



Leaving Cert Chemistry

Free Notes

Redox Reactions



Redox Reactions

Oxidation in terms of electron transfer

- Oxidation is the **loss of electrons**
- The **substance** which **loses electrons** is said to be **oxidised**

Oxidising agent:

- This is the substance which causes **another substance to be oxidised** i.e. it **takes** electrons

Examples of oxidising agents

- 1) Hydrogen Peroxide (H_2O_2) – Used to bleach hair
- 2) Potassium Permanganate (KMnO_4)
- 3) Sodium Hypochlorite Na^+OCl^- - REMEMBER OCl^- Oxidising Agent found in domestic bleach
- 4) Compounds of chlorine and chlorine itself

Reduction in terms of electron transfer:

- Reduction is the **gain of electrons**
- When the **substance gains** electrons it is said to be **reduced**

Reducing agent:

- It is a substance which causes **another substance** to be **reduced** i.e. **it loses electrons**

Q) Name two reducing agents

- 1) Moist SO_2 (this is used to bleach straw and wood pulp)
 - 2) Sodium Thiosulphate ($\text{Na}_2\text{S}_2\text{O}_3$)
- Used in developing photographs i.e. it fixes the image

Oxidation Number:

- This is the **plus or minus charge** which an atom in a compound appears to have assuming the atoms are joined by an ionic bond.
- ON numbers are assigned to atoms according to certain rules:

Q) What are the 8 rules in assigning oxidation numbers?

- 1) In free elements, each atom has an oxidation number of 0. E.g. $\text{N}_2 = 0$
- 2) The sum of the Oxidation numbers of all the atoms in a molecule is 0 e.g. $\text{H}_2\text{O} = 0$
- 3) The oxidation number of a simple ion containing one atom is equal to the charge on the ion e.g. $\text{Cl}^- = -1$
- 4) The sum of the oxidation numbers of all the atoms in a complex ion is equal to the charge on the ion, e.g. $\text{NO}_3^- +5 + 3(-2) = -1$

- 5) Hydrogen has an oxidation number of +1 in its compounds, except in metallic hydrides where it is -1
- 6) Oxygen has an oxidation number of -2 in its compounds except in hydrogen peroxide where it is -1 and when it is bonded to fluorine where it is +2
- 7) The oxidation number of group 1 elements in their compounds is always +1 and group 2 is always +2
- 8) The ON of a halogen when bonded to a less electronegative atom is -1

The ON of chlorine in each of the following:

- 1) $\text{HCl} = (+1)(x) = -1$
- 2) $\text{Cl}_2 = (\text{ON} = 0, \text{chlorine not bonded to anything else})$
- 3) $\text{ClO}^- = (x)(-2) = -1 > x = +1$ (NOTICE CHARGE ON OXYGEN)
- 4) $\text{ClO}_2^- = (x)(-2)_2 = -1 > \text{Cl} = +3$ (NOTICE its O_2 not O)
- 5) $\text{Cl}_2\text{O} = (x)(-2) = (+1)_2(+2) = 0$

The ON of Hydrogen in the following:

- 1) $\text{H}_2 = (\text{ON} = 0)$
- 2) $\text{HCl} = (x)(-1) = (+1)(-1)$
- 3) $\text{H}_2\text{O} = (x)_2(-2) = (+1)_2(-2)$
- 4) $\text{NaH} = (+1)(x) = (+1)(-1)$

The ON of O_2 in the following:

- 1) $\text{O}_2 = 0$ (free elements have ON of 0)
- 2) $\text{O}_3 = 0$
- 3) $\text{H}_2\text{O} = (+1)_2(-2)$
- 4) $\text{H}_2\text{O}_2 = (+1)_2(-1)_2$

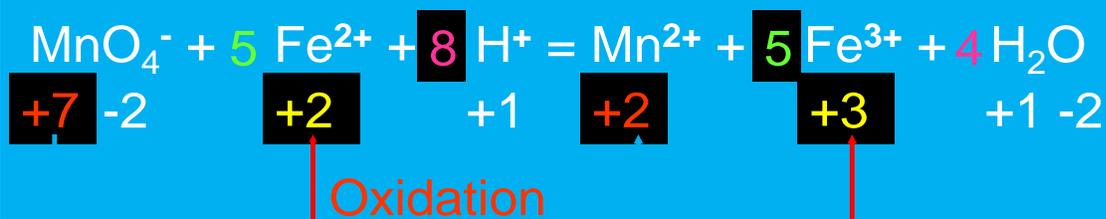
Q) What use is made of ON in chemistry?

- 1) Used to help balance chemical equations
- 2) Used to determine a reaction is a Redox reaction i.e. if electrons are transferred from one species to another
- 3) Used to show which species is oxidised and reduced

Example: Q) Using oxidation numbers or otherwise show which species is oxidised and reduced in the following reaction and hence otherwise balance the following reaction

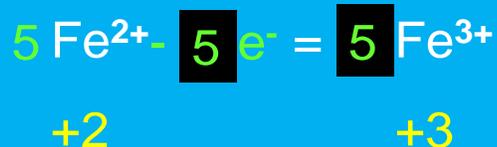
1. Assign oxidation numbers
2. Select those which change

3. (a) Assign Oxidation – increase in Ox. N^o
(b) Assign Reduction – decrease in Ox. N^o



5. Write electron gains and losses

6. Balance electron transfers



7. Put numbers up into the equation
8. Balance equation by inspection - leave H⁺ till last

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- (b) Assign Reduction – decrease in Ox. N^o



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7. Put numbers up into the equation

+6

+3

8. Balance equation by inspection - leave H⁺ till last :- O $3 + (2 \times 7) = (3 \times 2) + x \rightarrow x = 11$
 H $\rightarrow 3(6 \times 1) + x = (3 \times 4) + 11(2 \times 1) \rightarrow x = 16$

Transition Elements:

- Have variable valences
- Variable oxidation numbers e.g. Fe²⁺ and Fe³⁺
- Definite colours associated with oxidation states e.g. chromates green > orange etc.
- Fe²⁺ iron (II) > Green [+2]
- Fe³⁺ iron (III) > Yellow [+3]
- Manganese (VII) > Pink [+7]
- Manganese(IV) > Brown [+4]
- Manganese(II) > Colourless [+2]

Redox reaction:

- In this type of reaction, electrons are transferred from one substance to another i.e. oxidation and reduction occur
- Redox comes from REDuction and OXidation.
- Remember OILRIG (oxidation is loss and reduction is gain)

- Redox reactions are prevalent with the halogens as they are extremely powerful oxidising agents

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