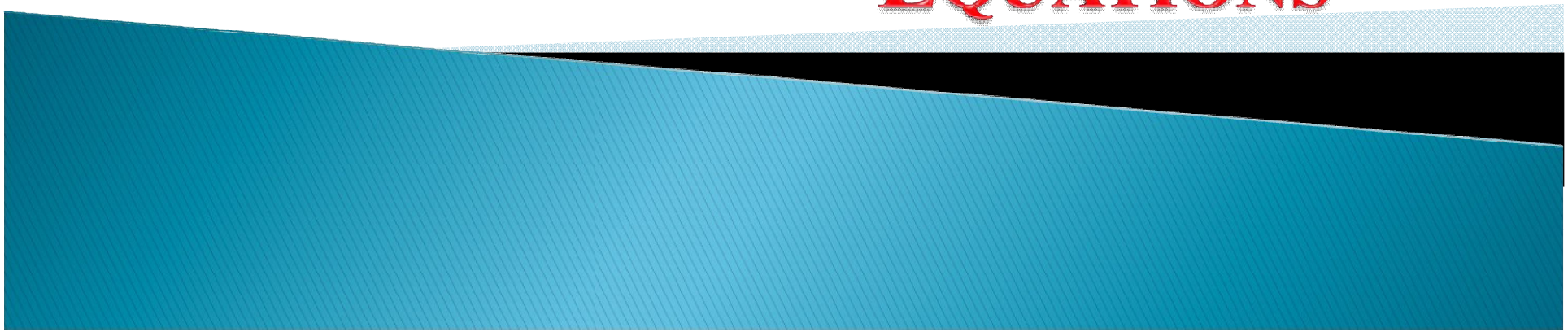
CLASS – 10

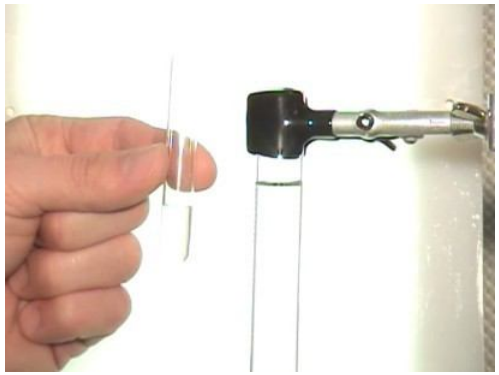
CHAPTER - 1

CHEMICAL REACTIONS AND EQUATIONS



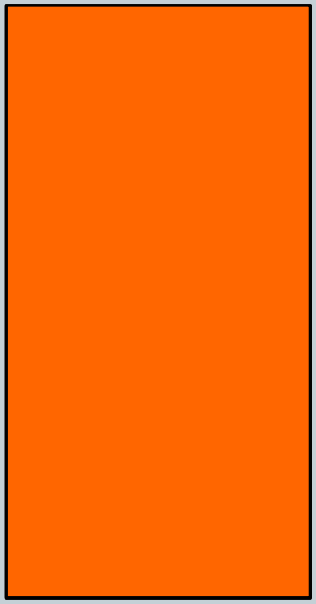
CHEMICAL REACTIONS

- Chemical Reactions are associated with chemical change.
- Whenever a chemical change occurs chemical reaction is said to take place.
- Chemical reactions are usually irreversible and a new product is formed.

