पुष्ना International School

Shree Swaminarayan Gurukul, Zundal

Class -X

Science (Chemistry)

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SCIENCE

Class X

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Textbook for Class X

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CHAPTER- 01
CHEMICAL REACTION AND EQUATIONS

Chemical Reaction: Whenever a chemical change occurs we can say that a chemical reaction (permanent change) has taken place which can be expressed symbolically by a **chemical equation.**

e.g. Food gets digested in our body

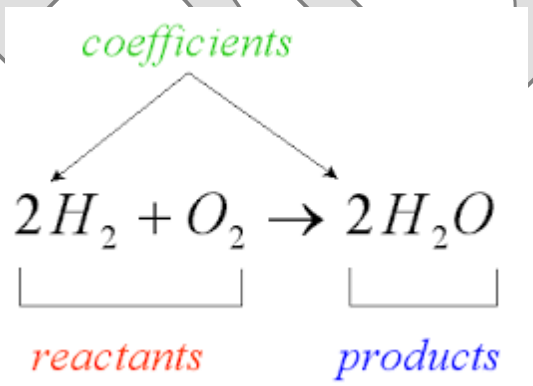
- Rusting of iron.

magnesium is burnt in air to form magnesium oxide. This chemical reaction can be represented as

$2Mg + O_2 \rightarrow 2MgO$

- We can observe or recognise a chemical reaction by observing change in state, colour, by evolution of gas or by change in temperature.
- Physical state of the reactants and the products are mentioned to make chemical reaction more informative. e.g. we use (g) for gas, (l) for liquid, (s) for solid and (aq) for aqueous.

Balanced Equation: A balanced equation is one in which the number of atoms on the reactant and product sides are equal.



Balancing Equation: We balance a chemical equation so that no. of atoms of each element involved in the reaction remains the same at the reactant and product side.

$Fe + H_2O \rightarrow FeO + H_2$

$3Fe+4H_2O \rightarrow Fe_3O_4+4H_2$

Types of Reaction

I. Combination Reaction:– The reaction in which two or more substances combine to form a new single substance.
e.g.

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$$

Calcium Oxide Quick lime	Water	Calcium hydroxide (slaked lime)

- $Ca(OH)_2$ slaked lime is used for white washing walls. It reacts with CO_2 to form Calcium Carbonate and gives a shiny finish to the walls

$Ca(OH)_{2(aq)}+CO_{2(g)} \rightarrow CaCO_{3(s)}+H_2O(l)$

Calcium Hydroxide Calcium Carbonate

(ii) Burning of Coal

$C_{(2)}+O_{2(g)} \rightarrow CO_{2(g)}$+heat+ light

(iii) Formation of water

$2H_{2(g)}+O_{2(g)} \rightarrow 2H_2O(l)$

Exothermic Reactions : Reaction in which heat is released along with the formation of products.

eg.. $CH_{4(g)}+2O_{2(g)} \rightarrow CO_{2(g)}+2H_2O_{(g)}$

Endothermic Reaction :The reactions which require energy in form of heat, light or electricity are called endothermic reaction

eg.. $2Ba(OH)_2+NH_4Cl \rightarrow 2BaCl_2+NH_4OH$

II. Decomposition Reactions :The reaction in which a single substance decomposes to give two or more substances. De composition reactions can be of three types:

DECOMPOSITION REACTIONS :-

1. **Thermal Decompostition** :-When a decomposition reaction is carried out by heating

$$eg\ \ 2\ FeSO_{4(s)} \xrightarrow{Heat} Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(g)}$$

Ferrous Sulphate *Ferric Oxide*

Green Colur → *Reddish brown Colour*

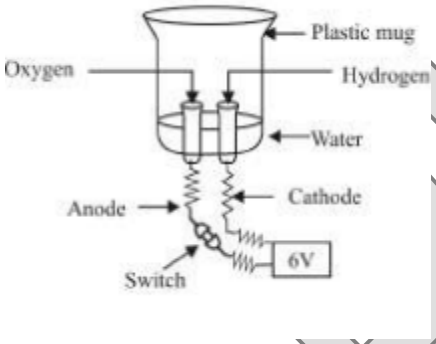
$$CaCO_{3(s)} \xrightarrow{Heat} CaO_{(s)} + CO_{2(g)}$$

