Class-X
Lesson Notes
Subject - Chemistry
Ch-Chemical Reactions and Equations
Topic-Types of Chemical Reactions
(Displacement & Double displacement Reactions)

Module -3 **Dt_24/3/2020**

Suggested Video - **https://youtu.be/tvYntqtQxmM**
https://youtu.be/WWJQpuv9ElE

To be done in CW Copy

Displacement Reactions may be of two types- **Single Displacement Reaction**, **Double Displacement Reaction**

A. Single Displacement Reaction-

A **single-displacement** reaction, is a chemical reaction in which **one** (or more) element(s) **replaces another element**(s) in a compound. It can be represented generically as:

$$A + B\text{-}C \rightarrow A\text{-}C + B$$

This will most often occur if **A is more reactive than B**, thus giving a more stable product. A and B must be either:

a) Different **metals** (hydrogen's behaviour as a cation renders it as a metal here), in which case **C represents an anion**;

{The reactivity of Metals can be known from the Reactivity Series, where Metals are arranged in the decreasing order of their reactivities. (Hydrogen's behavior as a cation renders it as a metal here). -

K, Na, Ca, Mg, Al, Zn, Fe, Ni, Sn, Pb, [H], Cu, Hg, Ag, Au, and Pt.}

b) Halogens, in which case C represents a cation.

Both metals and non-metals take part in displacement reactions.

- **When Element C is a metal :**

Example :

1. **Reaction of iron nails with copper sulphate solution-**

$Fe + Cu(SO_4)_2 \rightarrow Fe(SO_4)_2 + Cu(s)$ **[Fe>Cu]**
Blue sol. Pale green sol.

Observations-

a. Blue colour of solution changes to pale green due to the formation of FeSO4.
b. Reddish brown Cu gets deposited on the iron nails.

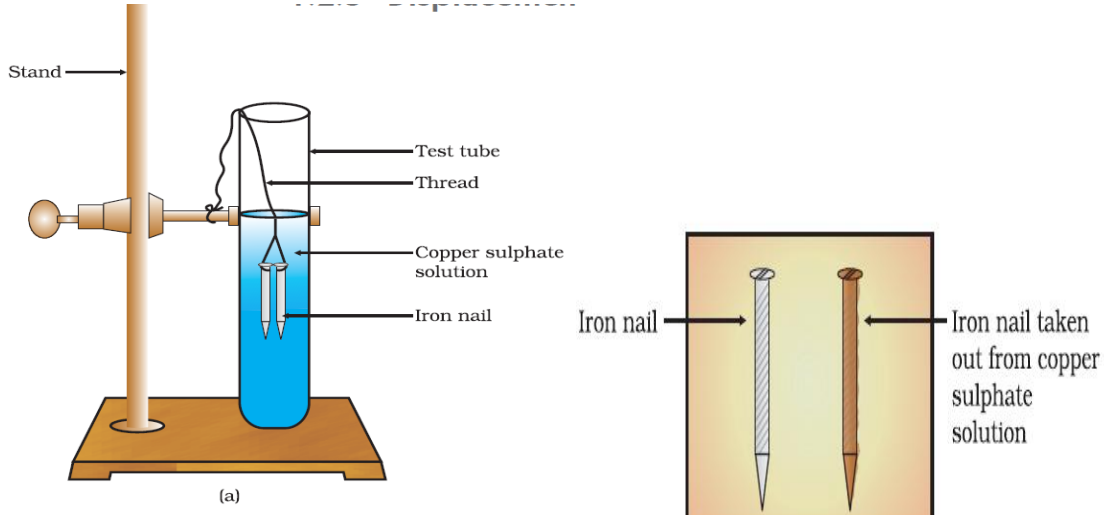


Figure 1.8
(a) Iron nails dipped in copper sulphate solution

2. Reaction of copper coin with silver nitrate solution-

$Cu + 2AgNO_3 \rightarrow 2Ag(s) + Cu(NO_3)_2$ [Cu>Ag]
colourless sol blue sol.

Observations-

a. Colour less solution turns blue due to the formation of $Cu(NO_3)_2$.
b. Silver gets deposited on the Cu coin.

3. Reaction of calcium with water solution-

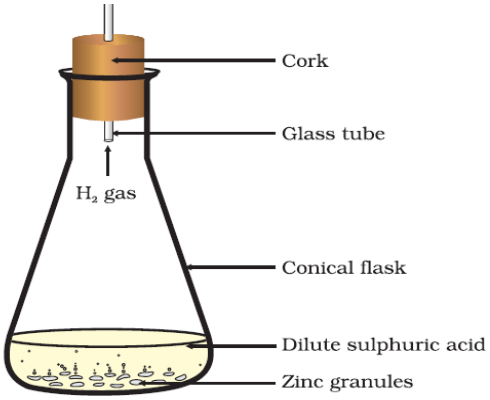
$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2(g)$ [Ca>H]

4. Reaction of zinc granules with hydrochloric acid solution-

$Zn + 2HCl \rightarrow ZnCl_2 + H_2(g)$ [Zn>H]

Observation for Ex. 3 & 4-

a. Fizzing occurs due to the liberation of Hydrogen, which burns with a pop sound when a lighted match stick is brought near the delivery tube.
b. The conical flask turns warm as it's an exothermic reaction.



