Chemical Changes and Reactions

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Solution 1:

1. A chemical reaction is the process of breaking the chemical bonds of the reacting substances (reactants) and making new bonds to form new substances (products).
2. Conditions necessary for a chemical change or reaction are
   - Evolution of gas
   - Change of colour
   - Formation of precipitate
   - Change of state

Solution 2:

- A chemical bond is the force which holds the atoms of a molecule together as in a compound.
- Formation of gas bubbles in a liquid during a reaction is called effervescence.
- Chemical reactions which are characterised by the formation of insoluble solid substances are called precipitates.

Solution 3:

(a) $CuCO_{3(s)} \xrightarrow{\Delta} CuO + CO_{2(g)}$

(b) $6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$

(c) $2H_2O \xrightarrow{\text{Electricity}} 2H_2 + O_2$

(d) $PbNO_{3(s)} + 2KI_{(s)} \longrightarrow 2KNO_{3(s)} + PbI_{2(s)}$

(e) $NaCl_{[s)} + AgNO_{3(s)} \longrightarrow AgCl \downarrow + NaNO_{3[aq)}$

(f) $N_2 + 3H_2 \underset{\text{Above 200 atm}}{\rightleftharpoons} 2NH_3$

(g) $2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$

Solution 4:

(a) It is a reaction which occurs with absorption of light energy.

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

(b) It is a reaction which occurs with absorption of electrical energy.

$$2H_2O \xrightarrow{\text{Electricity}} 2H_2 + O_2$$

Solution 5:

(a)

(i) $2AgNO_3 \xrightarrow{\text{Sunlight}} 2Ag + 2NO_2 + O_2$

(ii) $6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$

(b)

(i) $Fe + CuSO_{4(aq)} \longrightarrow FeSO_4 + Cu$

Blue solution — Green solution

(ii) $FeSO_4 + 2NaOH \longrightarrow Fe(OH)_2 + Na_2SO_{4(aq)}$

Dirty green ppt.

(c) $NH_{3(g)} + HCl_{(g)} \rightleftharpoons NH_4Cl_{(s)}$

(d) $Fe + CuSO_{4(aq)} \longrightarrow FeSO_4 + Cu$

Blue solution — Green solution

Solution 6:

(a) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

(b) $Fe + CuSO_{4(aq)} \longrightarrow FeSO_4 + Cu$

Blue solution — Green solution

(c) $NaCl_{(s)} + AgNO_{3(s)} \longrightarrow AgCl\downarrow + NaNO_{3(aq)}$

(d) $NH_{3(g)} + HCl_{(g)} \rightleftharpoons NH_4Cl_{(s)}$

Solution 7:

- Silver nitrate solution is kept in brown bottles in the laboratory because it decomposes in the presence of light.
- Molybdenum increases the efficiency of the catalyst iron used in the manufacture of ammonia.
- This is because the blue colour of the copper sulphate solution fades and eventually turns into light green due to the formation of ferrous sulphate.

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Solution 1:

- Displacement
- Double decomposition
- Accelerate, decelerate, unaffected

Solution 2:

Combination

Decomposition

Solution 3:

(a) Double decomposition: This is a type of chemical change in which two compounds in a solution react to form two new compounds by mutual exchange of radicals.

$NaCl_{(s)} + AgNO_{3(s)} \longrightarrow AgCl \downarrow + NaNO_{3(aq)}$

(b) Thermal decomposition

A decomposition reaction brought about by heat is known as thermal decomposition.

$2HgO(s) \xrightarrow{\Delta} 2Hg_{(s)} + O_{2(g)}$

(c) Reversible reaction

A chemical reaction in which the direction of a chemical change can be reversed by changing the conditions under which the reaction is taking place is called a reversible reaction.

$CuSO_4.5H_2O_{(s)} \leftrightharpoons CuSO_{4(s)} + 5H_2O_{(g)}$

(d) Displacement

It is a chemical change in which a more active element displaces a less active element from its salt solution.

$CuSO_4 + Zn \rightarrow ZnSO_4 + Cu$

Solution 4:

A reaction in which two or more substances combine together to form a single substance is called a synthesis or combination reaction.

