



REDOX REACTIONS

(PART-I)

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REDOX REACTIONS

- Chemical Reactions :
- The Chemical reactions are the back bone of Chemistry. There is no chemistry without chemical reactions. In order to understand chemical reactions it is necessary to know about the changes.

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- In our day to day life we come across several types of changes. A substance is said to undergo a change if it gets converted from one state to another.
- A substance can undergo two types of changes.
 - 1 Physical Change
 - 2 Chemical Change



- Physical Change :
- A physical change is a temporary change in which a specific property of the substance alters keeping the composition same.
- Melting of ice, wax or ghee.
- Evaporation of Water.
- Condensation of Water Vapour



- **Magnetization of iron**
- **Glowing of an electric bulb.**
- **Expansion or contraction of metals on heating or cooling.**
- **Stretching of rubber within the elastic limit.**



- Characteristics of physical changes :
- **It is temporary and reversible.**
- **There is no change in mass & chemical composition.**
- **No new substance is formed.**
- **Only a little heat is absorbed or liberated.**



- Chemical change:
- A Chemical change is a permanent change in which the chemical composition of the substance changes.
- Examples:
- Combustion of carbon or any substance.
- Decomposition of limestone



- **Rusting of iron.**
- **Electroplating**
- **Electrolysis of water**
- **Characteristics of a chemical change :**
- **It is a permanent change.**
- **One or more new substances with different composition are formed.**

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- It may be reversible or irreversible.
- A certain amount of heat may be absorbed or liberated.
- **Chemical Reactions:**
- A Chemical reaction can be defined as the process in which one or more substances (element or compound)



- undergo a chemical change with absorption or liberation of heat.
- The substances present before the chemical reaction (or chemical change) are called **reactants**.
- The substances formed after the chemical reactions (or chemical change) are called as **products**.

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- **Chemical Equation:**
- **A Chemical equation can be defined as the short scientific representation of a chemical reaction by using the symbol or formulae of the substances involved in the reaction.**
- **A Chemical equation for a given chemical reaction is written by**
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- following these steps.
 - i) The symbol or formulae of all the reactants are written, each one of them separated by “+” sign. This “+” sign indicates that the reactants interact or combine with each other.
 - ii) A horizontal arrow mark (\rightarrow) pointing towards right side is written after the

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last reactant. If the reaction is reversible, then arrow mark is replaced by “ \rightleftharpoons ” mark.

iii) Now the symbol or formulae of all the products are written, each one of them again separated by “+” sign. This “+” sign indicates that a mixture of products is formed.

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- iv) The gaseous products are indicated by writing a vertical arrow mark pointing upward (\uparrow) after its formula.
- v) If a precipitate is formed in the reaction, then it is indicated by writing a vertical arrow mark pointing downward (\downarrow) after its formula.



- A precipitate is an insoluble substance that separates when two solutions are mixed with each other.
- vi) The conditions of the reactions like temperature, pressure etc and catalyst if any, used in the reaction are indicated on the arrow mark between the reactants and products.

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In some reactions, the physical states of the reactants and products are also indicated.

Now let us write the chemical equation for the following chemical reactions.



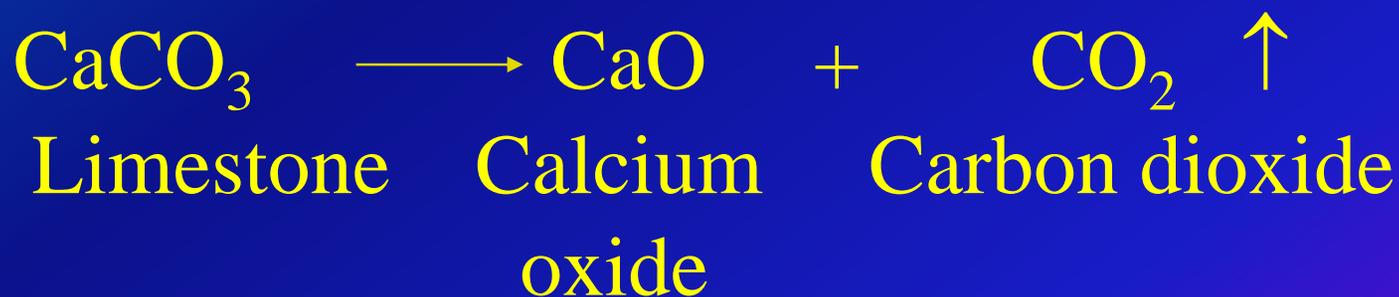
Example 1: Combustion of Carbon: Carbon burns in air or oxygen to form Carbon dioxide gas.