$$Pb(NO_3)_{2(s)} \xrightarrow{Heat} PbO_{(g)} + 4NO_{2(g)} + O_{2(g)}$$

Lead Nitrate LeadoxideNitrogen Oxygen

White colour → Brown colour dioxide

1. **Electrolytic Decomposition** :- When a decomposition reaction is carried out by electric current,
2. .$H_{2(l)}$− electric current → $2H_{2(g)}+O_{2(g)}$



$$e.g.\ 2AgCl_{(s)} \xrightarrow{sunlight} 2Ag_{(s)} + Cl_{2(g)}$$

White colour ⟶ *grey clour*

Silver bromide behaves similarly

$$2Ag\ Br \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$$

The above two reactions are used in black and white photography

- Silver bromide behaves similarly

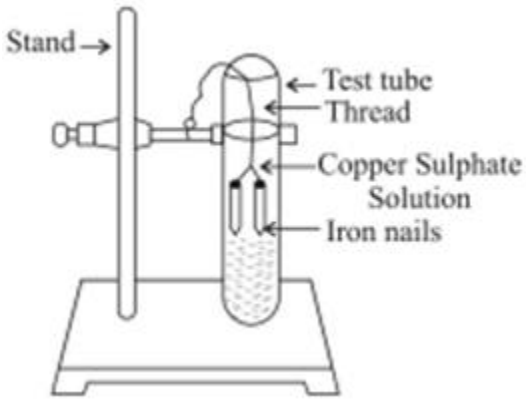
2AgBr− Sunlight → 2Ag(s)+Br_2(g)

III. **Displacement Reaction**:The chemical reaction in which an element displaces another element from its solution

$Fe_{(s)} + CuSO_{4(aq)} \rightarrow FeSO_4 + Cu_{(s)}$

Copper (aq)

Sulphate Iron Sulphate



Fe being more reactive than Cu displaces it from $CuSO_4$

$$Zn_{(s)} + CuSO_4 \rightarrow ZnSO_4 + Cu_{(s)}$$
$$(aq) \qquad (aq)$$
$$Copper \qquad Zinc$$
$$Sulphate \qquad Sulphate$$

$$Pb_{(2)} + CuCl_2 \rightarrow PbCl_2 + Cu^{(s)}$$
$$(aq) \qquad (aq)$$
$$Copper \qquad Lead$$
$$Chloride \qquad Chloride$$

- Zinc and lead are more reactive elements than copper. They displace copper from its compounds.

IV. **Double Displacement Reaction** :The reaction in which two different atoms or group of atoms are mutually exchanged

$$e.g..Na_2SO_4(aq) + BaCl_2(aq) \rightarrow BaSO_{4(s)} + 2NaCl(aq)$$

Sodium Sulphate	Barium Chloride	Barium Sulphate	Sodium Chloride

A white substance is formed due to above reaction. The insoluble substance i.e., $BaSO_4$ is called precipitate.

Precipitation Reaction – Any reaction that produces a precipitate is called a precipitation reaction.

$$e.g.Pb(NO_3)_2(aq) + 2KI(aq) \rightarrow PbI_2 \downarrow + 2KNO_3$$

Lead Nitrate — *Potassium Iodide* — *Lead Iodide* — *Potassium Nitrate*

the downward facing arrown represents the formation of precipitate.

V. **Oxidation** :Oxidation is the gain of oxygen or loss of hydrogen

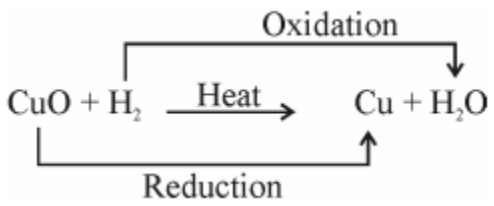
e.g.$2Cu + O_2 \xrightarrow{Heat} 2CuO$

When copper is heated a black colour appears. If this CuO is reactedwith hydrogen gas then again Cu becomes brown as reverse reaction takes place

$CuO + H_2 \xrightarrow{Heat} Cu + H_2O$

VI. **Reduction** : Reduction is the loss of oxygen or gain of hydrogen.

- **Redox Reaction** : The reaction in which one reactant gets oxidised while other gets reduced



eg.. $ZnO + C \rightarrow Zn + CO$

$MnO_2+4HCl \rightarrow MnCl_2+2H_2O+Cl_2$

- Corrosion :When a metal is attacked by substances around it such as moisture, acids etc.

(i) Rusting of iron. i.e Reddish brown coating on iron of Fe_2O_3 is formed.

(ii) Black coating on Silver.

