Redox Reactions Important Questions With Answers

NEET Chemistry 2023

1. The charge on cobalt in $[Co(CN)_6]^{3-}$ is

   a) +3 b) -3 c) +6 d) -6

   Solution : -

   $[CO(CN)_6]^{3-}$;x-6=-3 ;x+3

2. Correct order of tendency to loss of electrons

   a) Zn > Cu > Ag b) Zn < Cu < Ag c) Zn > Cu < Ag d) Cu> Zn > Ag

   Solution : -

   In the mole of electroeffective metal.

3. What is the equivalent mass of KIO_3 in the given reaction?

   $KIO_3 + 2KI + 6HCI \rightarrow 31CI + 3KCI + 3H_2O$

   a) 214 b) 428 c) 107 **d) 53.5**

   Solution : -

   $$\overset{+5}{KIO_3} \rightarrow \overset{+1}{I}\,CI$$

   M = 39 + 127 + 48 = 214

   $$E = \frac{M}{4} = \frac{214}{4} = 53.5$$

4. Identify the correct statement with respect to the following reaction,

   $$2K_2MnO_4 + Cl_2 \rightarrow 2KCl + 2KMnO_4$$

   a) Oxidation of potassium manganate is taking place.

   b) Reduction of potassium manganate is taking place. c) Oxidation of Cl_2 is taking place.

   d) Cl_2 acts as reducing agent in the reaction.

   Solution : -

   $$2K_2\overset{+6}{M}nO_4 + \overset{0}{C}l_2 \rightarrow 2KC\overset{-1}{I} + 2K\overset{+7}{M}nO_4$$

   Mn → Increase in oxidation number hence oxidation.

   Cl_2 → Decrease in oxidation number hence reduction.

   Cl_2 is acting as an oxidising agent.

5. Equivalent weight of FeC_2O_4 in the change, $FeC_2O_4 \rightarrow Fe^{3+} + 2CO_2$ is:

   a) M/3 b) M/6 c) M/2 d) M/1

   Solution : -

   $Fe^{+2} \rightarrow Fe^{+3} + e^-$

   $C_2O_4^{-2} \rightarrow 2CO_2 + 2e^-$

   Adding both the reactions, we get,

   $Fe^{+2} + C_2O_4^{-2} \rightarrow 2CO_2 + Fe^{+3} + 3e^-$

Equivalent weight is defined as the molecular weight divided by the number of moles of electron required by the molecule.

Hence, the equivalent weight is equal to $\frac{M}{3}$

6. In the reaction, $2S_2O_3^{2-} + I_2 \longrightarrow S_4O_6^{2-} + 2I^-$: The eq. mass of $Na_2S_2O_3$ is equal to its

a) M b) M/2 c) 2 x M d) M/6

Solution : -

According to reaction,

$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$

Oxidation of S in $S_2O_3^{2-}$ =2

Oxidation number of S in $S_4O_6^{2-} = \frac{5}{2}$

again, $2S_2O_3^{2-} \rightarrow S_4O_6^{-2}$

For 2 moles of $S_2O_3^{-2}$ change in oxidation number

$= 4 \times \frac{5}{2} - 2 \times 2 \times 2$

=2

For 1 mol = $\frac{2}{2}$=1

$\therefore$ Equivalent mass of $Na_2S_2O_3 = \frac{Molecular\ wt}{Change\ in\ Oxidation\ no.}$

$= \frac{Molecular\ wt}{1}$

7. Using the following Latimer diagram for bromine,

pH = 0; $BrO_4^- \overset{1.82V}{\rightarrow} BrO_3^- \overset{1.50V}{\rightarrow} HBrO \overset{1.595V}{\rightarrow} Br_2 \overset{1.06552V}{\rightarrow} Br^-$ the species undergoing disproportionation is

a) BrO_4^- b) BrO_3^- **c) HBrO** d) Br_2

Solution : -

If the potential to the left of a given chemical species is less than that to the right, the species will undergo disproportionation.

