or, $P_4 + 3OH^- + 3H_2O = 3H_2PO_2^- + PH_3$

This is the balanced equn.

③ $MnO_4^- + C_2O_4^{2-} \rightarrow Mn^{2+} + CO_2$ (in acid medium)

(a) The above equn can be broken into two partial equations.

$MnO_4^- \rightarrow Mn^{2+}$ (reduction)

$C_2O_4^{2-} \rightarrow CO_2$ (oxidation)

(b) $MnO_4^- \rightarrow Mn^{2+} + 4H_2O$ (to balance the 'O' atoms)

$\Rightarrow MnO_4^- + 8H^+ \rightarrow Mn^{2+} + 4H_2O$ (to balance the 'H' atoms)

$\Rightarrow MnO_4^- + 8H^+ + 5e \rightarrow Mn^{2+} + 4H_2O$ (to balance the electrical charges) ---(i) ×2

(c) $C_2O_4^{2-} \rightarrow 2CO_2$ (to balance 'C' and 'O' atoms)

$\Rightarrow C_2O_4^{2-} \rightarrow 2CO_2 + 2e$ ---(ii) ×5

Adding (i) and (ii), we get,

$2MnO_4^- + 16H^+ + 10e \rightarrow 2Mn^{2+} + 8H_2O$

$5C_2O_4^{2-} \rightarrow 10CO_2 + 10e$

$2MnO_4^- + 16H^+ + 5C_2O_4^{2-} = 2Mn^{2+} + 8H_2O + 10CO_2$

This is is balanced equn.

④ (a) $I_2 \rightarrow IO_3^- + I^- + H_2O$ (in alkaline medium)

$I_2 \rightarrow \overset{+5}{I}O_3^-$ (oxidation)

$I_2 \rightarrow 2I^-$ (reduction)

(b) $I_2^0 \rightarrow 2IO_3^-$ (to balance the 'I' atoms)

$\Rightarrow I_2^0 + 6H_2O \rightarrow 2IO_3^-$ (to balance the 'O' atoms)

$\Rightarrow I_2^0 + 6H_2O \rightarrow 2IO_3^- + 12H^+$ (to balance the 'H' atoms)

$\Rightarrow I_2^0 + 6H_2O + 12OH^- \rightarrow 2IO_3^- + 12H_2O$

$\Rightarrow I_2^0 + 12OH^- \rightarrow 2IO_3^- + 6H_2O + 10e$ (to balance electrical charges) ---(i) ×1

(c) $I_2 \rightarrow 2I^-$

$\Rightarrow I_2 + 2e \rightarrow 2I^-$ (to balance the electrical charges) ---(ii) ×2

Adding (i) and (ii), we get,

$I_2 + 12OH^- \rightarrow 2IO_3^- + 6H_2O + 10e$

$2I_2 + 10e \rightarrow 4I^-$

$3I_2 + 12OH^- = 2IO_3^- + 6H_2O + 4I^-$ This is the balanced equn.

5) $XeO_6^{4-} + Mn^{2+} + H^+ \rightarrow XeO_3 + MnO_4^- + H_2O$

(perxenate ion) (manganese)

a) The above equn can be broken into two partial equn's,

$Xe^{+8}O_6^{4-} \rightarrow Xe^{+6}O_3$ (reduction)

$Mn^{2+} \rightarrow Mn^{+7}O_4^-$ (oxidation)

b) $XeO_6^{4-} \rightarrow XeO_3 + 3H_2O$ (to balance 'O' atoms)

$\Rightarrow XeO_6^{4-} + 6H^+ \rightarrow XeO_3 + 3H_2O$ (to balance 'H' atoms)

$\Rightarrow XeO_6^{4-} + 6H^+ + 2e \rightarrow XeO_3 + 3H_2O$ (to balance electrical charges)

c) $Mn^{2+} + 4H_2O \rightarrow MnO_4^-$ ---(i) x5 (to balance 'O' atoms)

$\Rightarrow Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+$ (to balance 'H' atoms)

$\Rightarrow Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e$ ---(ii) x2

Adding (i) and (ii), we get,

$5XeO_6^{4-} + 30H^+ + 10e \rightarrow 5XeO_3 + 15H_2O$

$2Mn^{2+} + 8H_2O \rightarrow 2MnO_4^- + 16H^+ + 10e$

$5XeO_6^{4-} + 14H^+ + 2Mn^{2+} \rightleftharpoons 5XeO_3 + 7H_2O + 2MnO_4^-$

This is the balanced equn.

6) a) $BiO_3^- + Mn^{2+} + H^+ \rightarrow Bi^{3+} + MnO_4^- + H_2O$

(Bismuthate ion)

The above equn can be broken into two partial equns.

$Bi^{+5}O_3^- \rightarrow Bi^{3+}$ (reduction)

$Mn^{2+} \rightarrow Mn^{+7}O_4^-$ (oxidation)

b) $BiO_3^- \rightarrow Bi^{3+} + 3H_2O$ (to balance 'O' atoms)

$\Rightarrow BiO_3^- + 6H^+ \rightarrow Bi^{3+} + 3H_2O$ (to balance 'H' atoms)

$\Rightarrow BiO_3^- + 6H^+ + 2e \rightarrow Bi^{3+} + 3H_2O$ (to balance the electrical charges)

---(B) x5

c) $Mn^{2+} \rightarrow MnO_4^-$

$\Rightarrow Mn^{2+} + 4H_2O \rightarrow MnO_4^-$ (to balance the 'O' atoms)

$\Rightarrow Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+$ (to balance the 'H' atoms)

$\Rightarrow Mn^{2+} + 4H_2O \rightarrow MnO_4^- + 8H^+ + 5e$ (to balance the electrical charges)

x2

(7) $Cr_2O_7^{=} + Fe^{2+} + H^+ \longrightarrow Cr^{3+} + Fe^{3+} + H_2O$.