$A + B \rightarrow AB$

In the above reaction, substances A and B combine to give a molecule of a new substance, AB.
Carbon burns in oxygen to form a gaseous compound, carbon dioxide.
$C + O_2 \rightarrow CO_2$

Solution 5:

A decomposition reaction brought about by heat is known as thermal decomposition.

$2HgO(s) \xrightarrow{\Delta} 2Hg_{(s)} + O_{2(g)}$

A simultaneous reversible decomposition reaction brought about only by heat is thermal dissociation.

$NH_4Cl \rightleftharpoons NH_3 + HCl$

Solution 6:

The reaction between an acid and a base which forms salt and water only is referred to as reaction of neutralisation.
Applications of neutralisation reactions:

- When someone is stung by a bee, formic acid enters the skin and causes pain, which can be relieved by rubbing the spot with slaked lime or baking soda, both of which are bases.
- Acid which accidentally spills on to our clothes can be neutralised with ammonia solution.
- If the soil is somewhat acidic and thus unfavourable for growing of certain crops, then slaked lime is added to neutralise the excess acid.

Solution 7:

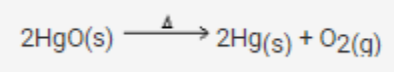
Hydrolysis is the process in which a salt and water react to form an acidic or basic solution.
In the process of hydrolysis, only those salts hydrolyse which are formed by the reaction of

- strong base and weak acid
- strong acid and weak base

This happens because a salt formed due to a strong base and a weak acid on dissolving in water will form a basic solution.
A basic solution turns red litmus blue.
$Na_2CO_3 + 2H_2O \rightarrow 2NaOH + H_2CO_3$
However, the salt formed due to a strong acid and a weak base on dissolving in water will make an acidic solution. Acidic solutions turn blue litmus red.
$FeCl_3 + 3H_2O \rightarrow Fe(OH)_3 + 3HCl$

Solution 8:
Iron(III) chloride is a salt prepared from strong acid HCl and a weak base $Fe(OH)_3$.
$Fe(OH)_3 + 3HCl \rightarrow FeCl_3 + 3H_2O$
On the other hand, sodium carbonate is a salt prepared from a strong base NaOH and a weak acid H_2CO_3.
$Fe(OH)_3 + 3HCl \rightarrow FeCl_3 + 3H_2O$

Solution 9:
Decomposition is the breaking up of a compound either into elements or simpler compounds such that these products do not combine to form the original compound. Decomposition may occur in the presence of heat or light or by the passage of an electric current.
Example: Mercuric oxide when heated decomposes to form two elements-mercury and oxygen.



Solution 10:

- $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$
  Displacement
- $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
  Displacement
- $2H_2O \rightarrow 2Hg + O_2$
  Decomposition
- $PbO_2 + SO_2 \rightarrow PbSO_4$
  Combination
- $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
  Double decomposition
- $2KClO_3 \rightarrow 2KCl + 3O_2$
  Decomposition
- $2H_2O_2 \rightarrow 2H_2O + O_2$
  Decomposition
- $KNO_3 + H_2SO_4 \rightarrow HNO_3 + KHSO_4$
  Double decomposition
- $CuO + H_2 \rightarrow Cu + H_2O$
  Displacement
- $CaCO_3 \rightarrow CaO + CO_2$
  Decomposition
- $NH_4Cl \rightarrow NH_3 + HCl$
  Decomposition

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Solution 1:

Main characteristics of chemical reactions are

(i) Evolution of gas: In many chemical reactions, one of the products is a gas.

$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2\uparrow$

(ii) Change of colour:

Certain chemical reactions are characterised by a change in the colour of the reactants.

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

(iii) Formation of precipitates:

Certain chemical reactions are characterised by the formation of insoluble solid substances called precipitates.

$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl\downarrow + NaNO_3(aq)$

(iv) Change of state:

In many chemical reactions, a change of state is observed. The reaction might start with gaseous or liquid reactants and end with solid products and *vice versa*.

$NH_{3(g)} + HCl_{(g)} \leftrightharpoons NH_4Cl$

Solution 2:

Exothermic reaction:

A chemical reaction in which heat is given out is called an exothermic reaction.