8. Consider the change in oxidation state of Bromine corresponding to different emf values as shown in the diagram below:

$BrO_4^- \xrightarrow{1.82\ V} BrO_3^- \xrightarrow{1.5\ V} HBrO \xrightarrow{1.595\ V} Br_2 \xrightarrow{1.0652\ V} Br^-$ Then the species undergoing disproportionation is:

a) BrO_3^- b) BrO_4^- c) Br_2 **d) HBrO**

Solution : -

$H\overset{+1}{Br}O \longrightarrow \overset{0}{Br_2}$, $E^0_{HBrO/Br_2} = 1.595$ V

$H\overset{+1}{Br}O \longrightarrow \overset{0}{Br}O_3^-$, $E^0_{BrO_3^-/HBrO} = 1.5$ V

E^0_{cell} for the disproportionation of HBrO,

$E^0_{cell} = E^0_{HBrO/Br_2} - E^0_{BrO_3^-/HBrO}$

= 1.595 - 1.5

= 0.095 V = + ve

$E^0_{cell} > 0$,

So, $\Delta G^0 < 0$ (Spontaneous)

9. Mark the correct statement from the following:

a) Copper metal can be oxidised by Zn^{2+} ions. b) Oxidation number of phosphorus in P_4 is 4.

c) An element in the highest oxidation state acts only as a reducing agent.

d) The element which shows highest oxidation number of +8 is Os in OsO_4.

Solution : -

A. Copper metal cannot be oxidised by Zn^{2+} ion because the reduction potential of copper ions is higher than zinc ions. Thus will get reduced in the presence of zinc metal as:

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

B. Oxidation number of an atom in its elemental form is zero. Thus oxidation number of phosphorus is zero in P_4

C. An element in its highest oxidation state can not loose more electrons and thus can not be oxidised further. Therefore will get reduced only and will act as an oxidising agent or oxidant.

D. Osmium is the element which shows highest oxidation number of +8 in OsO_4 as

$x + 4 \times (-2) = 0$

$x = +8.$

10. Oxidation numbers of Mn in its compounds $MnCl_2$, $Mn(OH)_3$, MnO_2 and $KMnO_4$ respectively are

a) +2, +4, +7, +3 **b) +2, +3, +4, +7** c) +7, +3, +2, +4 d) +7, +4, +3, +2

Solution : -

The charges on Cl,O,H,K are −1,−2,+1,+1 respectively. Therefore, the oxidation states of Mn in its given compounds can be calculated as follows:

$MnCl_2 \rightarrow x+(-2)=0 \Rightarrow x=+2$

$Mn(OH)_3 \rightarrow x+(-3)=0 \Rightarrow x=+3$

$MnO_2 \rightarrow x+(-4)=0 \Rightarrow x=+4$

$KMnO_4 \rightarrow +1+x+(-8)=0 \Rightarrow x=+7$

11. Fill up the table from the given choice.

Element	Oxidation number
Oxygen	-2 in most compounds _(i)_ in H_2O_2 and _(ii)_ in OF_2
Halogen	-1 for _(iii)_ in all its compounds
Hydrogen	_(iv)_ in most of its compounds _(v)_ in binary metallic hydrides
Sulphur	_(vi)_ in all sulphides

a)

(i)	(ii)	(iii)	(iv)	(v)	(vi)
+1	+1	Cl	+1	-1	+2

b)

(i)	(ii)	(iii)	(iv)	(v)	(vi)
-1	**+2**	**F**	**+1**	**-1**	**-2**

c)

(i)	(ii)	(iii)	(iv)	(v)	(vi)
-1	+1	F	+1	+2	+2

d)

(i)	(ii)	(iii)	(iv)	(v)	(vi)
+1	+2	Cl	+1	+1	+6

Solution : -

Oxygen: -2 in most compounds ($2 \times 1 + 2x = 0 \Rightarrow x = -1$)$\underline{-1}$ (i) in H_2O_2 and ($x - 2 \Rightarrow x = +2$) $\underline{+2}$ (ii) in OF_2

Halogen: -1 for $\underline{Fluorine(F)}$ (iii) in all its compounds

Hydrogen:$\underline{+1}$ (iv) in most of its compounds $\underline{-1}$ (v) in binary metallic hydrides Sulphur: $\underline{-2}$ (vi) in all sulphides.

12. What is E_{O_3} in the following reaction, $2O_3 \rightarrow 3O_2$

a) 16 b) 48 c) 32 **d) 8**

Solution : -

$2O_3 \rightarrow 3O_2$

2moles of O_3 = 3 x 4 eq of O_2 $\left(Eo_2 = \frac{32}{4}\right)$

1mole of O_3 = 6eq of O_2

1eq. of O_2 = $\frac{48}{6}$ gm O_3

1eq of O_2 = 8g of O_3

13. Match the column I with column II and mark the appropriate choice.

	Column I (Compound)		Column II (Oxidation stateof Fe)
(A)	$K_3[Fe(OH)_6]$	(i)	+8/3
(B)	$K_2[FeO_4]$	(ii)	+2