The above equn can be broken into two partial equations.

$Cr_2O_7^{=} \longrightarrow Cr^{3+}$ (reduction)

$Fe^{2+} \longrightarrow Fe^{3+}$ (oxidation)

(b) $Cr_2O_7^{=} \longrightarrow 2Cr^{3+}$ (to balance the Cr atoms)

$\Rightarrow Cr_2O_7^{=} \longrightarrow 2Cr^{3+} + 7H_2O$ (to balance 'O' atoms)

$\Rightarrow Cr_2O_7^{=} + 14H^+ \longrightarrow 2Cr^{3+} + 7H_2O$ (to balance 'H' atoms)

$\Rightarrow Cr_2O_7^{=} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$ (to balance the electrical charges)

..... (i) x1

(c) $Fe^{2+} \longrightarrow Fe^{3+} + e$ (to balance the electrical charges)

..... (ii) x6

Adding (i) and (ii) we get,

$Cr_2O_7^{=} + 14H^+ + 6e \longrightarrow 2Cr^{3+} + 7H_2O$

$6Fe^{2+} \longrightarrow 6Fe^{3+} + 6e$

$Cr_2O_7^{=} + 14H^+ + 6Fe^{2+} \rightleftharpoons 2Cr^{3+} + 7H_2O + 6Fe^{3+}$

This is the balanced equn.

(8) (a) $MnO_4^- + Fe^{2+} + H^+ \longrightarrow Mn^{2+} + Fe^{3+} + H_2O$

The above equn can be broken into two partial equations.

$MnO_4^- \longrightarrow Mn^{2+}$ (reduction)

$Fe^{2+} \longrightarrow Fe^{3+}$ (oxidation)

(b) $MnO_4^- \longrightarrow Mn^{2+} + 4H_2O$ (to balance the 'O' atoms)

$\Rightarrow MnO_4^- + 8H^+ \longrightarrow Mn^{2+} + 4H_2O$ (to balance the 'H' atoms)

$\Rightarrow MnO_4^- + 8H^+ + 5e \longrightarrow Mn^{2+} + 4H_2O$ (to balance the electrical charges)

..... (i) x1

(c) $Fe^{2+} \longrightarrow Fe^{3+} + e$ (to balance the electrical charges)

..... (ii) x5

Adding (i) and (ii), we get

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

$5Fe^{2+} \longrightarrow 5Fe^{3+} + 5e$

$MnO_4^- + 8H^+ + 5Fe^{2+} \rightleftharpoons Mn^{2+} + 4H_2O + 5Fe^{3+}$

This is the balanced equn.

Adding (i) and (ii), we get,

$5BiO_3^- + 30H^+ + 10e \longrightarrow 5Bi^{3+} + 15H_2O$.

$2Mn^{2+} + 8H_2O \longrightarrow 2MnO_4^- + 16H^+ + 10e$

$5BiO_3^- + 14H^+ + 2Mn^{2+} + 8H_2O = 5Bi^{3+} + 7H_2O + 2MnO_4^-$

Disproportionation or Dismutation Rxn

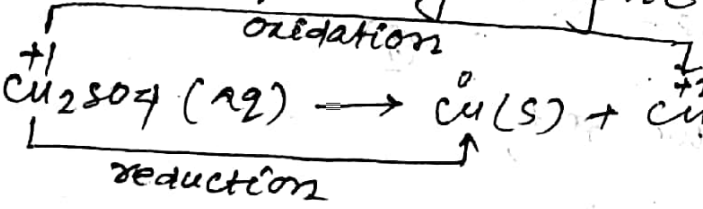
There are some chemical changes in which an element is converted into two oxidation states one higher and another lower, than its oxidation state in the reactant. Such reactions are called Disproportionation or Dismutation reaction.

Q. explain disproportionation rxn and identify the driving force behind that rxn to occur?

Disproportionation is that redox rxn in which some part of a substance undergoes oxidation while the remaining part of the same substance undergoes reduction i.e; the same substance is oxidised as well as reduced. Hence this substance acts both as oxidising as well as reducing agent.

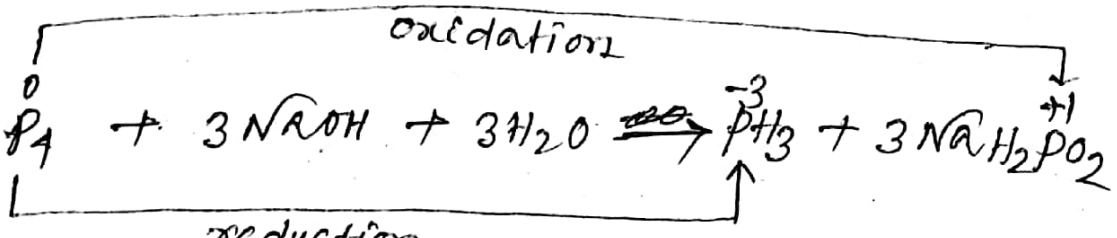
Examples :-

(1) The soluble cuprus compounds disproportionate in soln with the formation of metallic copper and corresponding cupric salt.



$$Cu_2SO_4(aq) \longrightarrow Cu(s) + CuSO_4(aq)$$

(2) When white phosphorous is boiled with caustic soda, in an inert atmosphere PH_3 (phosphine) is evolved and sodium hypo-phosphite is also produced.



$$P_4 + 3NaOH + 3H_2O \longrightarrow PH_3 + 3NaH_2PO_2$$