



Government of Tamilnadu

Department of Employment and Training

Course : TNPSC Group II Exam
Subject : Chemistry
Topic : **Oxidation and Reduction**

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OXIDATION AND REDUCTION

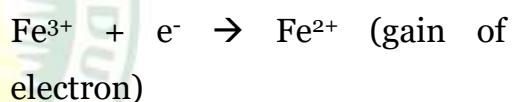
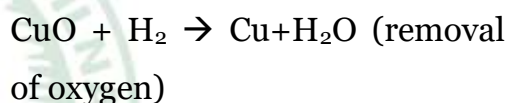
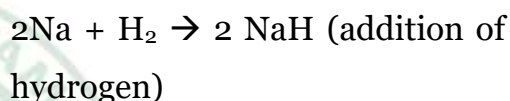
- ❖ Oxygen is the most essential element for sustaining life.
- ❖ One can live without food (or) even water for a number of days, but not without oxygen.
- ❖ In our daily life we come across phenomena like fading of the colours of the clothes, burning of combustible substances like cooking gas, wood and coal, and also rusting of iron articles. All such process fall in the category of a specific type of chemical reaction called oxidation reduction reaction (redox reaction)

Oxidation

- ❖ A chemical reaction which involves addition of oxygen (or) removal of hydrogen (or) loss of electron is called as oxidation.
 $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$ (addition of oxygen)
 $\text{H}_2\text{S} + \text{Br}_2 \rightarrow 2\text{HBr} + \text{S}$ (removal of hydrogen)
 $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+} + \text{e}^-$ (loss of electron)

Reduction

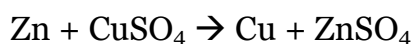
- ❖ A chemical reaction which involves addition of hydrogen (or) removal of oxygen (or) gain of electrons is called as reduction.



eg: when detergent is dissolved in water, heat is given out.

Redox reaction

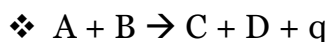
- ❖ A chemical reaction in which oxidation and reduction takes place simultaneously is called Redox reaction.



Exothermic reactions

- ❖ The chemical reactions which proceed with the evolution of heat energy are called exothermic reactions

Oxidation also has damaging effects on food and eatables. When food containing fat and oil is left as such for a long time, it becomes stale. The stale food develops bad taste and foul smell. This is very common in curd or cheese, particularly in summer. Oils and fats are slowly oxidised to certain foul-smelling compounds.

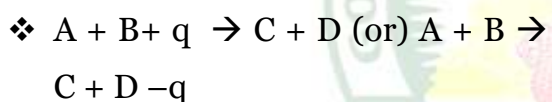


❖ q is evolution of energy. Its unit is joule and kilojoule.

❖ Ex: respiration, Acid-base, neutralisation, Combustion of petrol.

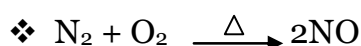
Endothermic reactions

❖ The chemical reactions which proceed with the absorption of heat energy are called endothermic reactions.



❖ q is absorption of heat.

❖ Ex: Formation of nitrogen monoxide



Rate of the chemical reaction

❖ Rate of the chemical reaction is defined as change in concentration of any one of the reactions (or) products per unit time.

+ve sign

❖ +ve sign indicates increase in concentration of B with time.

-ve sign

❖ -ve sign indicates decrease in concentration of A with time.

Valency

❖ Valency is the number of electrons transferred (or) sharing takes place between the two atoms of same (or) different electrons. This number is called valency.

Valency = 1

Positively charged ions	Negatively charged ions
H ⁺ (Hydrogen ion)	Cl ⁻ chloride ion
Na ⁺ (Sodium ion)	Br ⁻ Bromide ion
K ⁺ (Potassium ion)	I ⁻ Iodide ion
Ca ⁺ (Calcium ion)	OH ⁻ Hydroxide ion
Ag ⁺ (Silver ion)	NO ₃ ⁻ Nitrate ion
NH ₄ ⁺ (Ammonium ion)	HCO ₃ ⁻ Bicarbonate ion
	CN ⁻ Cyanide ion
	NO ₂ ⁻ Nitrate ion
	NO ₂ ⁻ Nitrite ion
	MnO ₄ ⁻ Permanganate ion
	HSO ₄ ⁻ bisulphate ion

	ClO_3^- Chlorate ion
	ClO_2^- Chlorite ion

Valency = 2

Positively charged ion	Negatively charged ion
Mg^{2+} Magnesium	O^{2-} Oxide ion
Ca^{2+} Calcium ion	S^{2-} Sulphide ion
Ba^{2+} Barium ion	SO_3^{2-} Sulphide ion
Zn^{2+} Zinc ion	SO_4^{2-} Sulphate ion
	CO_3^{2-} Carbonate ion
	$\text{Cr}_2\text{O}_7^{2-}$ Dichromate ion
	MnO_4^{2-} Manganate ion
	$\text{S}_2\text{O}_3^{2-}$ Thiosulphate ion

Valency = 3

Positively charged ion	Negatively charged ion
Al^{3+} Aluminium ion	PO_4^{3-} phosphate ion
	BO_3^{3-} Borate ion

Polyvalent cations

Formula	Name	Formula	Name
Ag^+	Gold (I) (or) Agnous	Ag^{3+}	Gold (III) (or) Agric
Ce^{3+}	Cerium (III) (or) Cerous	Ce^{4+}	Cerium (IV) (or) Ceric
Co^{2+}	Cobalt (II) (or) Cobaltous	Co^{3+}	Cobalt (III) (or) Cobaltic
Cr^{2+}	Chromium (II) (or) Chromous	Cr^{3+}	Chromium(III) (or) Chromic
Cu^+	Copper (I) (or) Cuprous	Cu^{2+}	Copper (II) (or) Cupric
Fe^{2+}	Iron (II) Ferrous	Fe^{3+}	Iron (III) (or) Ferric
Mn^{2+}	Manganese (ii) (or) Manganous	Mn^{3+}	Manganes (III) (or) manganic
Pb^{2+}	Lead (II) (or) Plumbous	Pb^{4+}	Lead (IV) (or) Plumbic
Sn^{2+}	Tin (II) (or) Stannous	Sn^{4+}	Tin (IV) (or) Stannic

In Tube Light there is vapour of mercury and argon.