	Column I (Compound)		Column II (Oxidation stateof Fe)
(C)	$FeSO_4.(NH_4)_2\ SO_4.6H_2O$	(iii)	+2
(D)	Fe_3O_4	(iv)	+6

a) (A) → (iii), (B) → (i), (C) → (ii), (D) → (iv) **b) (A) → (iii), (B) → (iv), (C) → (ii), (D) → (i)**
c) (A) → (i), (B) → (iii), (C) → (ii), (D) →(iv) d) (A) → (iv), (B) → (ii), (C) → (i), (D)→ (iii)

Solution : -
$K_3[Fe(OH)_6]$ → +3+x-6=0 ⇒x=+3
$K_2[FeO_4]$ → +2+x-8=0 ⇒ x=+6
$FeSO_4.(NH_4)_2\ SO_4.6H_2O$ → x-2+2x-6=0 ⇒ 3x=+8 ⇒ x= +8/3

14. When Cl_2 reacts with hot and concentrated sodium hydroxide solution, the oxidation number of chlorine changes from:
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

Solution : -
$3\overset{0}{Cl_2} + \underset{(hot\quad\&\quad conc.)}{6NaOH} \rightarrow 5\overset{-1}{NaCl} + \overset{+5}{NaClO_3}$ + $3H_2O$ This is an example of disproportionation reaction in which oxidation state of chlorine changes from 0 to -1 and +5.

15. Given $E^0_{Ag^+/Ag} = +0.80V;\ E^0_{Cu^{2+}/Cu} = +0.34V;\ E^0_{Fe^{3+}/Fe^{2+}} = +0.76V;\ E^0_{Ce^{4+}/Ce^{3+}} = +1.60V$ Which of the following statements is not correct?
a) Fe^{3+} does not oxidise Ce^{3+}. b) Cu reduces Ag^+ to Ag. **c) Ag will reduce Cu^{2+} to Cu.**
d) Fe^{3+} reduces Cu^{2+} to Cu.

Solution : -
Since Ag has higher reduction potential than Cu, Ag will not reduce Cu^{2+} to Cu. Cu can reduce Ag^+ to Ag.

16. What is the equivalent mass of $KBrO_3$ in the given reaction?
$BrO_3^- + 5Br^- + 6H^+ \rightarrow 3Br_2 + 3H_2O$
a) M/8 b) M/3 **c) M/5** d) M/6

Solution : -
$\overset{+5}{Br}O_3^- \rightarrow \overset{0}{Br_2}; E = \frac{M}{5}$

17. Which compound among the following has lowest oxidation number of chlorine?
a) $HClO_4$ b) $HClO_3$ **c) HCl** d) HOCl

Solution : -
Let the oxidation number of chlorine be x.
Oxidation number of H = +1 and O = -2
(A) $HCLO_4$: 1 + x + 4 × (-2) = 0
x - 7 = 0 or x = 7
(B) $HClO_3$: 1 + x + 3 × (-2) = 0
x - 5 = 0 or x = 5
(C) HCl: 1 + x = 0
x = -1
(D) HOCl: 1 + (-2) + x = 0
x - 1 = 0 or x = +1
Therefore lowest oxidation number of chlorine is -1 in HCl.

18. The mass of 50% (mass/mass) solution of HCl required to react with 100g of $CaCO_3$ would be

a) 73 g b) 100 g **c) 146 g** d) 200 g

Solution : -

eq of HCl = eq of $CaCO_3$

$\frac{W}{36.5} = \frac{100}{50}; W_{HCI} = 73gm$

50g of HCl is present in 100gm of HCl solution

73g of HCl $\rightarrow$? =146gm of HCl

19. The E_0 values of redox complex of halogens are given. Based on these values mark the correct statement.

$E^0_{I_2/I^-} = +0.54 \;\; E^0_{Br_2/Br^-} = +1.08V, \;\; E^0_{Cl_2/Cl^-} = +1.36V,$

a) Chlorine can displace bromine and iodine from their salt solutions.

b) Chlorine can only displace iodine from its salt solution.

c) Bromine can displace chlorine from its salt solution.

d) Iodine can displace chlorine and bromine from their salt solutions.

Solution : -

Since chlorine has higher reduction potential than bromine and iodine so it can displace them from their salt solutions.

