown below;
$A \mid A^{+}(xM) \mid\mid B^{+}(yM) \mid B$
The emf measured is +0.20 V.The cell reaction is
(2006)

Options:

A. $A + B^{+} \rightarrow A^{+} + B$

B. $A^{+} + B \rightarrow A + B^{+}$

C. $A^{+} + e^{-} \rightarrow A; B^{+} + e \rightarrow B$

D. the cell reaction cannot be predicted

Answer: A

Solution:

From the given expression:
At node : $A \rightarrow A^{+} + e$
At cathode : $B^{+} + e \rightarrow B$
Overall reaction is : $A + B^{+} \rightarrow A^{+} + B$

Question58

$E^{\circ}_{Fe^{2+}/Fe} = -0.441V$ $E^{\circ}_{Fe^{3+}/Fe^{2+}} = 0.771V$ the standard EMF of the reaction $Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$ will be
(2006)

Options:

A. 0.111 V

B. 0.330 V

C. 1.653 V

D. 1.212 V

Answer: D

Solution:

$Fe^{2+} + 2e^- \rightarrow Fe; E° = -0.441V$ ....(i)
$Fe^{3+} + e^- \rightarrow Fe^{2+}; E° = 0771V$ .... (ii)
$Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}; E° = ?$
To get the above equation (ii)×2-(i)
$2Fe^{3+} + 2e^- \rightarrow 2Fe^{2+}; E° = 0.771V$
$-Fe^{2+} - 2e^- \rightarrow -Fe; E° = 0.441V$
$2Fe^{3+} + Fe \rightarrow 2Fe^{2+}; E° = 1.212V$

Question59

4.5g of aluminium (at. mass 27 amu) is deposited at cathode from Al^{3+} solution by a certain quantity of electric charge. The volume of hydrogen produced at STP from H^+ ions in solution by the same quantity of electric charge will be
(2005)

Options:

A. 44.8L

B. 22.4L

C. 11.2L

D. 5.6L

Answer: D

Solution:

We know that,
1 Faraday charge liberates 1 eq. of substance. This is the Faraday Law.
eq. wt. of Al $= \frac{27}{3} = 9$
no. of eq. of Al $= \frac{\text{wt. of Al}}{\text{eq. wt.}} = \frac{4.5}{9} = 0.5$
no. of Faraday required $= 0.5$
⇒ no. of eq. of H_2 produced $= 0.5$ eq.

Volume occupied by 1 eq. of $H_2 = \frac{22.4}{2} = 11.2L$

⇒ Volume occupied by 0.5 eq. of $H_2 = 11.2 \times 0.5 = 5.6L$ at STP

Question60

The mass of carbon anode consumed (giving only carbon dioxide) in the production of 270 kg of aluminium metal from bauxite by the Hall process is
(Atomic mass : Al = 27)
(2005)

Options:

A. 270 kg

B. 540 kg

C. 90 kg

D. 180 kg

Answer: C

Solution:

$$3C + \underset{\text{(From bauxite)}}{2Al_2O_3} \rightarrow 4\,Al + 3CO_2$$

4 moles of Al is produced by 3 moles of C

1 mole of Al is produced by $\frac{3}{4}$ mole of C

10^4 moles of Al is produced by $\frac{3}{4} \times 10^4$ molesof C.

Amount of carbon used $= \frac{3}{4} \times 10^4 \times 12g = 90\,\text{Kg}$

Question61

The standard e.m.f. of a galvanic cell involving cell reaction with n = 2 is found to be 0.295V at 25°C. The equilibrium constant of the reaction would be
(Given $F = 96500 C mol^{-1}$, $R = 8.314 JK^{-1} mol^{-1}$)
(2004)

Options:

A. 2.0×10^{11}

C. 1.0×10^2

D. 1.0×10^{10}

Answer: D

Solution:

$E = E° - \frac{0.0591}{n} \log_{10} Q$ at 25°C
At equilibrium, $E = 0$, $Q = K$
$0 = E° - \frac{0.0591}{n} \log_{10} K$
$\Rightarrow K = \text{antilog}\left[\frac{nE°}{0.0591}\right]$
$\Rightarrow K = \text{antilog}\left[\frac{2 \times 0.295}{0.0591}\right] = \text{antilog}\left[\frac{0.0591}{0.0591}\right]$
$= \text{antilog } 10 = 1 \times 10^{10}$

Question62

On the basis of the information available from the reaction, $\frac{4}{3}Al + O_2 \rightarrow \frac{2}{3} \rightarrow Al_2O_3$, $\Delta G = -827\,kJ\,mol^{-1}$ of O_2, the minimum e.m.f. required to carry out an electrolysis of Al_2O_3 is
$(F = 96500 C mol^{-1})$
(2003)

Options:

A. 2.14V

B. 4.28V

C. 6.42V

D. 8.56V

Answer: A

Solution:

For O_2, $\Delta G = -nFE°$
$E° = \Delta G - nF = \frac{-827000}{-2 \times 96500} = 4.28$
Minimum EMF required to carry out electrolysis of $Al_2O_3 = \frac{4.28}{2} = 2.14V$