Rusting of iron can be prevented by painting, oiling the surface or by galvanisation.

- Rancidity :When fats and oils are oxidised they become rancidand their smell and taste change.
- Antioxidants are added to foods containing fats and oil.

e.g. N_2 is added to packet of chips to prevent oxidation of fats and oils.

Intext Exercise:-

(Page No. 6)

1. Why should a magnesium ribbon be cleaned before burning in air?
Ans. Magnesium ribbon is cleaned before burning to remove the protective layer of basic magnesium carbonate from the surface of magnesium ribbon.

2. Write the balance equation for the following reactions Give reasons for the following reactions?
i. Hydrogen + Chlorine → Hydrogen chloride
ii. Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride
iii. Sodium + water → Sodium hydroxide + water
Ans. The chemical equations are as follows-
i. $H_2 + Cl_2 \rightarrow\rightarrow 2HCl$.
ii. $3BaCl_2 + Al_2(SO_4)_3 \rightarrow\rightarrow 3BaSO_4 + 2AlCl_3$.
iii. $2Na + 2H_2O \rightarrow\rightarrow 2NaOH + H_2$

3. Write the balanced chemical equation with state symbols for the following reactions?
i. Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and solution of sodium chloride.
ii. Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.
Ans. Balance chemical reaction with state symbols are as follows-

$i.\ BaCl_2\,(aq)\ +\ Na_2SO_4\,(aq) \rightarrow\ BaSO_4\,(s)\ +\ 2NaCl\ (aq)$

$ii.\ NaOH\ (aq)\ +\ HCl\ (aq) \rightarrow NaCl\ (aq)\ +\ H_2O$

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1. A solution of a substance 'X' is used for white washing

i. Name the substance 'X' and writes its formula.

ii. Write the reaction of the substance 'X' named in (i) above with water

Ans. i. The substance whose solution is water is used for white washing is calcium oxide. Its formula is CaO.

ii. $CaO_{(s)} + H_2O_{(l)} \rightarrow \rightarrow Ca(OH)_{2(aq)}$

2. Why the amount of gas collected in one of the tubes in Activity 1.7 double of the amount collected in the other? Name this gas.

Ans. The gas which is collected in double the amount in the electrolysis of water experiment is hydrogen. This is because water contains 2 parts of hydrogen element as compared to only 1 part of oxygen element.

(Page No. 13)

1. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Ans. When iron nail is dipped in copper sulphate solution, than iron sulphate solution and copper solution and copper metal are formed:

$CuSO_4\,(aq)\ +\ Fe\ (s) \rightarrow FeSO_4\,(aq)\ +\ Cu\ (s)$

In this reaction, iron displaces copper from copper sulphate solution. The deep blue colour of copper sulphate fades due to the formation of light green solution of iron sulphate.

2. Give an example of a double displacement reaction other than the one given in Activity 1.10.

Ans. An example of double displacement reaction is

$Pb(NO_3)_2\,(aq)\ +\ 2KI\ (aq) \rightarrow PbI_2\,(s)\ +\ 2KNO_3\,(aq)$

3. Identify the substances that are oxidized and the substances that are reduced in the following reactions.

$i.\quad 4Na\ (s)\ +\ O_2\,(g) \rightarrow 2Na_2O\ (s)$

$ii.\quad CuO\ (s)\ +\ H_2 \rightarrow Cu\ (s)\ +\ H_2O\ (l)$

Ans. (i). $4Na\ +\ O_2 \rightarrow 2Na_2O$

In this reaction, Na is oxidized because it combines with O_2 to form Na_2O. O_2 is reduced because it is converted into Na_2O.

(ii). $CuO + H_2 \rightarrow Cu + H_2O$

In this reaction, CuO is reduced because it loses oxygen. H_2 is oxidized because it combines with oxygen of CuO to form water

Textbook exercises;-

1. Which of the following statement about the reaction below are incorrect?

$2PbO\ (s) + C\ (s) \rightarrow 2Pb\ (s) + CO_2\ (g)$

(a) Lead is getting reduced.
(b) Carbon dioxide is getting oxidized
(c) Lead oxide is getting oxidized
(d) Lead is getting reduced
i. (a) and (b)
ii. (a) and (c)
iii. (a), (b) and (c)
iv. All

Ans. As statement (a) and (b) are incorrect, answer (i) is correct.