$2NaI + Cl_2 \rightarrow 2NaCl + I_2$

$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2$

20. What is the correct representation of reaction occurring when HCl is heated with MnO_2?

a) MnO_4^- + $5Cl^-$ + $8H^+$ → Mn^{2+} + $5Cl^-$ + $5H_2O$ **b) MnO_2 + $2Cl^-$ + $4H^+$ → Mn^{2+} + Cl_2 + $2H_2O$**

c) $2MnO_2$ + $4Cl^-$ + $8H^+$ → $2Mn^{2+}$ + $2Cl_2$ + $4H_2O$ d) MnO_2 + 4HCl → $MnCl_4$ + Cl_2 + H_2O

Solution : -

Reaction involved is:

MnO_2 + HCl → $MnCl_2$ + cl_2 + H_2 O

Assign the oxidation states we get:

+4   -1 +2   0

MnO_2 + HCl → $MnCl_2$ + Cl_2

thus electron change in oxidation of Cl and reduction of Mn are same-2 electrons each

balance Cl

+4   -1 +2   0

MnO_2 + 4HCl → $MnCl_2$ + Cl_2

Balance O by adding H_2O

MnO_2 + 4HCl → $MnCl_2$ + Cl_2 + $2H_2O$

The reaction can be represented in the ionic form as:

MnO_2 + $4Cl^-$ + $4H^+$ → Mn^{2+} +$2Cl^-$ + Cl_2 + $2H_2O$

OR

MnO_2 + $2Cl^-$ + $4H^+$ → Mn^{2+} + Cl_2 + $2H_2O$ is the correct representation of reaction occurring when HCl is heated with MnO_2

21. Most stable oxidation state of gold is

a) +1 **b) +3** c) +2 d) +4

Solution : -

Gold exhibits, 1, +3 oxidation states. But most stable oxidation state is +3

22. Which of the following is true about the given redox reaction?

$SnCl_2 + 2FeCl_3 \rightarrow SnCl_4 + 2FeCl_2$

a) $SnCl_2$ is oxidised and $FeCl_3$ acts as oxidising agent. b) $FeCl_3$ is oxidised and acts as oxidising agent.

c) $SnCl_2$ is reduced and acts as oxidising agent. d) $FeCl_3$ is oxidised and $SnCl_2$ acts as a oxidising agent.

Solution : -

Separating the oxidation and reduction reaction from the redox reaction:

$SnCl_2 + 2FeCl_3 \rightarrow SnCl_4 + 2FeCl_2$

assigning the oxidation number on central atom (Sn and Fe) in each molecules by considering oxidation number of Cl = −1 we get oxidation state as:

+2 +3 +4 +2

$SnCl_2 + 2FeCl_3 \rightarrow SnCl_4 + 2FeCl_2$

as the oxidation number of Sn changes from +2 to +4 as:

$SnCl_2 \rightarrow SnCl_2$

its a oxidation reaction where $SnCl_2$ gets oxidized and acts as reducing agent

Similarly, as the oxidation number of Fe changes from +3 to +2 as:

$FeCl_3 \rightarrow FeCl_2$

its a reduction reaction where $FeCl_3$ gets reduced and acts as oxidising agent.

Therefore SnCl2 is oxidised and $FeCl_3$ acts as oxidising agent.

23. The oxidation state of sulphur in the anions SO_3^{2-}, $S_2O_4^{2-}$ and $S_2O_6^{2-}$ follow the order

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) $S_2O_6^{2-} < S_2O_4^{2-} < SO_3^{2-}$

Solution : -

SO_3^{2-} : oxidation state of ' S ' is +4

$S_2O_4^{2-}$: oxidation state of ' S ' is +3.

$S_2O_6^{2-}$: oxidation state of ' S ' is +5.

So, the order is $S_2O_4^{2-} < SO_3^{2-} < S_2O_4^{2-}$

24. When $KMnO_4$ is reduced with oxalic acid in acidic solution, the oxidation number of Mn changes from

a) +2 to +7 b) +4 to +7 **c) +7 to +2** d) +6 to +2

Solution : -

Reaction involved:

$KMnO_4 + H_2C_2O_4 + H_2SO_4 \rightarrow K_2SO_4 + MnSO_4 + CO_2 + H_2O$

Assign the oxidation number to Mn

Let the oxidation number of Mn be 'x'.

Oxidation number of SO_4^2- = O = -2, K = +1.

In $KMnO_4$: 1 + x + 4 $\times$ (-2) = 0

x + 1 - 8 = 0 or x = +7

In $MnSO_4$: x + (-2) = 0

x = +2 in the reaction thus:

+7 +2

$KMnO_4 + H_2C_2O_4 + H_2SO_4 \rightarrow K_2SO_4 + MnSO_4 + CO_2 + 8H_2O$

When $KMnO_4$ is reduced with oxalic acid in acidic solution , the oxidation number of Mn changes from +7 to +2.