Question63

In electrolysis of NaCl when Pt electrode is taken then H_2 is liberated at cathode while with Hg cathode it forms sodium amalgam. The reason for this is
(2002)

Options:

A. Hg is more inert than Pt

B. more voltage is required to reduce H^+ at Hg than at Pt

C. Na is dissolved in Hg while it does not dissolve in Pt

D. conc. of H^+ ions is larger when Pt electrode is taken.

Answer: B

Solution:

When sodium chloride is dissolved in water, it ionises as $NaCl \rightleftharpoons Na^+ + Cl^-$.
Water also dissociates as : $H_2O \rightleftharpoons H^+ + OH^-$
During passing of electric current through this solution using platinum electrode, Na^+ and H^+ ions move towards cathode. However, only H^+ ions are discharged more readily than Na^+ ion because of their low discharge potential (In the electromotive series hydrogen is lower than sodium). These H^+ ions gain electrons and change into neutral atoms.
At cathode $H^+ + e^- \rightarrow H$, $H + H \rightarrow H_2$
Cl^- and OH^- ions move towards anode. Cl^- ions lose electrons and change into neutral atom.
At anode, $Cl^- - e^- \rightarrow Cl$, $Cl + Cl \rightarrow Cl_2$
If mercury is used as cathode, H^+ ions are not discharged at mercury cathode because mercury has a high hydrogen overvoltage. Na^+ ions are discharged at the cathode in perference to H^+ ions, yielding sodium, which dissolves in mercury to form sodium amalgam.
At cathode : $Na^+ + e^- = Na$

Question64

Standard electrode potentials are Fe^{2+} / Fe; $E° = -0.44$ and Fe^{3+} / Fe^{2+}; $E° = 0.77$. Fe^{2+}, Fe^{3+} and Fe blocks are kept together, then
(2001)

Options:

A. Fe^{3+} increases

B. Fe^{3+} decreases

C. Fe^{2+} / Fe^{3+} remains unchanged

D. Fe^{2+} decreases.

Answer: B

$E^\circ_{Fe^{2+}/Fe} = -0.44V$
$E^\circ_{Fe^{3+}/Fe^{2+}} = -0.77V$
If a cell is constructed combining these two electrodes oxidation occurs at Fe^{2+} / Fe electrode.
At anode :$Fe \rightarrow Fe^{2+} + 2e^-$
At cathode :$[Fe^{3+} + e^- \rightarrow Fe^{2+}] \times 2$
Cell reaction : $Fe + 2Fe^{3+} \rightarrow 3Fe^{2+}$
If Fe^{2+}, Fe^{3+} and Fe block are kept together then Fe^{3+} reacts with Fe to yield Fe^{2+} i.e. concentration of Fe^{3+} is decreased.

Question65

Equivalent conductances of Ba^{2+} and Cl^- ions are 127 and 76 $ohm^{-1}cm^{-1}eq^{-1}$ respectively. Equivalent conductance of $BaCl_2$ at infinite dilution is
(2000)

Options:

A. 139.5

B. 101.5

C. 203

D. 279

Answer: A

Solution:

$$\lambda_\infty = \frac{1}{n_+}\lambda_+^\infty + \frac{1}{n_-}\lambda_-^\infty$$

$$\text{So, } \lambda_\infty(BaCl_2) = \frac{1}{2} \times \lambda^\infty_{Ba^{2+}} + \frac{1}{1} \times \lambda^\infty_{Cl^-}$$

$$= \frac{1}{2} \times 127 + 76 = 139.5$$

Question66

For the disproportionation of copper $2Cu^+ \rightarrow Cu^{2+} + Cu$, E° is (Given: E° for Cu^{2+} / Cu is 0.34V and E° for Cu^{2+} / Cu^+ is 0.15V)
(2000)

Options:

A. 0.49V

C. 0.38V

D. -0.38V

Answer: C

Solution:

For the reaction, $2Cu^{+} \rightarrow Cu^{2+} + Cu$
the cathode is Cu^{+} / Cu and anode is Cu^{+} / Cu^{2+}.
Given, $Cu^{2+} + 2e^{-} \rightarrow Cu;\ E°_1 = 0.34\text{V}$...(1)
$Cu^{2+} + e^{-} \rightarrow Cu^{+};\ E°_2 = 0.15\text{V}$...(2)
$Cu^{+} + e^{-} \rightarrow Cu;\ E°_3 = ?$...(3)
Now $\Delta G°_1 = -nFE°_1 = -2 \times 0.34 \times F$
$\Delta G°_2 = -1 \times 0.15 \times F,\ \Delta G°_3 = -1 \times E°_3 \times F$
Again, $\Delta G°_1 = \Delta G°_2 + \Delta G°_3$
$\Rightarrow -0.68F = -0.15F - E°_3 \times F$
$\Rightarrow E°_3 = 0.68 - 0.15 = 0.53\text{V}$
As, $E°_{cell} = E°_{cathode}(Cu^{+} / Cu) - E°_{anode}(Cu^{2+} / Cu^{+})$
$= 0.53 - 0.15 = 0.38\text{V}$