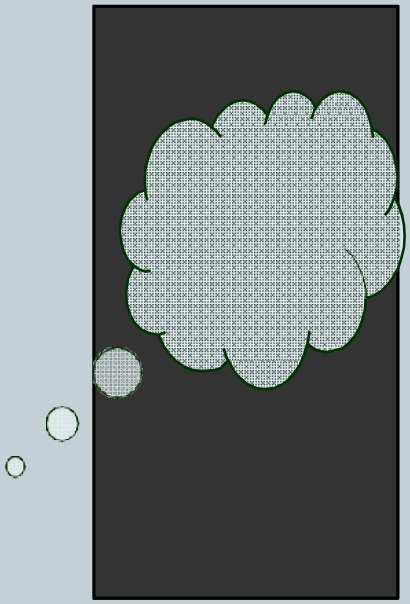


Signs of Chemical Reactions

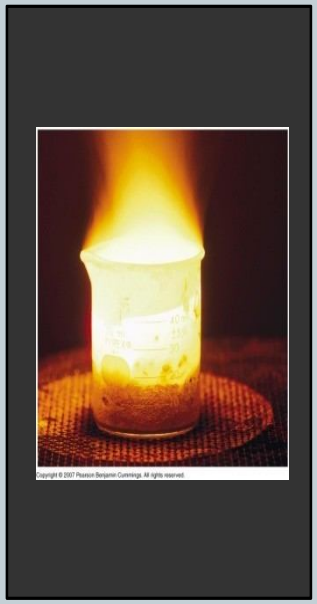
There are five main signs that indicate a chemical reaction has taken place:



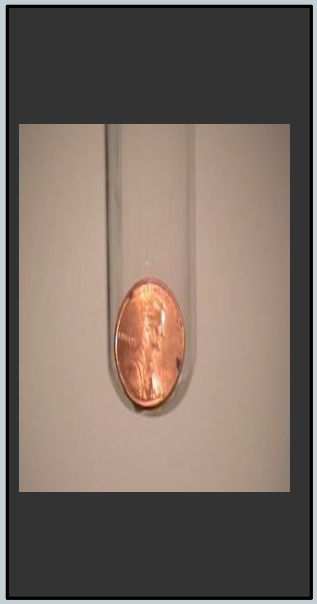
change in color



Evolution of a gas



Change in temperature



Change in state

Word Equations

- A WORD EQUATION describes chemical change using the names of the reactants and products.

Write the word equation for the reaction of methane gas with oxygen gas to form carbon dioxide and water.

methane + oxygen ⟶ carbon dioxide + water

Reactant **Product**

$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$

CHEMICAL EQUATIONS

- The simplest form of description of a chemical reaction in a shorter form is by writing it in the form of an equation. E.g.-

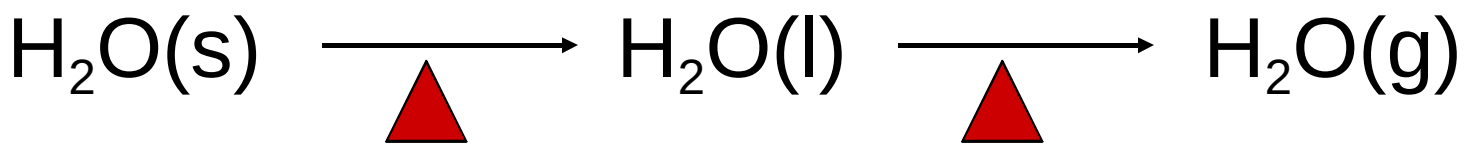
$$Mg + O_2 \longrightarrow MgO$$

- The reactants are written on the left side and product is written on the right side.
- An arrow is placed between them to show the direction of reaction.

Characteristics Of Chemical Equations

- *The equation must represent known facts.*
- *The equation must contain the correct formulas for the reactants and products.*
- *The law of conservation of mass must be satisfied.*

Showing Phases in Chemical Equations



Solid Phase – **the substance is relatively rigid and has a definite volume and shape. NaCl(s)**

Liquid Phase – **the substance has a definite volume, but is able to change shape by flowing. $H_2O(l)$**

Gaseous Phase – **the substance has no definite volume or shape, and it shows little response to gravity. $Cl_2(g)$**