25. Equivalent weight of $Ba(MnO_4)_2$ in acidic medium (M = molar mass)

a) M b) M/3 c) M/5 **d) M/10**

Solution : -

For one permanganate ion, n-factor is 5. But $Ba(MnO_4)_2$ has two permanganate ions. So its n-factror is 10.

26. Consider the following reaction,

$$\begin{matrix} CHO \\ | \\ CHO \end{matrix} + OH^- \rightarrow \begin{matrix} COO^- \\ | \\ CH_2OH \end{matrix}$$

Select the incorrect statement.

a) It is not a disproportionation reaction. b) It is intramolecular redox reaction.

c) OH^- is a reducing as well as oxidising agent d) $\begin{matrix} CHO \\ | \\ CHO \end{matrix}$ is a reducing as well as oxidising agent.

Solution : -

One CHO is oxidised to COO- and one CHO is reduced to CH_2OH.

Thus, it is not a disproportionation reaction. It is intramolecular redox reaction. Thus, options (a) and (b) are true and $\begin{matrix} CHO \\ | \\ CHO \end{matrix}$ is reducing as well as oxidising agent. Thus, (d) is also true. Thus, (c) is incorrect.

27. Thiosulphate reacts differently with iodine and bromine in the reactions given below:

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I_-$$
$$S_2O_3^{2-} + 2Br_2 + 5H_2O \rightarrow 2SO_4^{2-} + 2Br^- + 10H^+$$

Which of the following statements justifies the above dual behaviour of thiosulphate?

a) Bromine is a stronger oxidant than iodine b) Bromine is a weaker oxidant than iodine.

c) Thiosulphate undergoes oxidation by bromine and reduction by iodine in these reactions.

d) Bromine undergoes oxidation and iodine undergoes reduction in these reactions.

Solution : -

Br_2 oxidises S to a higher oxidation state (i.e.; $\overset{+2}{S_2}O_3^{2-} \rightarrow \overset{+2.5}{S_4}O_6^{2-}$) and I_2 Oxidises S to a lower oxidation state (i.e.; $\overset{+2}{S_2}O_3^{2-} \rightarrow \overset{+2.5}{S_4}O_6^{2-}$) Thus, Br_2 is stronger oxidising agent than I_2.

28. What mass of HNO_3 is needed to convert 5 g of iodine into iodic acid according to the reaction? (at mass of I = 127 u)

a) 12.4g b) 24.8g c) 0.24g d) 49.6g

Solution : -

$M_{eq.}$ of HNO_3 = $M_{eq.}$ of I_2

$$\frac{w}{\frac{63}{1}} \times 1000 = \frac{5}{\frac{254}{10}} \times 1000$$

w = 12.4g

29. Experimentally it was found that a metal oxide has formula $M_{0.98}O$. Metal M, is present as M^{2+} and M^{3+} in its oxide. Fraction of the metal which exits as M^{3+} would be

a) 6.05% b) 5.08% c) 7.01% **d) 4.08%**

Solution : -

Since the oxidation state of oxygen is -2. So, for $M_{0.98}0$ to be neutral, the total oxidation state of $M_{0.98}$ has to be +2.

Let the fraction of M^{3+} be x.

then fraction of M^{2+} will be (0.98 - x).

now for the compound to be neutal,

3x + 2(0.98 - x) = 2

3x + 1.96 - 2x = 2

x = 2 - 1.96

x = 0.04

So, fraction of M^{3+} will be 4%.

30. The reaction is balanced if, $5H_2O_2 + XClO_2 + 2OH^- \rightarrow XCl^- + YO_2 + 6H_2O$

a) X = 5, Y = 2 **b) X = 2, Y = 5** c) X = 4, Y = 10 d) X = 5, Y = 5

Solution : -

The balanced reaction is as follows:
$5H_2O_2 + 2ClO_2 + 2OH^- \rightarrow 2Cl^- + 5O_2 + 6H_2O$
Hence, X is 2 and Y is 5.

31. Equivalent mass of N_2 in the change $N_2 \rightarrow NH_3$ is

a) 28/6 b) 28 c) 28/2 d) 28/3

Solution : -
$N_2 \longrightarrow NH_3$
Oxidation no. of N in N_2 = 0
Oxidation no. of N in NH_3 = -3
Valence factor = no. of atoms $\times$ change in oxidation no. = $2\times|0 - (-3)||$ = 6
Molecular weight of N_2 = 28 g
As we know that,
eq. wt. = $\frac{mol.\ wt.}{valence\ factor}$
$\therefore$ Equivalent weight of N_2 for the given change = $\frac{28}{6}$
Hence for the given change, the equivalent weigt of N_2 will be $\frac{28}{6}$.

