Redox Reactions 7.1

Redox Reactions

Oxidation Numbers

Oxidation Reduction Reactions

Often referred to as REDOX Reactions

Electron transfer reactions

- One substance gets **oxidized**
  - **(**referred to as the reducing agent)
    - It loses electrons
- The other substance gets **reduced**
  - **(referred to as** the oxidizing agent)
    - It gains electrons

Single Replacement REDOX Reaction

Ex) A piece of iron is immersed in a solution of copper (II) sulfate.

Reduction

Cu^{2+} is the oxidizing agent

$$Fe_{(s)} + Cu^{2+}_{(aq)} \rightarrow Fe^{2+}_{(aq)} + Cu_{(s)}$$

Oxidation

Fe is the reducing agent

How can you tell what gets oxidized and what get reduced?

$2Ca + O_2 \rightarrow 2CaO$

The answer is in the oxidation numbers.

Rules for Determining Oxidation Numbers

1) For an atom in its elemental form, its oxidation number is zero.

Mg, Fe, H_2, O_2, Cl_2, O_3, etc.

Oxidation Number for each = 0

Rules for Determining Oxidation Numbers

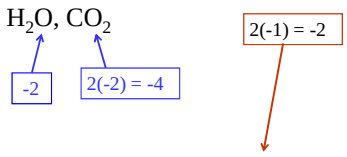
2) For a monoatomic ion, its oxidation number is equal to its charge.

Mg^{2+}: Oxidation Number = +2

Cl^- : Oxidation Number = -1

Rules for Determining Oxidation Numbers

3) The oxidation number for Oxygen in a molecular compound is –2.



Exception: Peroxides: ON = -1 (e.g. H_2O_2)

Rules for Determining Oxidation Numbers

4) Hydrogen

- +1 when it is bonded to a nonmetal (e.g.HCl)
- -1 when it is bonded to a metal (e.g. MgH_2)

Rules for Determining Oxidation Numbers

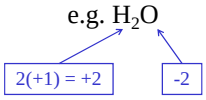
5) For other covalent compounds that do not contain Hydrogen or Oxygen, the most electronegative element has an oxidation number equal to its charge as an ion.

BF_3: the oxidation number for Fluorine = -1

PCl_5: the oxidation number for Chlorine = -1

Rules for Determining Oxidation Numbers

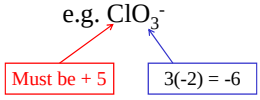
6) The sum of the oxidation numbers for all of the atoms in a compound must equal the overall charge of that compound.



+2 – 2 = 0

Rules for Determining Oxidation Numbers

6) The sum of the oxidation numbers for all of the atoms in a compound must equal the overall charge of that compound.



-6 + (+5) = -1

Ex) Find the Oxidation Numbers

PCl_5

How can you tell what gets oxidized and what get reduced?

$2Ca_{(s)} + O_{2(g)} \rightarrow 2CaO_{(s)}$

The answer is in the oxidation numbers

Ex1) What is oxidized and what is reduced?

$KClO_3 + 3\ HNO_2 \rightarrow KCl + 3\ HNO_3$

Ex1) Reduction Half-Reaction

$KClO_3 + 6\ e^- \rightarrow KCl$

+5 -1

Chlorine gains 6 e^- as its oxidation number changes from +5 to -1

Ex1) Oxidation Half-Reaction

$3HNO_2 \rightarrow 3HNO_3 + 6\ e^-$

+3 +5

Each of the three Nitrogen atoms loses 2 e^- as its oxidation number changes from +3 to +5

Ex2) What is oxidized and what is reduced?

$2\ PbS_{(s)} + 3O_{2(g)} \rightarrow 2\ PbO_{(s)} + 2\ SO_{2(g)}$