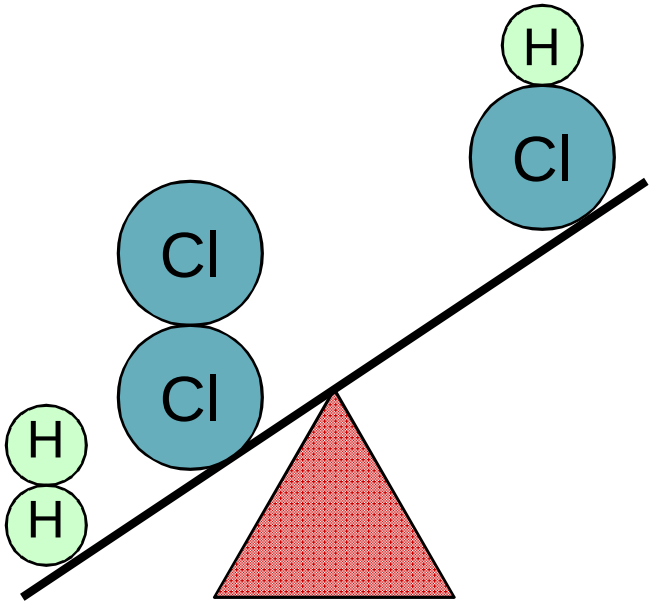
Balanced Chemical Equations

- According to the law of conservation of mass, total mass must be equal on the both sides of the equation.
- This type of equation is known as a balanced chemical reaction. E.g.-

$$2Mg + O_2 \longrightarrow 2MgO$$

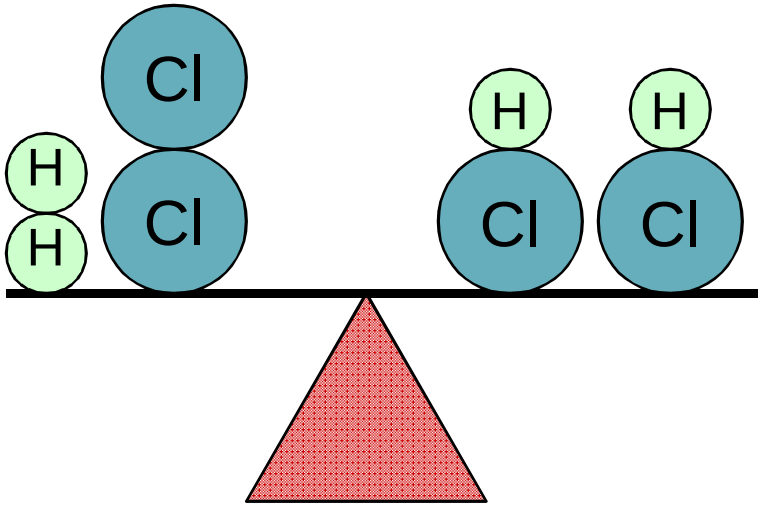
- Here both sides have two atoms of Magnesium and two atoms of Oxygen.

Unbalanced and Balanced Equations



$H_2 + Cl_2 \rightarrow HCl$ (unbalanced)