32. What will be the balanced equation in acidic medium for the given reaction?
$Cr_2O^{2-}_{7(aq)} + SO_{2(g)} \rightarrow Cr^{3+}_{(aq)} + SO^{2-}_{4(aq)}$

a) $Cr_2O^{2-}_{7(aq)} + 3SO_{2(g)} + 2H^+_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3SO^{2-}_{4(aq)} + H_2O_{(l)}$
b) $2Cr_2O^{2-}_{7(aq)} + 3SO_{2(g)} + 4H^+_{(aq)} \rightarrow 4Cr^{3+}_{(aq)} + 3SO^{2-}_{4(aq)} + 2H_2O_{(l)}$
c) $Cr_2O^{2-}_{7(aq)} + 3SO_{2(g)} + 14H^+_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3SO^{2-}_{4(aq)} + 7H_2O_{(l)}$
d) $Cr_2O^{2-}_{7(aq)} + 6SO_{2(g)} + 7H^+_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 6SO^{2-}_{4(aq)} + 7H_2O_{(l)}$

Solution : -
$Cr_2O^{2-}_{7(aq)} + SO_2 \rightarrow 2Cr^{3+} + 6SO^{2-}_4$ (in acidic solution) Oxidation half equation:
$SO_2 + 2H_2O \rightarrow SO^{2-}_4 + 4H^+ + 2e^-$ -- (i)
Reduction half equation:
$Cr_2O^{2-}_{7(aq)} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$ --- (ii)
Multiplying eqn. (i) by 3 and adding to eqn. (ii) we get
$Cr_2O^{2-}_{7(aq)} + 3SO_{2(g)} + 2H^+_{(aq)} \rightarrow 2Cr^{3+}_{(aq)} + 3SO^{2-}_{4(aq)} + H_2O_{(l)}$

33. Identify disproportionation reaction.

a) $CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$ b) $CH_4 + 4Cl_2 \longrightarrow CCl_4 + 4HCl$ c) $2F_2 + 2OH^- \longrightarrow 2F^- + OF_2 + H_2O$
d) $2NO_2 + 2OH^- \longrightarrow NO^-_2 + NO^-_3 + H_2O$

Solution : -
In elements, in the free state each atom bears an oxidation number of zero. Oxidation number of oxygen in most of its compounds is -2 with two exceptions : in peroxides, oxidation number of oxygen is -1 and in superoxides, oxidation number of oxygen is -1/2

34. The oxidation number of "V" in $Rb_4Na[HV_{10}O_{28}]$ is

a) +3 **b) +5** c) +7 d) +6

Solution : -
Oxidation number of Rb = +1
Oxidation number of Na = +1
Oxidation number of H = +1
Let oxidation number of V = x
Oxidation number of O = -2

$4 \times 1 + 1 + 1 + 10x + 28 \times (-2) = 0$

$6 + 10x - 56 = 0$

$10x = 50$

$x = \frac{50}{10} = +5$

35. The atomic number of an element which shows the oxidation state of + 3 is

a) 13 b) 32 c) 33 d) 17

Solution : -

For +3 oxidation state the outer orbital configuration has to be ns^2ns^1 and that is possible for atomic number 13.
Al having atomic no. 13 shows +3 oxidation state

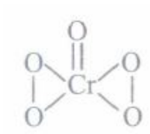
36. In the reaction $3Mg + N_2 \longrightarrow Mg_3N_2$

a) Magnesium is reduced **b) Magnesium is oxidized** c) Nitrogen is oxidized d) Nitrogen is reduced

Solution : -

In the given reaction oxidation state of Mg is changing from 0 to +2 while in nitrogen it is changing from 0 to −3.
So oxidation of Mg and reduction of nitrogen takes place.

37. The oxidation number of Cr in CrO_5 which has the following structure is



a) +4 b) +5 **c) +6** d) +3

Solution : -

It has four O atoms as peroxide with oxidation number = -1 and one O atom with oxidation number = -2.
Hence, x + 4(-1) + 1(-2) = 0 or x = +6

38. In the reaction $MnO_4^- + SO_3^{2-} + H^+ \longrightarrow Mn^{2+} + SO_4^{2-}$ the number of H^+ ions involved is

a) 2 b) 6 c) 8 d) 16

39. Consider the following reaction:

$HCHO + 2[Ag(NH_3)_2] + 30H^- \longrightarrow 2Ag + HCOO^- + 4NH_3 + 2H_2O$

Which of the following statements regarding oxidation and reduction is correct?

a) HCHO is oxidised to $HCOO^-$ and $[Ag(NH_3)_2]^+$ is reduced to Ag

b) HCHO is reduced to $HCOO^-$ and $[Ag(NH_3)_2]^+$ is oxidised to Ag.

c) $[Ag(NH_3)_2]^+$ is reduced to Ag while OH^- is oxidised to $HCOO^-$.

d) $[Ag(NH_3)_2]^+$ is oxidised to NH3 while HCHO is reduced to H_2O.