Question67

The specific conductance of a 0.1N KCl solution at 23°C is $0.012\,\text{ohm}^{-1}\text{cm}^{-1}$. The resistance of cell containing the solution at the same temperature was found to be 55 ohm. The cell constant will be (1999)

Options:

A. 0.918cm^{-1}

B. 0.66cm^{-1}

C. 1.142cm^{-1}

D. 1.12cm^{-1}

Answer: B

Solution:

Solution:
$\kappa = 0.012\,\text{ohm}^{-1}\text{cm}^{-1}$
$R = 55\text{ ohm} \Rightarrow C = \frac{1}{R} = \frac{1}{55}\text{ohm}^{-1}$
Cell Constant $\left(\frac{l}{a}\right) = \frac{\text{Specific Conductance}}{\text{Conductance}} = \frac{0.012}{1/55} = 55 \times 0.012 = 0.66\text{cm}^{-1}$

E° for the cell, Zn | $Zn^{2+}{}_{(aq)}$||$Cu^{2+}{}_{(aq)}$ | Cu is 1.10V at 25°C, the equilibrium constant for the reaction Zn + $Cu^{2+}{}_{(aq)}$ → Cu + $Zn^{2+}{}_{(aq)}$ is the order of
(1997)

Options:

A. 10^{+18}

B. 10^{+17}

C. 10^{-28}

D. 10^{-37}

Answer: D

Solution:

Nernst equation is
$E = E° - \frac{0.059}{2} \log K$
$\Rightarrow E° = \frac{0.059}{2} \log K$
($E = 0$ at equilibrium condition)
$\Rightarrow 1.1 = \frac{0.059}{2} \log K$
$\Rightarrow K = 1.9 \times 10^{-37}$

Question69

A 5 ampere current is passed through a solution of zinc sulphate for 40 minutes. The amount of zinc deposited at the cathode is
(1996)

Options:

A. 0.4065g

B. 65.04g

C. 40.65g

D. 4.065g

Answer: D

Solution:

Current (I) = 5 ampere and time (t) = 40 minutes = 2400 seconds.
Amount of electricity passed (Q) = $I \times t = 5 \times 2400 = 12000C$
Now , $Zn^{2+} + 2e^{-} \rightarrow Zn$ (1 mole = 65.39)
since, two charges (i.e., 2 × 96500 C) deposits 65.39 gm of zinc,
therefore 12000 C will deposit $= \frac{65.39 \times 12000}{2 \times 96500} = 4.065$g of zinc

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Question70

Reduction potential for the following half-cell reactions are
$Zn = Zn^{2+} + 2e^{-}; E° = +0.76V$
$Fe = Fe^{2+} + 2e^{-}; E° = +0.44V$
The EMF for the cell reaction
$Fe^{2+} + Zn \rightarrow Zn^{2+} + Fe$ will be
(1996)

Options:

A. $-0.32V$

B. $+1.20V$

C. $-1.20V$

D. $+0.32V$

Answer: D

Solution:

$$E°_{Zn / Zn^{2+}} = +0.76V$$
$$E°_{Fe / Fe^{2+}} = 0.44V$$
$$\Rightarrow E°_{Fe / Fe} = -0.44V$$
$$E.M.F. = +0.76 - 0.44 = +0.32V$$

Question71

An electrochemical cell is set up as :
Pt; H_2(1 atm) | HCl(0.1M) || CH_3COOH(0.1M) | H_2(1 atm); Pt.
The e.m.f. of this cell will not be zero, because
(1995)

Options:

A. acids used in two compartments are different

C. the temperature is constant

D. pH of 0.1M HCl and 0.1MCH_3COOH is not same.

Answer: D

Solution:

Solution:
since it is a concentration cell and the concentration of ions in two electrolyte solutions (HCl and CH_3COOH) are different, therefore e.m.f. of this cell will not be zero.

Question72

On heating one end of a piece of a metal, the other end becomes hot because of
(1995)

Options:

A. energised electrons moving to the other end

B. minor perturbation in the energy of atoms

C. resistance of the metal

D. mobility of atoms in the metal.

Answer: A

Solution:

Solution:
Conductivity of heat in metals is due to the presence of free electrons, which move due to increase in temperature.

Question73

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?
(1994)

Options:

A. Ba^{2+}

B. Mg^{2+}

C. Na^+

D. Li^+

Answer: B

Solution:

More is the reduction potential of an oxidizing agent (i.e., less ve value) it has more tendncy to undergo reduction and hence acts as a strong oxidizing agent. ∴ Reduction potential are as follows:
$Li^{\oplus}|Li(-3.05) < Ba^{2+}|Ba(-2.73) < Mg^{2+} \mid Mg$
Hence, Mg^{2+} acts as the strongest oxidizing agents.

Question74

On electrolysis of dilute sulphuric acid using platinum electrodes, the product obtained at the anode will be
(1992)

Options:

A. hydrogen

B. oxygen

C. hydrogen sulphide

D. sulphur dioxide.

Answer: B

Solution:

Product obtained at anode will be oxygen. At anode : $2OH^- \rightleftharpoons H_2O + \frac{1}{2}O_2$
