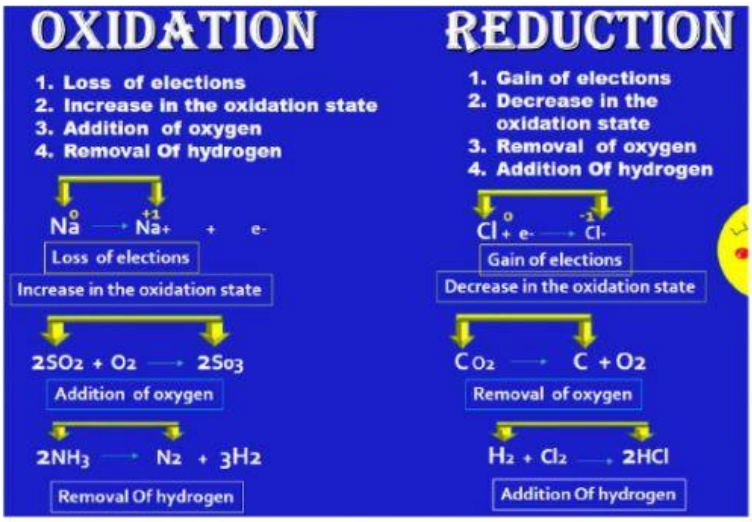
Balancing redox equation (Ion inspection method)

1) Determine species undergo oxidation and reduction



2) Separate the half equation

3) Balance the metal at both sides

4) Balance non-metal other than H and O at both sides

5) Balance the O by adding H2O at the other side of equation

6) Balance the H by adding H+ at the other side

7) Balance the charge by adding e- at positive side

8) Combine both half equations by removing the e from both equations

9) Recheck

Tutorial Chapter 4 Question 2

A redox reaction between oxalate ions, $C_2O_4^{2-}$ and permanganate ions, MnO_4^- in an acidic solution produces carbon dioxide, CO_2 and manganese(II) ions, Mn^{2+}. Write a balanced equation for the above reaction.

1) Determine species undergo oxidation and reduction

Oxidation number

2C + 4(-2) = -2

C =

$C_2O_4^{2-}$ + MnO_4^- → CO_2 + Mn^{2+}

[ ] reaction

[ ] reaction

Oxidation number C in CO_2

C + 2(-2) = 0

C =

Oxidation number of C has [ ] . C in $C_2O_4^{2-}$ is [ ]

MnO_4^- loss Oxygen to form Mn^{2+}. Mn in MnO_4^- is [ ]

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2) Separate the half equation

Oxidation: ⟶

Reduction: ⟶

3) Balance the metal at both sides

Oxidation: $C_2O_4^{2-}$ ⟶ CO_2 (C is not balanced)

Reduction: MnO_4^- ⟶ Mn^{2+} (Do nothing. Mn at both sides is balanced)

4) Balance non-metal other than H and O at both sides

Oxidation: $C_2O_4^{2-}$ ⟶ $2CO_2$ (Do nothing. C is considered as a metal)

Reduction: MnO_4^- ⟶ Mn^{2+} (Do nothing. Mn is a metal)

5) Balance the O by adding H_2O at the other side of equation

Oxidation: $C_2O_4^{2-}$ ⟶ $2CO_2$ (There is 4 O at both sides. It is balanced)

Reduction: MnO_4^- ⟶ Mn^{2+} + ☐ (There is no O at the right hand side. It is not balanced)

6) Balance the H by adding H+ at the other side

Oxidation: $C_2O_4^{2-}$ ⟶ $2CO_2$ (Skip. There is no H at either sides)

Reduction: MnO_4^- + ☐ ⟶ $Mn^{2+} + 4H_2O$ (There are 8 H at the right hand side. H is not balanced)

7) Balance the charge by adding e- at positive side

Oxidation: $C_2O_4^{2-}$ ⟶ $2CO_2$ + ☐

-2 | 0 + ☐ = -2

Charge for both sides are balanced after _____ are added to the +ve side

Reduction: $MnO_4^- + 8H^+ +$ ☐ ⟶ $Mn^{2+} + 4H_2O$

-1 + 8 + ☐ = +7 | 2 + ☐ = +2

Charge for both sides are balanced after ____ are added to the +ve side

Initially, it is +7 on the left and +2 at the right-hand side. Thus, the charge is not balanced

8) Combine both half equations by removing the e from both equations

Oxidation: $(C_2O_4^{2-} \longrightarrow 2CO_2 + 2e)$ ☐

Reduction: $(MnO_4^- + 8H^+ +$ ☐ $e \longrightarrow Mn^{2+} + 4H_2O)$

Both equations have different number of electrons. How do you want to balance the e for both equations?

Oxidation: ☐ $C_2O_4^{2-}$ ⟶ ☐ CO_2 + ☐ e

Reduction: ☐ MnO_4^- + ☐ H^+ + ☐ e ⟶ ☐ Mn^{2+} + ☐ $4H_2O$

Overall equation: ☐ MnO_4^- + ☐ H^+ + ☐ $C_2O_4^{2-}$ ⟶ ☐ Mn^{2+} + ☐ H_2O + ☐ CO_2

Recheck:

	Mn=	Mn=
	O=	O=
	H=	H=

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Net Charge=

Net Charge=

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