Solution : -

Separating the oxidation and reduction reaction from the redox reaction:

$HCHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow 2Ag + HCOO^- + 4NH_3 + 2H_2O$

assigning the oxidation number on central atom (C and Ag) in each molecules by considering oxidation number of H = +1, O = -2, NH_3 = 0 we get oxidation state as:

0 +1 0 +2

$HCHO + 2[Ag(NH_3)_2]^+ + 3OH^- \rightarrow 2Ag + HCOO^- + 4NH_3 + 2H_2O$

as the oxidation number of C changes from 0 to +2 as:

$HCHO \rightarrow HCOO^-$

its a oxidation reaction where C gets oxidized

Similarly, as the oxidation number of Ag changes from +1 to 0 as:

$[Ag(NH_3)_2]^+ \rightarrow Ag$

its a reduction reaction where Ag gets reduced.

40. Which of the following reactions does not involve the change in oxidation state of metal?

a) $VO^{-2} \rightarrow V_2O_3$ b) $K \rightarrow K^+$ **c)** $Cu^{2+} \rightarrow Cus$ d) $Cu^{2+} \rightarrow Cu$

Solution : -

In $Cu^{2+} \rightarrow Cus$, Cu is in +2 oxidation state in both reactant and product.

41. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

Assertion: The only way to get F_2 from F^- is to oxidise electrolytically.

Reason: The recovery of halogens from their halides requires an oxidation process.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion.

c) If assertion is true but reason is false. d) If both assertion and reason are false.

Solution : -

The best method to get halogens from their halides is an Electrolytic method as it is safe and prevents an explosion in case of fluorine. The conversion of halide to halogens is an oxidation process in which the oxidation state of halogen changes from −1 to 0. Hence it requires oxidation process.

42. In the following question, a statement of assertion is followed by a statement of reason. Mark the correct choice as :

Assertion: In titrations involving potassium permanganate no indicator is used.

Reason: MnO_4^- acts as the self-indicator.

a) If both assertion and reason are true and reason is the correct explanation of assertion.

b) If both assertion and reason are true but reason is not the correct explanation of assertion

c) If assertion is true but reason is false d) If both assertion and reason are false.

Solution : -

$KMnO_4$ or MnO_4^- acts as its own indicator so during titrations involving $KMnO_4$ no indicator is added from outside. $KMnO_4$ is dark purple in +7 oxidation state and on reaching end point its color changes to pale pink color. Therefore, Assertion and reason both statements are correct with reason being explaining assertion.

43. 0.5 g mixture of oxalic acid ($H_2C_2O_4$) and some sodium oxalate ($Na_2C_2O_4$) with some impurities requires 40 ml of 0.1M NaOH for complete neutralization and 6ml of 0.2 M $KMnO_4$ for complete oxidation. Calculate the % of $Na_2C_2O_4$ in the mixture

a) 90% **b) 26.8%** c) 40% d) 50%

Solution : -

No. of milli equivalents of $H_2C_2O_4$ = No. of milli equivalents of NaOH = 4 No. of milli equivalents of $H_2C_4O_4$ + $Na_{20}C_2O_4$ = No. of milli equivalents of $KMnO_4$ = 6 × 0.2 × 5 = 6

Milli equivalent of $Na_2C_2O_4$ = 2

Weight of $Na_2C_2O_4$ = 2 × 10^{-3} × 67 = 0.134 g

% $Na_2C_2O_4$ = $\frac{0.134}{0.5} \times 100 = 26.8$

44. In the reaction, $I_2 + 2KClO_3 \longrightarrow 2KIO_3 + Cl_2$

i) Iodine is oxidised ii) Chlorine is reduced iii) Iodine displaces chlorine iv) KCl03 is decomposed

The correct combination is

a) Only i & iv are correct b) Only iii & iv are correct **c) i, ii, iii are correct** d) All are correct

Solution : -

1) In the above reaction $I_2^0 \longrightarrow I^{+5} \Rightarrow$ oxidation

2) $Cl^{+5} \longrightarrow Cl_2^0 \Rightarrow$ reduction

3) Lower halogen displaces higher halogen.