Carbon dioxide is a gas. It is indicated by an arrow mark \uparrow Vikasana - CET 2012



Example 2: Decomposition of Limestone: -
Limestone decomposes on heating to give calcium oxide and carbon dioxide gas.



Reactant

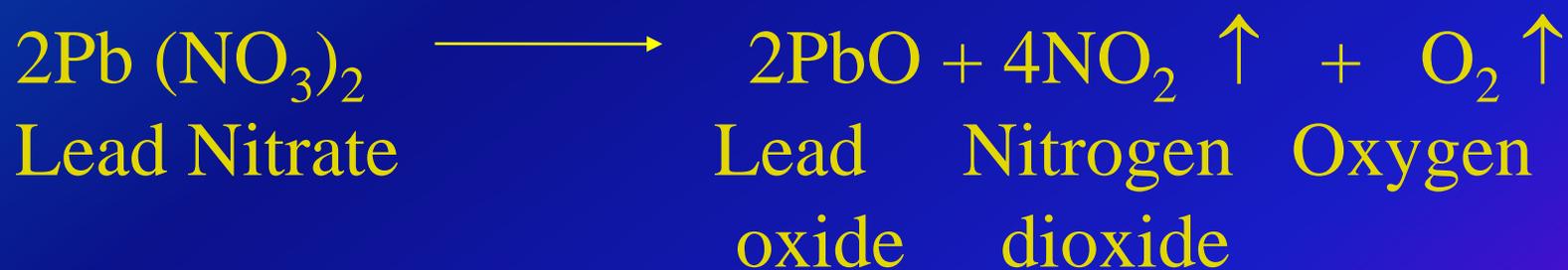
Products

Carbon dioxide is a gas. It is indicated by arrow mark(↑)

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Example 3: Decomposition of Lead nitrate Lead nitrate decomposes on heating to give lead oxide, nitrogen dioxide gas and oxygen gas.

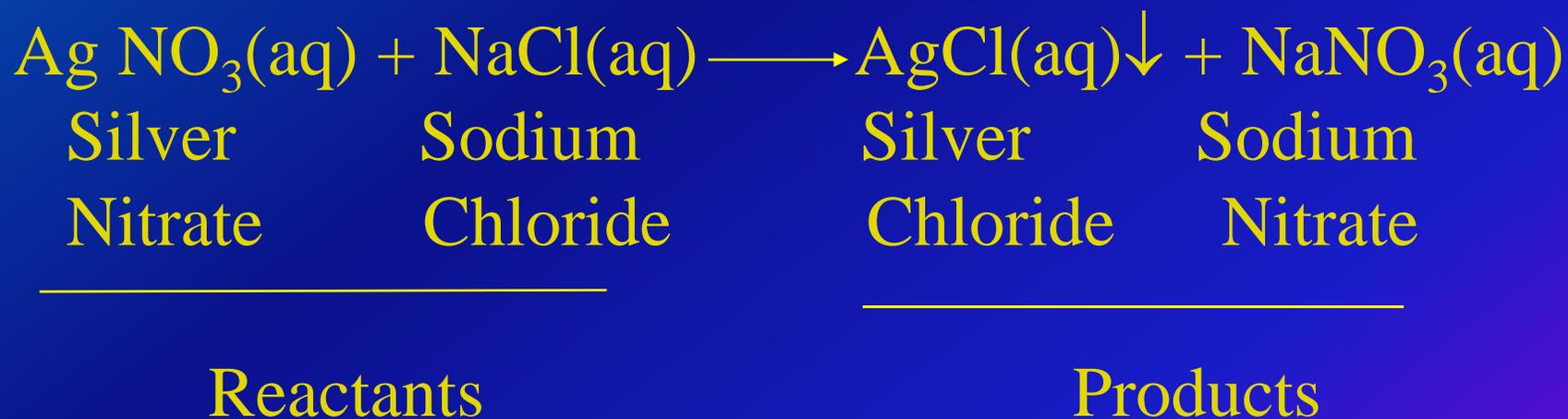


Reactant

Products



Example 4: When silver nitrate solution is added to sodium chloride solution, an insoluble substance silver chloride separates out



Silver chloride is a precipitate. It is indicated by an arrow mark (\downarrow)

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Example: 5 when a solution of barium chloride is added to a solution of sodium sulphate, an insoluble substance barium sulphate separates out.



