Oxidation Numbers

CANLYNIAD DYSGU / LEARNING OUTCOMES:

- To assign and determine the oxidation numbers of atoms in a compound
- To assign and determine the oxidation numbers of atoms in an ion

Roman numerals in a name show the oxidation state of that element in the compound;

- *e.g.* iron(II) chloride contains Fe^{2+} and iron(III) chloride contains Fe^{3+}
- for potassium nitrate(V) the anion is NO_3^- and potassium nitrate(III) contains NO_2^-. The roman numerals refer to the nitrogen.

The roman numerals help us to name a substance unambiguously,

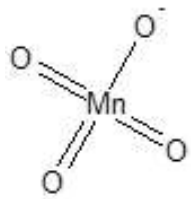
- because some elements can have different oxidation states
- *e.g.* transition metals, sulfur, phosphorous, nitrogen

Oxidation number is the number of electrons that need to be added to, or taken away from, an element to make it neutral.

or another way to explain it is…

The **oxidation number** of an atom is the number of electrons it accepts or donates (ionic) or shares (covalent) when it forms a bond.

For example, look at the permanganate ion below:



- *Count the number of bonds coming from the manganese atom.*
- *This is the number of electrons it is using and thus its oxidation number.*
- *This is why we call it manganate(VII)*

Rules for assigning oxidation numbers:

Uncombined elements = ……..

Sum of ox'no's in a compound = ……..

Sum of ox'no's in an ion = overall charge

In compounds, Group 1 = ……. , Group 2 = …….

In compounds, hydrogen is ……. , except in metal hydrides

In compounds, oxygen is ……. , except in peroxides and with fluorine

In compounds, the most electronegative element has the negative oxidation number

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The best way to check and improve your understanding of oxidation numbers is to practice. Assign oxidation numbers to all the elements in the following substances:

Na			
Mg^{2+}			
O_2			
SiO_2			
NaI			
P_4O_{10}			
Al_2O_3			
CaF_2			
NH_4^+			
Na_2SO_4			
Na_2SO_3			
$KMnO_4$			
$Na_2Cr_2O_7$			
Na_2CrO_4			
NaClO			

This becomes easier with more practice so complete plenty of examples to build your confidence with assigning oxidation numbers.

Redox Reactions

We can use oxidation numbers to keep track of electron transfers.

Remember OILRIG:

- *Oxidation is the loss of electrons*
- *Reduction is the gain of electrons*

Oxidation and reduction go together. Whenever a substance loses electrons another substance gains electrons.

When looking at reactions rather than individual substances, first do as you have above, assigning oxidation numbers to all elements in all reactants and products. Then work out which element(s) has been oxidised and which has been reduced. *Note: in some examples there is more than one element for each so make sure to check all of those on the equation*.

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