45. Oxidation number of chlorine in chlorine heptaoxide is

a) +1 b) +4 c) +6 **d) +7**

Solution : -

Cl_2O_7; 2x - 14 = 0; x = +7

46. Which change occurs when lead monoxide is converted into lead nitrate?

a) Oxidation b) Reduction **c) Neither oxidation nor reduction** d) Both oxidation and reduction

Solution : -

$$\overset{+2}{Pb}O \rightarrow \overset{+2}{Pb}(NO_3)_2$$

Neither oxidation nor reduction

47. Write the following ions in order of decreasing capacity to accept electrons. H^+, Mg^{2+}, K^+, Ag^+, Zn^{2+}

a) $Ag^+ > H^+ > Zn^{2+} > Mg^{2+} > K^+$ b) $H^+ > Zn^{2+} > Mg^{2+} > K^+ > Ag^+$ c) $K^+ > Mg^{2+} > Zn^{2+} > H^+ > Ag^+$

d) $Mg^{2+} > Zn^{2+} > K^+ > Ag^+ > H^+$

Solution : -

Based on electrochemical series, elements can be arranged in order of decreasing capacity to accept electrons i.e decreasing reduction potentials.

$Ag^+ > H^+ > Zn^{2+} > Mg^{2+} > K^+$ where reduction potential of Ag^+ is positive, for H^+ is zero and others have negative E^0

Alkali metals are most electropositive followed by alkaline earth metals, thus have most negative reduction potential and least capacity to accept electrons.

48. Oxidation number of Cr in CrO_5 is:

a) +5 b) -3 **c) +6** d) +7

Solution : -

CrO_5 has one Cr=O double bond. The oxygen atom of this double bond has oxidation number of −2. The remaining 4 oxygen atoms are part of peroxide linkages. The oxygen atom of peroxide linkage has oxidation number of −1. Let, X be the oxidation number of Cr

X + (-2) + 4(-1) = 0

X - 2 - 4 = 0

X = +6

Hence, the oxidation number of Cr = +6

49. In the conversion of Br_2 to BrO_3^-, the oxidation state of bromine changes from

a) 0 to + 5 b) -1 to + 5 c) 0 to - 3 d) + 2 to + 5

Solution : -

$$\overset{0}{Br_2} \longrightarrow \overset{+5}{Br}O_3^-$$

50. Indicate whether the following conversions represent an oxidation, a reduction or none (neither oxidation nor reduction).

(i) $HClO_3$ to $HClO_4$

(ii) NH^+_4 to NH_3

(iii) NO_2 to N_2O_4

(iv) HSO^-_3 to SO^{2-}_4

(v) H_2O_2 to H_2O

a)

(i)	(ii)	(iii)	(iv)	(v)
Oxidation	Reduction	None	None	Oxidation

b)

(i)	(ii)	(iii)	(iv)	(v)
Oxidation	**None**	**None**	**Oxidation**	**Reduction**

c)

(i)	(ii)	(iii)	(iv)	(v)
Reduction	Oxidation	Reduction	None	Reduction

d)

(i)	(ii)	(iii)	(iv)	(v)
Oxidation	Reduction	None	Reduction	Reduction

Solution : -

Oxidation is loss of electron and reduction is the gain of electron. Thereby assigning the oxidation number on central atom in each molecule for each conversion will determine oxidation or reduction process. Considering oxidation number of H = +1,O = −2 we get oxidation state as:

(i) Oxidation number of Cl in $HClO_3 \rightarrow HClO_4$

+5 +7

$HClO_3 \rightarrow HClO_4$

Oxidation number of Cl changes from +5 to +7, by losing two electron is oxidation process.

(ii) Oxidation number of N in $NH_4^+ \rightarrow NH_3$

-3 -3

$NH_4^+ \rightarrow NH_3$

Oxidation number of N does not change. Thus its neither oxidation nor reduction.

(iii) Oxidation number of N in $NO_2 \rightarrow N_2O_4$

+4 +4

$NO_2 \rightarrow N_2O_4$

Oxidation number of N does not change. Thus its neither oxidation nor reduction.

(iv)Oxidation number of S in HS$O_3^- \rightarrow$ SSO_4^2-

+4$^-$ +6

$HSO_3 \rightarrow SO_4^{2-}$

Oxidation number of S changes from +4 to +6, by losing two electron is oxidation process.

(v) Oxidation number of S in $H_2O_2 \rightarrow H_2O$

-1 -2

$H_2O_2 \rightarrow H_2O$

Oxidation number of O changes from -1 to -2, by gaining one electron is reduction process.

Therefore: (i) Oxidation(ii) None(iii) None(iv) Oxidation(v) Reduction