2. $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

The above reaction is an example of a
(a) combination reaction
(b) double displacement reaction
(c) decomposition reaction
(d) displacement reaction

Ans. This is an example of displacement reaction because Fe in FeO_3 has been displaced by Al. Hence correct answer is (d).

3. What happens when dilute hydrochloric acid is added to iron filling? Tick the correct answer
(a) Hydrogen gas and iron chloride are produced.
(b) Chlorine gas and iron hydroxide are produced
(c) No reaction takes place
(d) Iron salt and water are produced

Ans. Answer (a) is correct.

4. What is balanced chemical equation? Why should chemical equation be balanced?

Ans. The reaction in which the number of atoms of each element is equal on the reactant side and product side is called balanced equation.
Chemical reaction should be balanced because only a balanced equation tells us the

relative quantities of different reactants and products involved in the reaction.

5. Translate the following statements into chemical equations and then balance them.
(a) Hydrogen gas combines with nitrogen to form ammonia.
(b) Hydrogen sulphide gas burns in air to give water and Sulpher dioxide.
(c) Barium chloride reacts with aluminum sulphate to give aluminum chloride and precipitate of barium sulphate
Ans. (a). $H_2 + N_2 \rightarrow NH_3$

$3H_2 + N_2 \rightarrow 2NH_3$

(b). $H_2S + O_2 \rightarrow H_2O + SO_2$

$2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2$

(c). $BaCl_2 + Al_2(SO_4)_3 \rightarrow AlCl_3 + BaSO_4$

$3BaCl_2 + Al_2(SO_4)_3 \rightarrow 2AlCl_3 + 3BaSO_4$

(d). $K + H_2O \rightarrow KOH + H_2$

$2K + 2H_2O \rightarrow 2KOH + H_2$

6. Balance the following chemical equations:
(a) $HNO_3+Ca(OH)_2 \rightarrow Ca(NO_3)_2+H_2O$
(b) $NaOH+H_2SO_4 \rightarrow Na_2SO_4+H_2O$
(c) $NaCl+AgNO_3 \rightarrow AgCl+NaNO_3$
(d) $BaCl_2+H_2SO_4 \rightarrow BaSO_4+HCl$
Ans. Balanced chemical equation are:
(a) $2HNO_3+Ca(OH)_2 \rightarrow Ca(NO_3)_2+2H_2O$
(b) $2NaOH+H_2SO_4 \rightarrow Na_2SO_4+2H_2O$
(c) $NaCl+AgNO_3 \rightarrow AgCl+NaNO_3$
(d) $BaCl_2+H_2SO_4 \rightarrow BaSO_4+2HCl$

7. Write the balanced chemical equations for the following reactions.
(a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water
(b) Zinc + Silver nitrate → Zinc nitrate + Silver
(c) Aluminum + Copper chloride → Aluminum chloride +Copper
(d) Barium chloride + Potassium sulphate → Barium sulphate + potassium chloride
Ans. Balanced chemical equation for reactions are:
(a) $Ca(OH)_2+CO_2 \rightarrow CaCO_3+H_2O$
(b) $Zn+2AgNO_3 \rightarrow Zn(NO_3)_2+2Ag$

(c) $2Al+3CuCl_2 \rightarrow 2AlCl_3+3Cu$
(d) $BaCl_2+K_2SO_4 \rightarrow BaSO_4+2KCl$

8. Write the balanced chemical equation for the following and identify the type of reaction in each case.
(a) Potassium bromide (s) + Barium iodide (aq) → Potassium iodide (aq) + Barium bromide(s)
(b) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)
(c) Hydrogen (g) + Chlorine (g) → Hydrogen chloride (g)
(d) Magnesium (s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen (g)
Ans. Balanced equations are:
(a) $2KBr_{(aq)}+BaI_{2(aq)} \rightarrow 2KI_{(aq)}+BaBr_{2(s)}$ Double Displacement Reaction
(b) $ZnCO_{3(s)} \rightarrow ZnO_{(s)}+CO_{2(g)}$; Decomposition Reaction
(c) $H_{2(g)}+Cl_{2(g)} \rightarrow 2HCl$; Combination Reaction
(d) $Mg_{(s)}+2HCl_{(aq)} \rightarrow MgCl_{2(aq)}+H_{2(g)}$; Displacement Reaction

9. What does one mean by exothermic and endothermic reactions? Give examples.
Ans. A reaction in which energy is released in the form of heat or light is called exothermic reaction. Example of exothermic reaction are:

a. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + heat$

b. $2Al + FeO_3 \rightarrow Al_2O_3 + Fe + heat$

A reaction in which energy is absorbed from the surrounding and cooling is produced is called endothermic reaction. Example of endothermic reaction are:

a. $CaCO_3 \rightarrow CaO + CO_2$

b. $N_2 + O_2 \rightarrow 2NO$

10. Why respiration is considered an exothermic reaction? Explain.
Ans. During respiration, we inhale oxygen from the atmosphere which reacts with glucose in your body cells to produce carbon dioxide and water.