Barium Chloride
Sodium Sulphate

Reactants

Barium Sulphate
Sodium Chloride

Products

Barium sulphate is a precipitate. It is indicated by an arrow mark (\downarrow)

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Balancing the chemical Equations : When a

chemical reaction takes place. There is change in chemical composition of the reactants, however there is no change in mass. According to law of conservation of mass. **“Mass can neither be created nor destroyed”**. The number of atoms of different elements present in the molecules of reactants and products must be the same. It is therefore necessary to equalise the number of atoms of different elements present in both reactants and products.

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The process of equalising the number of atoms present in the molecules of reactants and products is called balancing the chemical equations. The following are different methods of balancing the equations.

- 1) Trial and error method (or Hit and Trial method)
- 2) Oxidation number method.



Balancing a chemical equation by trial and error method.

There are no hard and fast rules for balancing a chemical equation by trial and error method. However following procedure can be applied.

- Write the skeleton of chemical equation.
- First consider a particular element either from the reactants or from the products
- Count the number of atoms of that element in molecules of reactants and products.



- If this number is equal then consider another element. Otherwise balance this element by writing a suitable number as coefficient of the formula of molecule containing that element in reactants (or products)
- After writing this co-efficient, the number of other element/ elements present in the molecule of that compound will be affected. Now balance the affected element with a suitable coefficient to the formula on the other side.

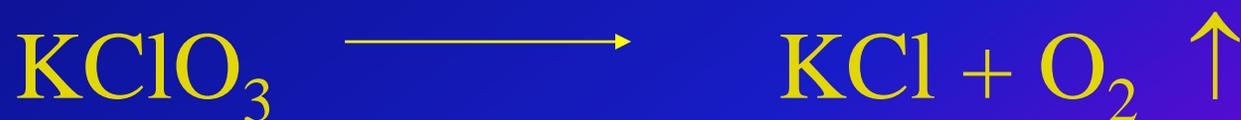
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- The same method is applied to balance every element in the equation.
- In some equations, there may be diatomic molecules as one of the reactants or products and the atom of the same molecule exists in odd number on the other side. In such cases, equalise that element with a suitable number as coefficient such that it becomes even.

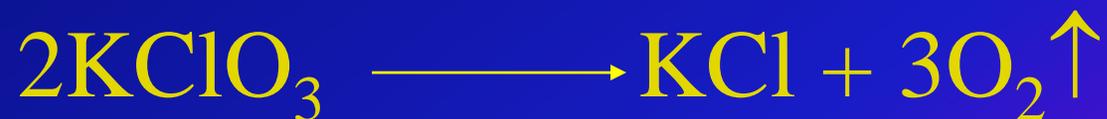


- Consider the following examples.
- Potassium chlorate decomposes on heating to give potassium chloride and oxygen. Skeleton of chemical equation for this reaction is as follows :



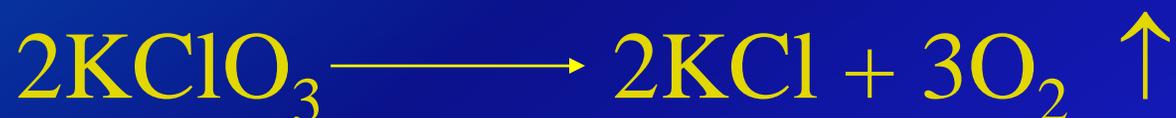


- Consider oxygen atom, there are 3 oxygen atoms on the left side and 2 on the right. To balance this, we have to make even number of oxygen atoms on both sides by writing 2KClO_3 and 3O_2 .





Now K & Cl are 2 on the left side therefore write 2KCl on the right side.



Now it is a balanced chemical equation.

- Zinc reacts with concentrated sulphuric acid to form zinc sulphate liberating sulphur dioxide gas.