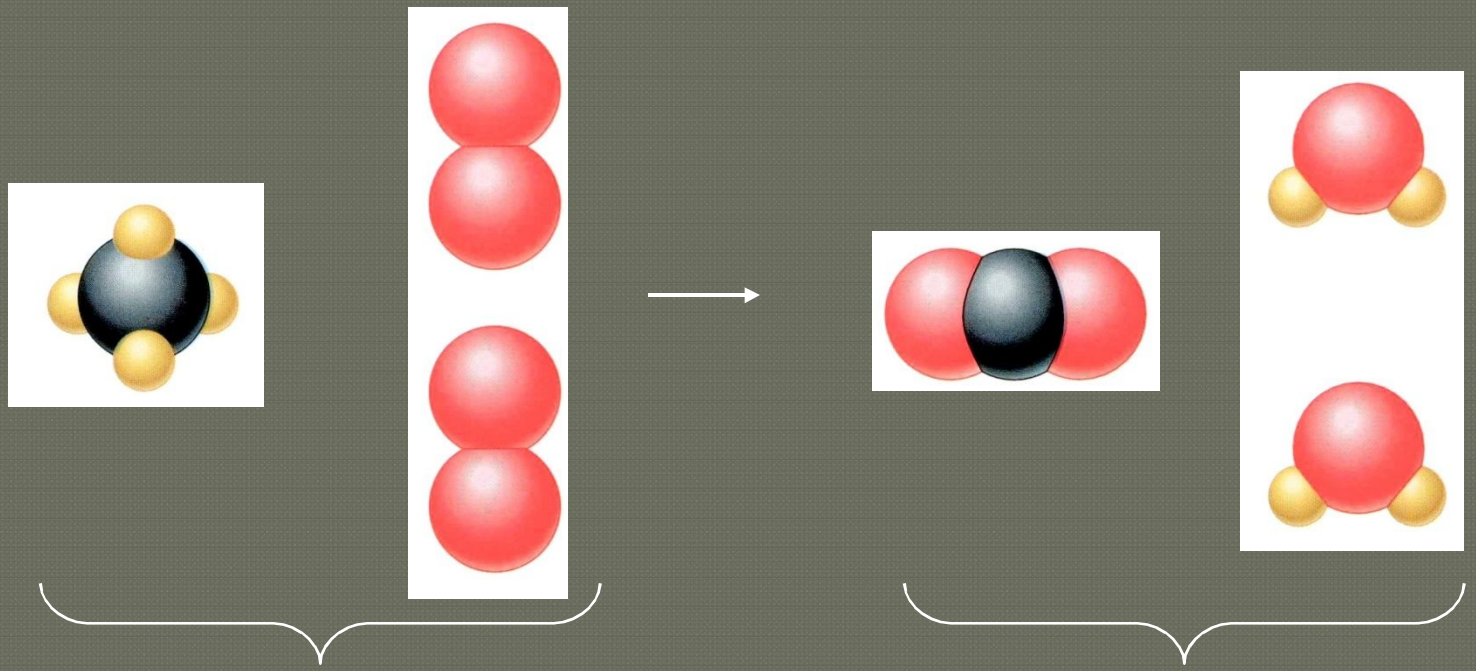
	reactants	products
H	2	1
Cl	2	1



$H_2 + Cl_2 \rightarrow 2\ HCl$ (balanced)

