

OXIDATION NUMBERS

The concept of oxidation numbers (also called oxidation states) was devised as a simple way of keeping track of electrons in chemical reactions.

We define the **oxidation number** of an atom in a substance to be the actual charge of the atom if it is a monatomic ion; otherwise, it is the hypothetical charge assigned to the atom using a set of rules.

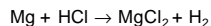
An oxidation-reduction reaction is one in which atoms change oxidation numbers, implying the transfer of electrons.

Oxidation occurs when there is an increase in oxidation number, whereas reduction occurs when there is a reduction in oxidation number.

- For an atom in its elemental form, the oxidation number is always zero.
- For any monatomic ion, the oxidation number equals the charge on the ion.
- Nonmetals usually have negative oxidation numbers, although they can sometimes be positive:
 - The oxidation # of oxygen is usually -2 in both ionic and molecular compounds (peroxides are an exception).
 - The oxidation # of hydrogen is $+1$ when bonded to nonmetal and -1 when bonded to metals
 - The oxidation # of fluorine is -1 in all compounds.
- The sum of the oxidation numbers of all atoms in a neutral compound is zero. For a polyatomic ion the sum of oxidation numbers must sum up to the charge of the ion.

Oxidation and Reduction

When a metal undergoes corrosion, it loses electrons and forms cations.



Loss of electrons by a substance is called **oxidation**.

The gain of electrons by a substance is called **reduction**.

Two mnemonic devices:

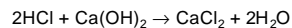
"**Leo**" the Lion goes "**ger**" or think "**oil rig**".

Acid-Base Reactions

Acids are compounds that release H^+ ions when dissolved in water. Acids also decrease the concentration of OH^- when dissolved in water.

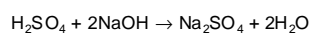
Bases are compounds that accept (consume) H^+ ions when dissolved in water. Bases also increase the concentration of OH^- when dissolved in water.

How many mL of $0.190\text{M Ca(OH)}_2(\text{aq})$ are required to completely neutralize 50.0 mL of $0.201\text{ M HCl}(\text{aq})$?



$$0.050\text{ L } 0.201\text{ M} \left| \frac{1 \text{ mol Ca(OH)}_2}{2 \text{ mol HCl}} \right| = 0.026447 \text{ mol Ca(OH)}_2$$
$$\frac{0.026447 \text{ mol Ca(OH)}_2}{0.19 \text{ M HCl}} = 0.1392 \text{ L} = 139.2 \text{ mL}$$

How many mL of 0.197M NaOH_(aq) are required to completely neutralize 50.0 mL of 0.202 M H₂SO_{4(aq)} ?



$$\frac{0.050 \text{ L } 0.202\text{M}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{2 \text{ mol NaOH}}{1 \text{ mol H}_2\text{SO}_4} \times \frac{1}{0.197 \text{ M NaOH}} = 0.1025381$$

103 mL