Electro Chemistry

→Is the branch of chemistry that deals with the interconversion of electrical energy and chemical energy.

Redox Reactions

Electro chemical processes are redox (oxidation-reduction)

In redox reactions electrons are transferred from one substance to

There are 2 types of redox reactions

- In acidic medium
- In basic medium

In acidic medium

More complex redox reactions involving Oxo anions such as chromate (Cro_4^{2-}), di chromate ($Cr_2o_7^{2-}$) , permanganate (mno_4^-), No_3^- and (so_4^{2-}).

Example

The oxidation of Fe^{2+} ions to Fe^{3+} ions by ($Cr_2o_7^{2-}$) in acidic medium, the ($Cr_2o_7^{2-}$) ions are reduced to Cr^{3+} ions.

Balancing Redox Reactions

Step1: UN balanced equation

$Fe^{2+} + Cr_2o_7^{2-} \rightarrow Fe^{3+} + Cr^{3+}$

Step2: The two half reactions are

Oxidation $Fe^{2+} \rightarrow Fe^{3+}$

Reduction $Cr_2o_7^{2-} \rightarrow Cr^{3+}$

Step3:

For reaction in acidic medium add H_2o to balance the O atom and H^+ to balance the H atoms.

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

$$Cr_2o_7^{2-} \rightarrow 2Cr^{3+} + 7H_2o$$

To balance H atoms, we add $14H^+$ ions on the left hand side

$$14H^+ + Cr_2o_7^{2-} \rightarrow 2Cr^{3+} + 7H_2o$$

$$14H^+ + Cr_2o_7^{2-} + 6e^- \rightarrow 2Cr^{3+} + 7H_2o$$

$$6(Fe^{2+} \rightarrow Fe^{3+} + e^-)$$

$$14H^+ + Cr_2o_7^{2-} + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$$

$$6Fe^{2+}\ 14H^+ + Cr_2o_7^{2-} + 6e^- \rightarrow 6Fe^{3+} + 2Cr^{3+} + 7H_2O + 6e^-$$

$$6Fe^{2+} + 14H^+ + Cr_2o_7^{2-} \rightarrow 6Fe^{3+}\ 2Cr^{3+} + 7\ H_2O$$

The resulting equation is 'atomically' and 'electrically" balanced.

In basic solutions

For every H^+ ion, we add an equal number of OH^- ions to both sides of equations.

Example

Oxidation of iodide ion (I^-) by permanganate ion (Mno_4^-) to yield molecular (I_2) and manganese (IV) oxide (Mno_2).

Balancing redox reactions

Step1: The unbalanced equation is

$$MnO_4^- + I^- \rightarrow MnO_2 + I_2$$

Step2: The 2 half reactions are

Oxidation $I^- \rightarrow I_2$

Reduction $MnO_4 \rightarrow MnO_2$

Step3: To balance each half reaction, we first balance I atoms.

$$\mathbf{2I^- \rightarrow I_2}$$

We add two electrons to the right hand side of the equation

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

Reduction half reactions: To balance the O atoms, we add two H_2O molecules on the right

$$MnO_4^- \rightarrow MnO_2 + 2H_2O$$

To balance atom, we add for H^+ ions to the left

$$MnO_4 + 4H^+ \rightarrow MnO_2 + 2H_2O$$

There are 3 net positive charges on the left, so we add three electrons to the same side to balance the charges

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

Step4: add the oxidation and reduction half reactions to give the overall reaction, multiplying the oxidation half reaction by 3 and the reduction half reaction by 2 as follows

$$3\ (2I^- \rightarrow I_2 + 3e^-)$$

$$2\ (MnO4^- + 4H^+ + 3e^- \rightarrow MnO_2 + H_2O)$$

$$6I^- + MnO_4^- + 8H^+ \rightarrow 3I_2 + MnO_2 + 4H_2O$$

Because the reaction carried out in a basic medium, we need to equal number of OH ions to both sides.

$$6I^- + 2MnO_4^- + 8H^+ \rightarrow 3I_2 + MnO_2 + 4H_2O + OH^-$$

Finally, combining the H^+ and the OH^- ions to form water.

$$6I^- + 2MnO_4^- + 4H_2O \rightarrow 3I_2 + MnO_2 + OH^-$$

Equation is balanced in terms of both atoms and charges.

Examples

1) The branch of chemistry that deals with the inter conversion of electrical energy and chemical energy, is the definition of ……..

A) **Electro chemistry** C) Organic chemistry
B) General chemistry D) Analytical chemistry

2) Electrons are Transferred from one substance to another in ……..

A) Oxidation reaction C) **Redox reaction**
C) Reduction reaction D) None of al

3) There is a…… in oxidation number resulting from a gain of electrons by elements in reduction.

A) Increase C) Stability
B) **decrease** D) Both A and B

4) This reaction $Fe^{2+} \rightarrow Fe^{3+} + e^-$ represents ……. reaction.

A) **Oxidation** C) reduction
B) redox D) None of all