	reactants	products
H	2	2
Cl	2	2

$$CH_4 + 2\,O_2 \rightarrow CO_2 + 2\,H_2O$$



Reactants

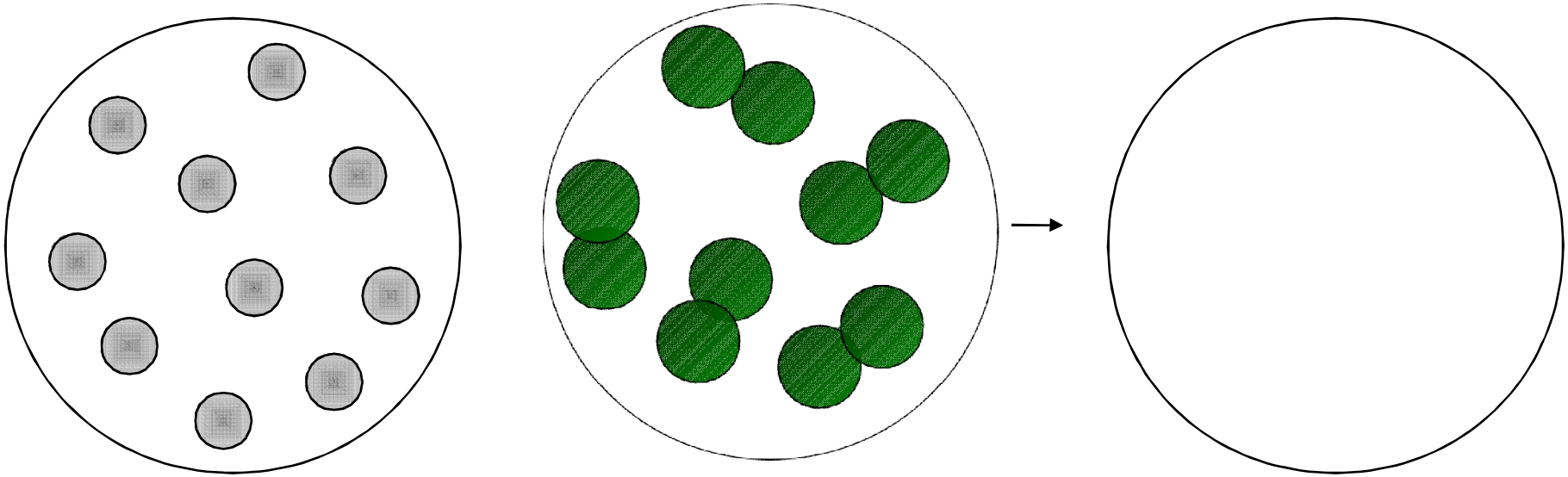
1 C atom
4 H atoms
4 O atoms

Products

1 C atom
4 H atoms
4 O atoms

Visualizing a Chemical Reaction

2 **Na** + **Cl_2** ⟶ 2 **NaCl**



10 mole Na **5** mole Cl_2 **10** mole NaCl

TYPES OF CHEMICAL REACTIONS

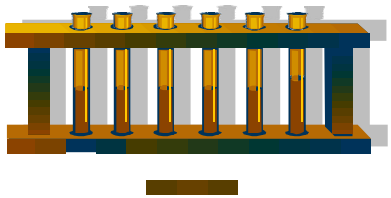
1. Combination reaction $A + B \rightarrow AB$

2. Decomposition reaction $AB \rightarrow A + B$

3. Single-displacement reaction $A + BC \rightarrow AC + B$

4. Double-displacement reaction $AB + CD \rightarrow AD + CB$

5. Redox reaction



Combination Reactions

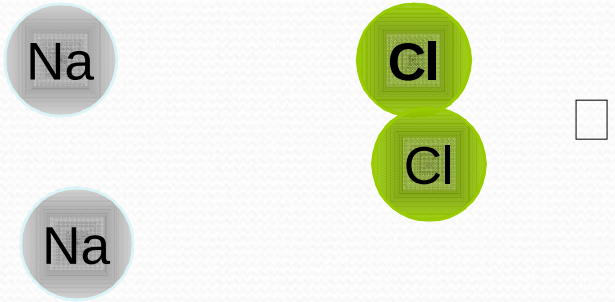
- These type of reactions occur when two reactants combine to form one or more products. E.g. –

1. $CaO + H_2O \longrightarrow Ca(OH)$
2. $C + O_2 \longrightarrow {}_2CO_2$

- They are generally exothermic reactions which involve evolution of heat during reaction.

Combination Reaction

$$2\,Na + Cl_2 \rightarrow 2\,NaCl$$



General form: **A** + **B** → **AB**

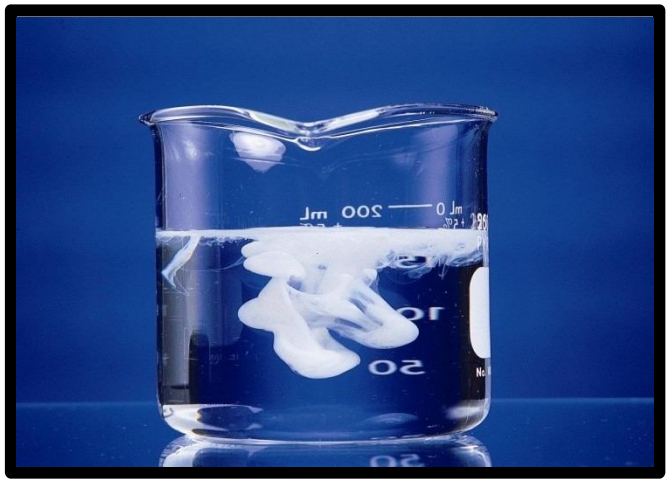
element or compound + element or compound → compound