Example:

When carbon burns in oxygen to form carbon dioxide, a lot of heat is produced.

$C + O_2 \rightarrow CO_2 + Heat$

When hydrogen is burnt in oxygen, water is formed and heat is released.

$2H_2 + O_2 \xrightarrow{\Delta} 2H_2O + Heat$

Endothermic reaction:

A reaction in which heat is absorbed is called endothermic reaction.

Example:

When carbon is heated with sulphur at high temperature, liquid carbon disulphide is formed.

$C + 2S \xrightarrow{\Delta} CS_2$

When nitrogen and oxygen are heated together to a temperature of about 3000°C, nitric oxide gas is formed.

$N_2 + O_2 \xrightarrow[3000°C]{Heat} 2NO$

Solution 3:

Exothermic reactions are spontaneous and warm their surroundings with the release of heat energy.
Endothermic reactions absorb heat energy from their surroundings and cause their surroundings to cool down.

Solution 4:

(a) $C + O_2 \rightarrow CO_2 + \text{Heat}$

(b) $C + 2S \xrightarrow{\Delta} CS_2$

(c) $N_2 + 3H_2 \underset{}{\overset{\text{Above 200atm}}{\rightleftharpoons}} 2NH_3$

Solution 5:

(a) It is a reaction which occurs with absorption of light energy.

Example: Photosynthesis

$$6CO_2 + 6H_2O \longrightarrow C_6H_{12}O_6 + 6O_2$$

(b) It is a reaction which occurs with absorption of electrical energy.

Example:
Acidulated water breaks into hydrogen and oxygen.

$$2H_2O \xrightarrow{\text{Electricity}} 2H_2 + O_2$$

Solution 6:

(a)

(i) Change of state

Ammonia gas reacts with HCl gas to give solid ammonium chloride.

$NH_{3(g)} + HCl_{(g)} \leftrightharpoons NH_4Cl_{(s)}$

(ii) Formation of precipitate

When a solution of silver nitrate is added to a solution of sodium chloride, a white insoluble substance, silver chloride, is formed.

$AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(aq)} + NaNO_{3(aq)}$

(b)

Exothermic reaction:

When carbon burns in oxygen to form carbon dioxide, a lot of heat is produced.

$C + O_2 \rightarrow CO_2 + Heat$

Endothermic reaction:

When carbon is heated with sulphur at high temperature, liquid carbon disulphide is formed.

$C + 2S \xrightarrow{\Delta} CS_2$

(c) Colour change

A few pieces of iron are added into a blue coloured copper sulphate solution; the blue colour of copper sulphate fades and eventually turns into light green due to the formation of ferrous sulphate.

$Fe + CuSO_4 \rightarrow FeSO_4 + Cu$

Solution 7:

A chemical reaction is the process of breaking the chemical bonds of the reacting substances (reactants) and making new bonds to form new substances (products).
A chemical change or chemical reaction occurs when particles collide. Collisions occur when reactants are in close contact or by supply of energy.

Solution 8:

(a) $NaCl_{(aq)} + AgNO_{3(aq)} \rightarrow AgCl_{(aq)} + NaNO_{3(aq)}$

(b) $Pb(NO_3)_2 + 2KI \rightarrow 2KNO_3 + PbI_2$

(c) $CuCO_3 \xrightarrow{\Delta} CuO_{(s)} + CO_{2(g)}$

(d) $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

(e) $4NH_3 + 5O_2 \xrightarrow{Pt} 4NO + 6H_2O$

Solution 9:

- Lead nitrate decomposes on heating leaving a yellow residue lead monoxide, brown gas nitrogen dioxide and colourless gas oxygen.

- If chlorine water is exposed to sunlight, oxygen is evolved.
- Hydrogen peroxide breaks down to form water and oxygen gas along with heat energy.
- When hydrogen sulphide gas is passed through a blue solution of copper sulphate, a black precipitate of copper sulphide is obtained and the sulphuric acid so formed remains in the solution.
- A white insoluble precipitate of barium sulphate is formed.

Solution 10:

- Sodium carbonate
- Sodium nitrate
- Zinc carbonate
- Lead nitrate