$C_6H_{12}O_6\,(aq) + 6O_2 \rightarrow 6CO_2\,(g) + 6H_2O\,(l) + heat$

Heat is liberated in this process; hence respiration is considered an exothermic reaction.

11. Why decomposition reactions are called the opposite of combination reactions? Write equations for these reactions.
Ans. $NH_4Cl\,(s) \rightarrow HCl\,(g) + NH_3\,(g)$

In a decomposition reaction, a single substance breaks down into two or more substances while in a combination reaction, two or more substances react to produce one substance. Therefore, decomposition reactions are called opposite of combination reactions.
Example of decomposition reaction: Example of combination reaction:

$$CaO\ (s)\ +\ CO_2\,(g) \rightarrow CaCO_3\,(s)$$

12. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.
Ans. Decomposition by heat:

$$CaCO_3\,(S)\ +\ heat \rightarrow CaO\ (s)\ +\ CO_2\,(g)$$

Decomposition by electricity:

$$2H_2O\ +\ light \rightarrow 2H_2\,(g)\ +\ O_2\,(g)$$

Decomposition by light:

$$2AgBr\ (s)\ +\ light \rightarrow 2Ag\,(s)\ +\ Br_2$$

13. What is difference between displacement and double displacement reactions? Write equations for these reactions.
Ans. In displacement reaction, more reactive element displaces the less reactive element from its compound. For example

$$Zn\ (s)\ +\ CuSO_4\,(aq) \rightarrow ZnSO_4\,(aq)\ +\ Cu\ (s)$$

But in double displacement reaction, exchange of ions takes place. For example

$$HCl\ (aq)\ +\ AgNO_3\,(aq) \rightarrow AgCl\ (s)\ +\ HNO_3\,(aq)$$

14. In refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.
Ans. The reaction involved is:
$AgNO_{3(aq)}$ + $Cu_{(s)}$ → → $Cu(NO_3)_{2(aq)}$ + 2 $Ag_{(s)}$
Copper + SilverNitrate → → CopperNitrate + Silver

15. What do you mean by a precipitation reaction? Explain by giving examples.
Ans. A chemical reaction in which an insoluble substance (precipitate) is formed is called precipitation reaction. For example

$$AgNO_3 + NaCl \rightarrow AgCl\ +\ NaNO_3$$

16. Explain the following in terms of gain and loss of oxygen with two examples each?
a. Oxidation

b. Reduction

Ans. Oxidation- addition of oxygen or removal of hydrogen in a chemical reaction is called oxidation reaction. For example

$$2Cu + O_2 \rightarrow 2CuO$$

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Reduction- addition of hydrogen or removal of oxygen in a chemical reaction is called oxidation reaction. For example

$$CuO + H_2 \rightarrow Cu + H_2O$$

$$H_2S + Cl_2 \rightarrow 2HCl + S$$

17. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.

Ans. The brown coloured element 'X ' is copper. On heating in air it forms copper oxide, which is black in colour.

$$2CuS + O_2 \rightarrow 2CuO$$

18. Why do we apply paint on iron articles?

Ans. We apply paint on iron articles to prevent rusting. Iron articles do not come in contact of atmospheric oxygen and moisture and thus the rusting is prevented.

19. Oil and fat containing food items are flushed with nitrogen. Why?

Ans. Oil and fat containing items get rancid due to oxidation with atmospheric oxygen. To prevent rancidity food items are flushed with nitrogen. Nitrogen do not reacts with oil and fat containing items.

20. Explain the following terms with one example each.

a. Corrosion

b. Rancidity.

Ans. Corrosion- action of air, water, acid or other substance on metal surface to form oxides and carbonates is called corrosion. Corrosion of iron is called rusting. Green coating on copper and black coating on silver is examples of corrosion.

Rancidity-change in smell of food item containing fat and oil when kept open for longer time due to oxidation is called rancidity. To prevent rancidity food items are flushed with nitrogen or kept in airtight containers.