Decomposition Reaction

- The types of reaction in which a single reactant breaks down to give simpler products are called decomposition reaction. E.g.-

$$2\,H_2O \longrightarrow 2\,H_2 + O_2$$

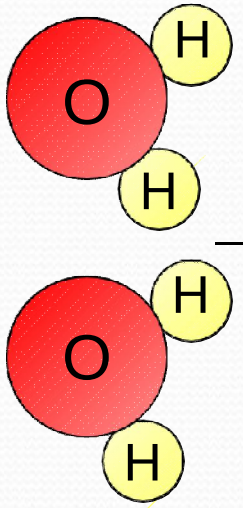
- When a decomposition reaction is carried out by heating, it is known as thermal decomposition.



Decomposition Reaction

Decomposition reaction

$2\ H_2O \longrightarrow 2\ H_2 + O_2$



General form: AB → A + B

compound → two or more elements or compounds

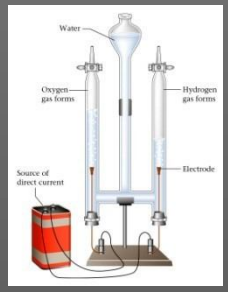
Decomposition Reactions

Hydrogen Peroxide

$$2\,H_2O_2 \longrightarrow 2\,H_2O + O_2$$

Electrolysis of water

$$2\,H_2O \xrightarrow{\textit{electricity}} 2\,H_2 + O_2$$



Nitrogen triiodide

$$2\,NI_3 \longrightarrow N_2 + 3\,I_2$$

General Form

$$AB \longrightarrow A + B$$

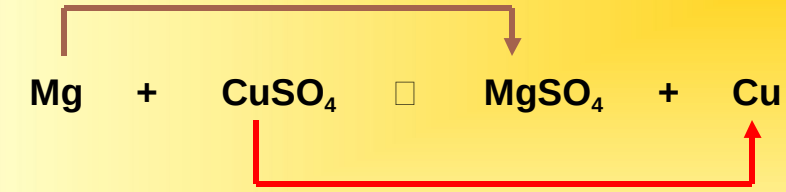
Displacement Reactions

- The reaction in which a more reactive element displaces a less reactive element from its solution is known as displacement reaction.
- They are of two types:-

1. Single Displacement Reaction
2. Double Displacement Reaction

SINGLE AND DOUBLE DISPLACEMENT REACTIONS

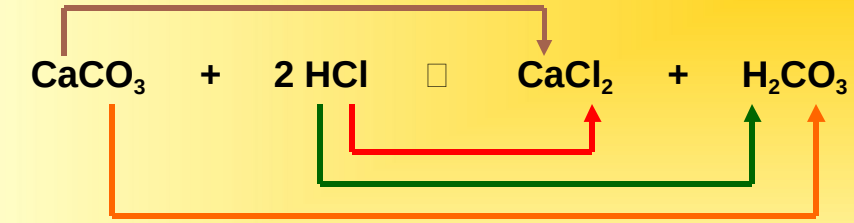
Single-replacement reaction



General form:

A + BC □ AC + B

Double-replacement reaction



General form:

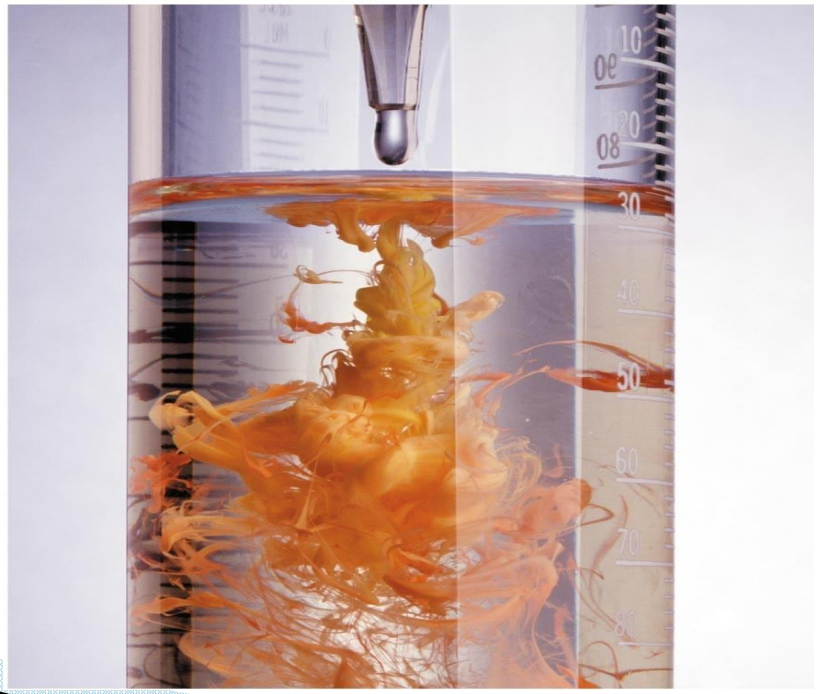
AB + CD □ AD + CB

Single Displacement Reaction

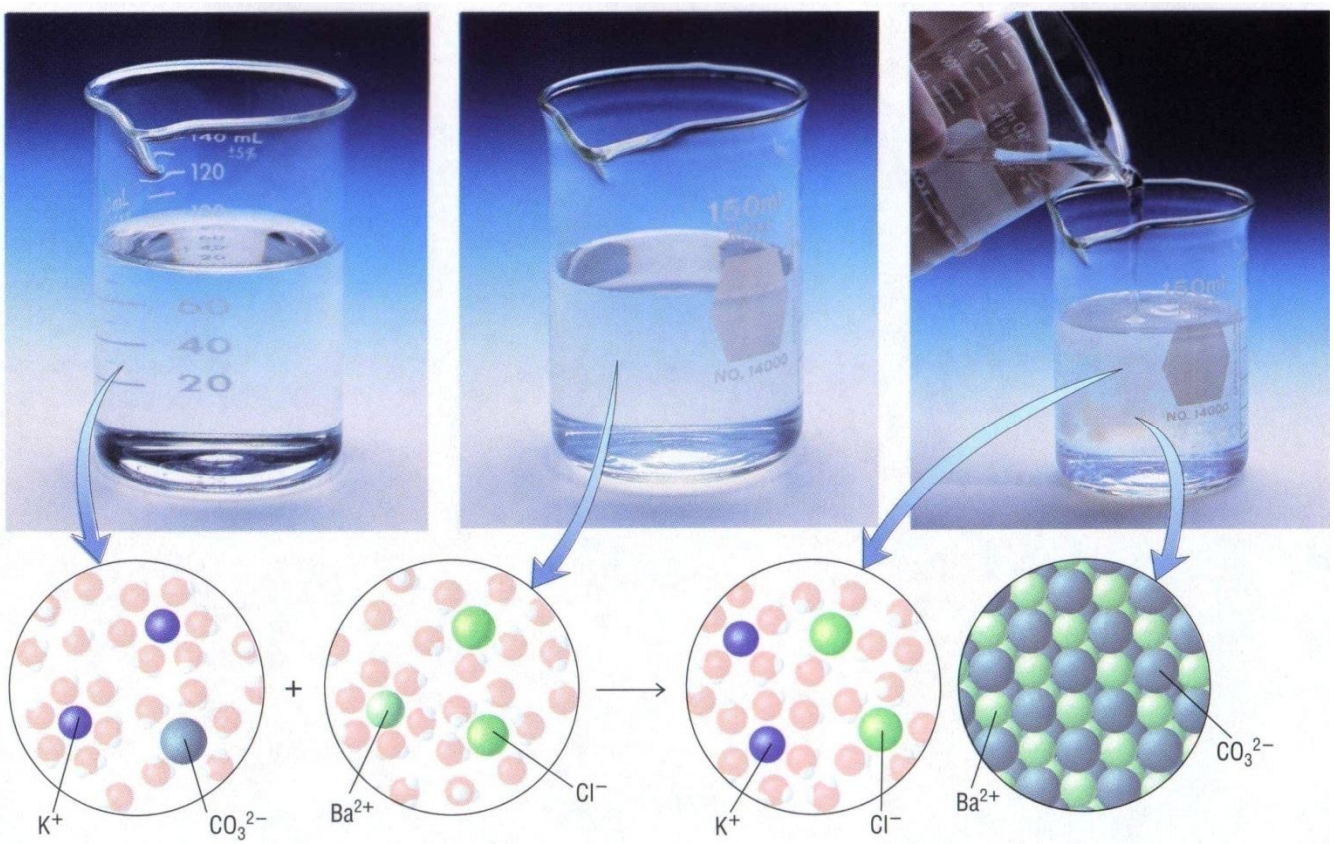
lead (II) chloride + potassium iodide ⟶ potassium chloride + lead (II) iodide