Skeleton of chemical equation for this reaction is as follows



- Consider sulphur, there are 2 sulphur atoms on right side, therefore write $2\text{H}_2\text{SO}_4$ on left side





- Now there are 4H atoms on left side therefore write 2H₂O on right side.



Now it is a balanced chemical equation.

- Lead nitrate decomposes on heating to give lead oxide, nitrogen dioxide gas and oxygen gas. The skeleton of the chemical equation for this reaction is.

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Consider oxygen, there are odd number of oxygen atoms (5) on right side make it even by writing 2PbO.



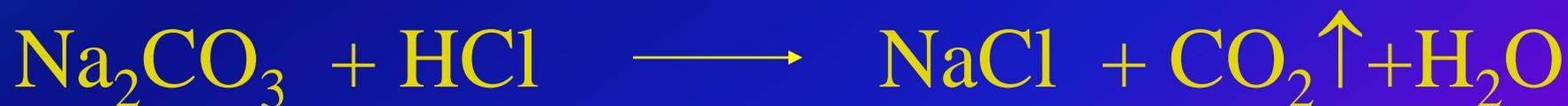
- Now there are 2 lead atoms on right side, therefore write 2 Pb(NO₃)₂.on left side.



- Lead is balanced. Now there are 4 nitrogen atoms on left side, therefore write 4 NO_2 on the right side.
- $2\text{Pb}(\text{NO}_3)_2 \longrightarrow 2\text{PbO} + 4\text{NO}_2 \uparrow + \text{O}_2 \uparrow$
- This is a balanced chemical equation.

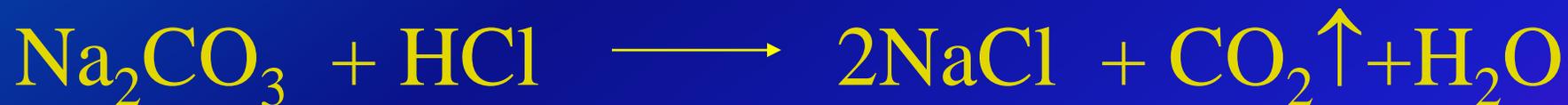


- Sodium carbonate reacts with dilute hydrochloric acid to form sodium chloride and water, liberating carbon dioxide gas with effervescence. The skeleton of the chemical equation for this reaction is as follows:

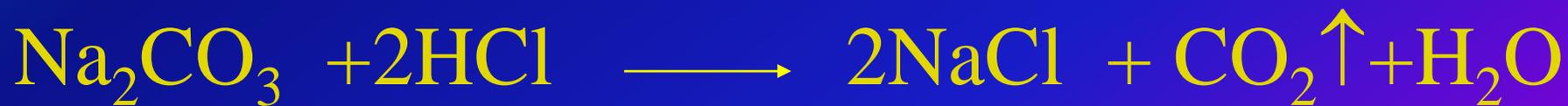




- Consider sodium, there are 2 sodium atoms on the left side, therefore write 2NaCl .



- Now there are 2 Cl atoms on right side, therefore write 2 HCl on left side.



Now this is a balanced chemical equation.

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- When Potassium dichromate is heated with concentrated sulphuric acid, it forms potassium sulphate, chromium sulphate, water and oxygen gas.
- The skeleton of the chemical equation for this reaction is





- There are 2 potassium atoms and 2 chromium atoms on both sides, therefore both potassium and chromium are balanced.



- There are 4 SO_4 groups on right side and 1 on left side, therefore write 4 H_2SO_4 on left side.



- Now there are 8 hydrogen atoms on left side and 2 on right side, therefore write 4 H₂O on right side.



- Now there are 23 oxygen atoms on left side and 22 on right side, therefore make even number on both sides by multiplying the equation throughout by 2 except O₂.



- Now there are 46 oxygen atoms on left side and 42 on right side, therefore write 3O_2 on right side.





A balanced chemical equation gives information about

- **The substances that react with each other.**
- **The products formed during the reaction.**
- **The symbol and formulae of the reactants and products.**
- **The substance formed is a gas or a precipitate.**
- **The number of moles of different reactants & products.**



- **Exercise:** Balance the following chemical equations





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THANK YOU

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