9.1 Oxidation and reduction Cheat Sheet

by Arsh.b via cheatography.com/179523/cs/37883/

Definitions

Oxidation and reduction can be considered in terms of oxygen gain/hydrogen loss, electron transfer or change in oxidation number.

The definition that covers all types of redox (reduction-oxidation) reactions is based on the transfer of electrons.

Oxidation is the loss of electrons by a chemical species, and can be identified when:
a species loses electrons
a species loses hydrogen atoms
a species gains oxygen atoms
the oxidation state of an atom increases.

Reduction is the gain of electrons by a chemical species, and occurs when:
a species Gaines electrons
a species loses hydrogen atoms
a species loses oxygen atoms
the oxidation state of an atom decreases.

An oxidizing agent is reduced and a reducing agent is oxidised.

An **oxidising agent** is a substance that oxidises another substance and is reduced itself by gaining electrons.

A **reducing agent** is a substance that reduces another substance and is oxidised itself by losing electrons.

Half-equations

Identification of the species oxidized and reduced and the oxidizing and reducing agents, in redox reactions.

A **half-equation** is an equation that shows the changes that happen in a redox reaction dude to either oxidation or reduction only.

The **oxidation half-equation** is a half-equation that shows only the chemical changes that happen in a redox reaction due to oxidation.

The **reduction half-equation** is a half-equation that shows only the chemical changes that happen in a redox reaction due to reduction.

Rules to write half-equations

Assign oxidation states to determine which atoms are being oxidized and which are being reduced.

Write half-equations for oxidation and reduction as follows:
balance the atoms other than H and O
balance each half-equation for O by adding H2O as needed
balance each half-equation for H by adding H+ as needed
balance each half-equation for charge by adding electrons to the sides with the more positive charge
check that each half-equation is balanced for atoms and for charge

Equalise the number of electrons in the two half-equations by multiplying each appropriately.

Rules to write half-equations (cont)

Add the two half-equations together, cancelling out anything that is the same on both sides.

Balanced oxidation half-equations will have electrons on the product side. Balanced reduction half-equations will have electrons on the reactant side.

Rules for oxidation state

Deduction of the oxidation states of an atom in an ion or compound.

Oxidation state is a measure of how many electrons an atom has gained or lost when forming a compound.

Atoms in the free (uncombined) element have an oxidation state of zero.

In simple ions, the oxidation state is the same as the charge on the ion.

The oxidation states of all the atoms in a neutral (uncharged) compound must add up to zero.

The oxidation states of all the atoms in a polyatomic ion must add up to the charge on the ion.

The usual oxidation state for an element is the same as the charge on its most common ion.

Most main group non-metals, the elements at the bottom of group 14, and transition elements have oxidation states that vary in different compounds – depending on the conditions and other elements present.

Common oxidation states

Deduction of the oxidation states of an atom in an ion or compound.

Substance	Usual oxidation state	Exceptions
Group 1 metals	+1	
Group 2 metals	+2	
Halogens	-1	(when Cl is combines with O or F)
Oxygen	-2	Peroxides
Hydrogen	+1	Metal hydrides

Redox titration

A redox titration determines the concentration of an unknown solution by titrating it against a standard solution. A colour change associated with the redox reaction shows when the equivalence point has been reached.

Activity series

The activity series ranks metals according to the ease with which they undergo oxidation.

Metals are ranked in the activity series according to how easily they lose electrons and are oxidized.

The activity series can be used to predict whether or not a redox reaction that involves a metal can happen.

Winkler Method

The Winkler Method can be used to measure biochemical oxygen demand (BOD), used as a measure of the degree of pollution in a water sample.

Biochemical oxygen demand (BOD) is the quantity of oxygen needed to break down organic matter in a sample of water over a 5-day period at a set temperature.

A high BOD means that high levels of bacteria or algae are present in the water, resulting in a low level of dissolved oxygen.

The **Winkler method** uses a series of three redox reactions to determine the concentration of dissolved oxygen in a water sample.

Dissolved oxygen reacts with Mn^{2+} ions in basic conditions to form MnO2.	MnO2(s) + O2(aq) +4OH^-(aq) -> 2MnO2(s) + 2H2O(l)
MnO2 reacts with I^- in acidic conditions to form Mn^{2+}	MnO2(s) + 2I^-(aq) +4H^+(aq) -> Mn^{2+}(aq) + I2(aq) +2H2O(l)
I2 is titrated with $S2O3^{2-}$ to give I^- and $S4O6^{2-}$	2$S2O3^{2-}$(aq) + I^2(aq) ➡ $S4O6^{2-}$(aq) + 2I^-(aq)
The moles of dissolved oxygen in the original solution can be calculated from the moles of $S2O3^{2-}$ used in the final reaction.	$n(S2O3^{2-}) = 4n(O2)$