Pb^{2+} Cl^{1-} K^{1+} I^{1-} Pb^{2+} Cl^{1-} K^{1+} I^{1-}

$PbCl_2 + KI \longrightarrow KCl_{(aq)} + PbI_{2(ppt)}$

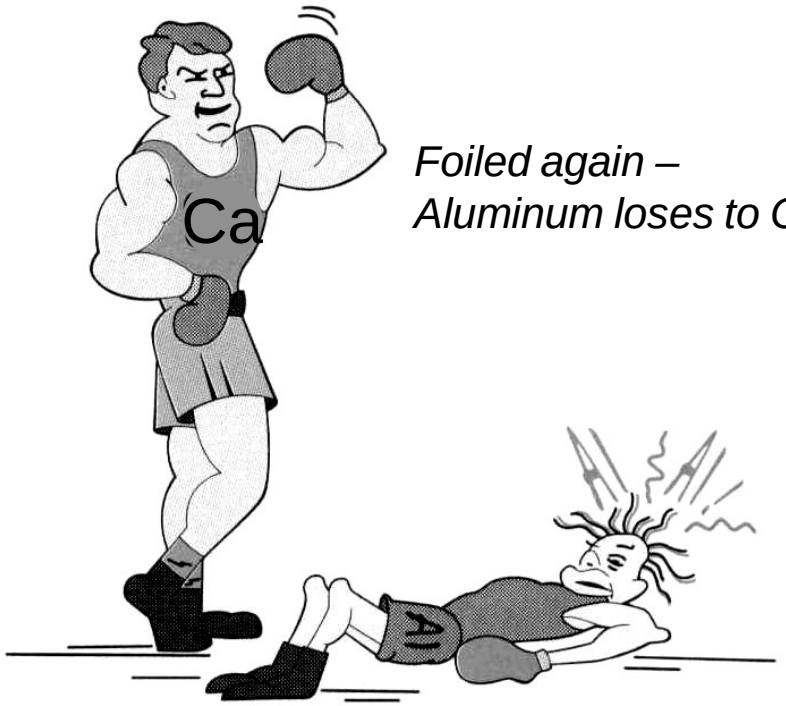


Double Displacement Reaction



K_2CO_3 (*aq*) Potassium carbonate + $BaCl_2$ (*aq*) Barium chloride → 2 KCl (*aq*) Potassium chloride + $BaCO_3$ (*s*) Barium carbonate

Reactivity Series



Foiled again –
Aluminum loses to Calcium

Element Reactivity

potassium	most reactive	K
sodium		Na
calcium		Ca
magnesium		Mg
aluminium		Al
carbon		C
zinc		Zn
iron		Fe
tin		Sn
lead		Pb
hydrogen		H
copper		Cu
silver		Ag
gold		Au
platinum	least reactive	Pt

Redox Reactions

- If a substance gains oxygen during a reaction, it is said to be oxidised.
- If a substance loses oxygen during a reaction, it is said to be reduced.
- Reactions in which this type of change occurs is known as Oxidation and Reduction reactions or Redox reactions. E.g. –

$$CuO + H_2 \longrightarrow Cu + H_2O$$