Alkali metal valency = +1

Alkali earth metal valency = +2

Calculation Of Oxidation

Number

1. What is the oxidation number of Mn in KMnO_4 ?

Valency K is 1. Valency of oxygen is

2. KMnO_4

$$1 \times 1 + x + 4 \times (-2) = 0$$

$$1 + x - 8 = 0$$

$$x - 7 = 0$$

$$x = +7$$

$$\text{Mn} = +7$$

2. What is the oxidation number of chlorine in HClO_3 ?

Valency H = 1

Valency O = -2

HClO_3

$$1 \times 1 + x + 3 \times (-2) = 0$$

$$1 + x - 6 = 0$$

$$x - 5 = 0$$

$$x = +5$$

$$\text{Cl} = +5$$

3. What is the oxidation number chlorine in HClO_3 ?

$$1 + x - 4 = 0$$

$$x - 3 = 0$$

$$x = +3$$

Chlorine oxidation number is +3

4. What is the oxidation number of Mn in MnO_4^{2-} ?

$$x + 4 \times (-2) = -2$$

$$x = 8 - 2$$

$$x = +6$$

Mn oxidation number is +6

5. $\text{K}_3[\text{Fe}(\text{CN})_6]$ What is the oxidation of Fe?

$$k = +1, \quad \text{CN} = -1$$

$$3 \times 1 + x + -1 \times 6 = 0$$

$$3 + x - 6 = 0$$

$$x - 3 = 0$$

$$x = +3$$

Oxidation number of Fe is +3

6. What is the oxidation number chromium in $\text{K}_2\text{Cr}_2\text{O}_7$?

$$2 \times 1 + 2x + 7 \times (-2) = 0$$

$$2 + 2x - 14 = 0$$

$$2x - 12 = 0$$

$$2x = 12$$

$$x = 12/2 = +6$$

$$\text{Cr} = +6$$

7. What is the oxidation number of Uranium in UO_2^{2+} ?

$$x + 2 \times (-2) = 2+$$

$$x - 4 = +2$$

$$x = +2 + 4$$

$$x = +6$$

Oxidation number of Uranium is +6

8. What is the oxidation number of Mn in Mn_2O_3 ?

$$2x + 3 \times (-2) = 0$$

$$2x - 6 = 0$$

$$2x = +6$$

$$x = 6/2$$

$$x = +3$$

$$\text{Mn} = +3$$

9. What is the oxidation number of Mn in MnO_2 ?

$$\begin{array}{rcl} x - 4 & = & 0 \\ x & = & +4 \end{array}$$

Oxidation number of Mn is +4

10. What is the oxidation number of Fe in $\text{Fe}_2(\text{SO}_4)_3$?

$$\begin{array}{rcl} \text{Fe} & = & x \\ \text{SO}_4 & = & -2 \\ 2x + (-6) & = & 0 \\ 2x - 6 & = & 0 \\ 2x & = & 6 \\ x & = & 6/2 \\ x & = & +3 \\ \text{Fe} & = & +3 \end{array}$$

11. What is the oxidation number of Al in AlCl_3 ?

$$\begin{array}{rcl} \text{Cl} = -1, & \text{Al} = & x \\ x + (1 \times -3) & = & 0 \\ x - 3 & = & 0 \\ x & = & +3 \\ \text{Al} & = & +3 \end{array}$$

12. What is the oxidation number of S in Na_2SO_4 ?

$$\begin{array}{rcl} \text{Na} = 1, & \text{O} = & -2 \\ 2 + x + 4(-2) & = & 0 \\ 2 + x - 8 & = & 0 \\ x - 6 & = & 0 \\ x & = & +6 \end{array}$$

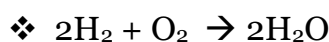
Oxidation number of Sulphur is +6

13. What is the oxidation number of Sr in SrCO_3 ?

$$\begin{array}{rcl} \text{Sr} = x & & \text{CO}_3 = -2 \\ x - 2 & = & 0 \\ x & = & +2 \end{array}$$

Oxidation number of Sr is +2

Balancing of chemical equations



❖ This is unbalanced chemical equation.

❖ According to the law of conservation of mass, two sides have the same number of atoms.

STEPS

Reactant side	Product side
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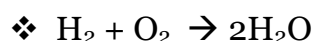
Number of hydrogen atoms	Number of oxygen atoms
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2	2
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Number of oxygen atoms	Number of hydrogen atoms
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2	1
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❖ Hydrogen atoms are equal but oxygen atoms are not equal. So multiple by 2 on products side



❖ Now check the number of atoms

Reactant side	Product side
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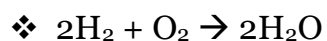
Hydrogen 2	4
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Oxygen 2	2
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In Flash bell Magnetism wire is kept in atmosphere of nitrogen gas.



- ❖ Both sides number of oxygen are equal. But number of Hydrogen are not equal. So left side multiple with 2 H₂.



$$\text{H} = 2 \times 2 = 4$$

$$2 = 4$$

$$\text{o} = 2$$

$$\text{H} = 2 \times$$

$$\text{o} = 2$$

- ❖ Both sides hydrogen and oxygen are equal. So equation is balanced.

