Redox reactions - oxidation numbers
Lesson 1

Redox reactions involve a transfer of electrons.
It is a two part process whereby electrons are lost and electrons are gained. Every redox reaction involves two processes, ***oxidation*** and ***reduction.***
Oxidation is the process where a reactant loses electrons, this reactant is known as the ***reductant.***
Reduction is the process where a reactant gains electrons, this reactant is known as the ***oxidant.***

It is often difficult to know if a reactant has given or taken electrons. To overcome this we assign ***oxidation numbers*** to reactants and products. Oxidation occurs when the oxidation number of a reactant increases and reduction occurs when the oxidation number of a reactant. Oxidation numbers are assigned according to the following rules.

i. The oxidation number of a species in its elemental form is 0.

ii. The oxidation number on an elemental ion is the charge of the ion.
Example the oxidation number of K^+ is +1, Cl^- is -1 or O^{2-} is -2.

iii. Hydrogen and oxygen found in compounds have fixed values.
Example H is always +1 except in metal hydrides, such as CaH_2 where it is -1.
O is always -2 except in H_2O_2 where it is -1 and in compounds with fluorine (OF_2) where it is +2.

iv. The sum of the oxidation numbers of each species in a compound is equal to the charge of that compound.
Example SO_4^{2-} the sum of all the oxidation numbers is -2
CO_2 the sum of all the oxidation numbers is 0, since CO_2 is a neutral compound.

Assign oxidation numbers to the underlined species.

i. $K\underline{Mn}O_4$

ii. $K\underline{Cl}O_4$

iii. $\underline{S}O_4^{2-}$

iv. $\underline{C}O_3^{2-}$

Reactants that are considered reductants increase in oxidation number while those that are oxidants reduce in oxidation number. So a redox reaction has a reactant that increases in oxidation number and one that decreases in oxidation number.

For each of the following reactions identify the redox reactions and give the reductant and oxidant in each

i. $CH_4(g) + O_2(g) => CO_2(g) + H_2O(g)$
Find the oxidation of each element in the reactants. C = -4, H = +1, O = 0
Find the oxidation of each element in the products. C = +4, H = +1, O = -2
Reductant is the carbon in CH_4
Oxidant is the oxygen in O_2

ii. $MnO_2(s) + 2H^+(aq) + S(s) \rightarrow Mn^{2+}(aq) + H_2O(l) + SO_2(g)$

iii. $2Cr_2O_7(aq) + 3CH_3CH_2OH(g) + 16H^+(aq) \rightarrow 4Cr^{3+}(aq) + 3CH_3COOH(aq) + 11H_2O(l)$

iv. $H_2O_2(aq) + 2Br^-(aq) + 2H^+(aq) \rightarrow Br_2(l) + 2H_2O(l)$

v. $AgNO_3(aq) + K_2Cr_2O_7(aq) \rightarrow Ag_2Cr_2O_7(s) + KNO_3(aq)$

vi. $2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$

vii. $Fe_2O_3(l) + 3CO(g) \rightarrow 2Fe(l) + CO_2(g)$

viii. $2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

ix. $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$