EXAMS ROAD

"Bringing Excellence to Students"

Handwritten Notes
On
Redox Reactions

Redox Reactions

* **Oxidation**: 1. Addition of oxygen or an electronegative element. 2. Removal of hydrogen or an electropositive element. 3. Loss of electrons or increase in oxidation number.

* **Reduction**: 1. Addition of hydrogen or an electropositive element. 2. Removal of oxygen or an electronegative element. 3. Gain of electrons or decrease in oxidation number.

* **Redox reactions** are the reactions which involve oxidation and reduction simultaneously.

  • A substance which undergoes reduction acts as an oxidising agent & the substance which undergoes oxidation acts as a reducing agent.

* **Oxidation number**: It is the residual charge which an atom appears to have when all the atoms surrounding it are removed.

* **Rules for assigning Oxidation Number**:

Species	ON	Examples
1. Elements	Zero	N_2, Cl_2, O_2
2. Monoatomic ions	Same as charge	Na^+(I), Mg^{2+}(II).
3. Hydrogen		
i) with non-metal	+1	H_2O, H_2S, HCl
ii) with metals	−1	LiH, CaH_2, KH
4. Oxygen	−2 (mostly)	H_2O, CaO, NaOH
i) in peroxides	−1	H_2O_2, BaO_2
ii) in superoxides	−1/2	KO_2, CsO_2
iii) in fluorides	+1, +2	O_2F_2, OF_2
iv) in ozonides	−1/3	KO_3

5. Alkali Metals	+1	Li, Na, K etc.
6. Alkaline earth metals	+2	Be, Mg, Ca etc.
7. Fluorine	-1 (always)	HF, OF_2, LiF.
8. p-, d-, f- block elements	Variable.	d- block : Fe (+2, +3), Cu (+1, +2), Mn (+7, +6, +5, +4, +3, +2 etc.) p- block : As (+3, +5), Sb (+3, +5), Sn (+2, +4) etc. f- block : Ce (+3, +4), Eu (+2, +3).

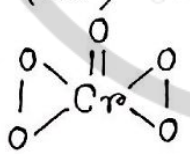
> Highest ON of any element is not more than group no. of the element in Periodic table.

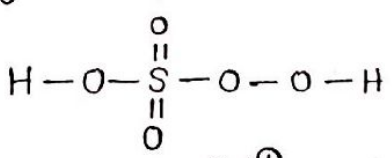
9. ON of ions.

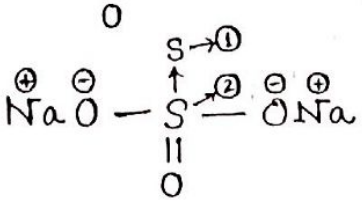
SO_4^{2-} - (-2), NO_3^- - (-1), NO_2^- - (-1), OH^- - (-1), PO_4^{3-} - (-3), OCl^- - (-1), PO_3^{3-} - (-3), NO^+ - (+1), CN^- - (-1).

* Some important determinations of ON :

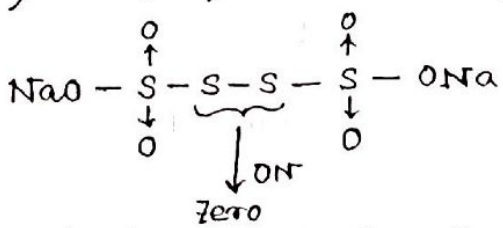
1. $\underline{Fe}(CO)_5$ → (CO) neutral. Hence, ON of Fe → zero.

2. $\underline{Cr}O_5$ →  $x + 1\times(-2) + 4\times(-1) = 0 \Rightarrow x = +6$

3. $H_2\underline{S}O_5$ →  $2\times(+1) + x + 2\times(-1) + 3\times(-2) = 0 \Rightarrow x = +6$.

4. $Na_2\underline{S_2}O_3$ →  S① → -2 due to coordinate bond

$2\times(+1) + 3(-2) + x + 1\times(-2) \Rightarrow x = +6$. S② → +6

5. $Na_2\underline{S_4}O_6$ → 

$2x + 2\times0 + 6\times(-2) + 2\times(+1) = 0 \Rightarrow x = +5$

6. Fe_3O_4 → Fe_3O_4 is a mixture of FeO & Fe_2O_3.

$FeO \longrightarrow Fe\ (+2)$ $\quad Fe_2O_3 \longrightarrow Fe\ (+3)$.

* Auto Oxidation - Reduction Reaction:

1. $2\overset{+5}{K}\overset{-2}{Cl}\overset{}{O_3} \longrightarrow 2\overset{-1}{K}\overset{}{Cl} + 3\overset{0}{O_2}$

2. $2\,Pb(\overset{+5}{N}\overset{-2}{O_3})_2 \longrightarrow 2PbO + 4\overset{+4}{N}O_2 + \overset{0}{O_2}$

3. $2\overset{-3}{N}H_4\overset{+5}{N}\overset{-2}{O_3} \longrightarrow 2\overset{0}{N_2} + 4H_2\overset{-2}{O} + \overset{0}{O_2}$

* Disproportionation reaction:

1. $\overset{0}{Cl_2} + 2NaOH = Na\overset{+1}{O}Cl + Na\overset{-1}{Cl} + H_2O$.

2. $\overset{0}{P_4} + 3NaOH + 3H_2O = \overset{-3}{P}H_3 + 3NaH_2\overset{+1}{P}O_2$

* Comproportionation reaction:

1. $K\overset{+5}{B}rO_3 + 5K\overset{-1}{B}r + 6HCl = 3\overset{0}{B}r_2 + 6KCl + 3H_2O$

* Balancing of Redox Reactions:

1. Oxidation number method: i) Identify atoms which undergo change in ON. ii) Calculate the increase or decrease in the ON per atom & multiply it by number of atoms undergoing that change, if increase or decrease is not equal then multiply by suitable number to make them equal. iii) Add H^+ (if medium is acidic) or OH^- (if medium is basic) on the appropriate side so that the total ionic charges of reactants & products are equal. iv). Make the no. of hydrogen atoms in the expression on the two sides

equal by adding H_2O to the reactants or products & finally check the no. of oxygen atoms.

2. Half reaction method: i) Separate the equation into half-reactions.

ii) Balance the atoms other than O and H in each reaction individually. iii) For reactions occurring in acidic medium, add H_2O to balance O atoms & H^+ to balance H atoms & for basic medium, H atoms are balanced by adding H_2O to the side deficient in H atoms & equal number of OH^- ions are added to opposite side & then duplicacy is removed if any. iv) Add electrons to one side of the half-reaction to balance the charges & make the number of electrons equal in two half-reactions by multiplying one or both half-reactions by appropriate number. v) Add two half-reactions to achieve the overall reaction & cancel the electrons on both sides.

* Fluorine is the strongest oxidising agent & lithium is the strongest reducing agent.