If the reactant in elemental form is not a more reactive metal, then no reaction will occur.

Some examples of this would be the reverse reactions to these:

1. **$Ag + Cu(NO_3)_2 \rightarrow$ No reaction** **[Ag<Cu]**

2. **$Au + HCl \rightarrow$ No reaction** **[Au<H]**

➢ **<u>When Element C is a Halogen :</u>**

One **halogen/anion replaces another**. A Halogen/anion is a **negatively charged** ion or a non-metal.

Some of the few examples that involve halogens are shown here:

1. **$Cl_2 + 2NaBr \rightarrow 2NaCl + Br_2$** **[Cl>Br]**

2. **$Br_2 + 2KI \rightarrow 2KBr + I_2$** **[Br>I]**

Again, the less reactive halogen cannot replace the more reactive halogen:

$Br_2 + 2KCl \rightarrow$ No reaction. **[Br<Cl]**

B. <u>Double Displacement Reaction-</u>

Reaction in which **two compounds** in their **aqueous solution** react to form **two new products** by **interchanging their radicals or ions** is called a **double decomposition** reaction or **double displacement** reaction

A-B + C-D → A-D + C-B

The bond between the reacting species can be either <u>ionic</u> or <u>covalent</u>.

Classically, these reactions may be of two types- **Precipitation Reaction**, **Neutralization Reaction**

a) <u>Precipitation Reaction –</u>

Precipitation reaction is that in which **one of the products** of a Double Displacement reaction **is an insoluble solid** which **separates out as precipitate**.

AX(aq) + BY(aq) → AY(aq) + BX(s).

Examples-

1. Reaction of BaCl2 with Sodium Sulphate-

$BaCl_{2(aq)} + Na_2SO_{4(aq)} \rightarrow BaSO_4\downarrow_{(s)} + 2NaCl_{(aq)}$

white ppt

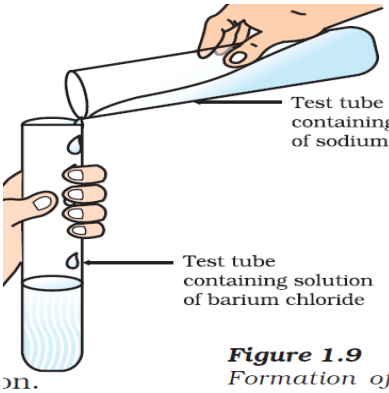


Figure 1.9
Formation of barium sulphate and sodium

2. Reaction of Lead Nitrate with Potassium Iodide-

$Pb(NO3)_2 + 2KI \rightarrow PbI_2\downarrow + 2KNO_3$
(Yellow ppt)

b) <u>Neutralization Reaction –</u>

Neutralisation reaction is that in which an **acid reacts with a base** to **form salt & water.**

$HX(aq) + BOH(aq) \rightarrow BX(aq) + H_2O(l)$.

Acid Base Salt Water

Examples-

1. $HCl + NaOH \rightarrow NaCl + H_2O$
2. $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2\,H_2O$

SOLUBILITY CHART

SOLUBLE-SALTS	INSOLUBLE –SALTS (in cold water)
1. All - Na^+, K^+, NH_4^+ SALTS	1.----------
2.ALL- NITRATES ,NITRITES	2.----------
3.ALL- BICARBONATES	3. $KHCO_3$, $NaHCO_3$-sparingly soluble
4. ALL- SULPHATES	4. $PbSO_4$, $AgSO_4$, $CaSO_4$, $BaSO_4$
5. ALL- CHLORIDES	5.$PbCl_2$, AgCl, HgCl,($PbCl_2$ soluble in hot water)
6.----------	6.ALL-SULPHITES
7.----------	7.ALL- SULPHIDES

8.----------	**8.ALL-CARBONATES**
9.----------	**9.ALL-OXIDES**
10.----------	**10.ALL-HYDROXIDES**
11.---------- **(All Na^+, K^+, NH_4^+- SULPHITES, SULPHIDES, CARBONATES, OXIDES, HYDROXIDES and POHOSPHATES ARE SOLUBLE.)**	**11.ALL-POHOSPHATES**

Assessment

MCQs

Q.1 What happens when copper rod is dipped in iron sulphate solution?
(a) Copper displaces iron
(b) Blue colour of copper sulphate solution is obtained
(c) No reaction takes place
(d)Reaction is exothermic

Q.2 Which of the following reaction is characterised by the yellow colour of product?
(a) $Zn\ (s) + H_2SO_4 \rightarrow ZnSO_4 + H_2$
(b) $Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + H_2O + CO_2$
(c) $Pb(NO_3)_2 \rightarrow 2PbO\ (s) + 4NO_2(g) + O_2(g)$
(d) $CaCO_3 \rightarrow CaO + CO_2$

Q.3 $Zn + H_2SO_4(dil) \rightarrow ZnSO_4 + H_2$
Above reaction is -
(a) decomposition reaction
(b) single displacement reaction
(c) combination reaction
(d) synthesis reaction

For Q.4&5 Assertion& Reason question follow the following directions.

DIRECTION:*Each of these questions contains an Assertion followed by Reason. Read them carefully and answer the question on the basis of following options. You have to select the one that best describes the two statements.*
(a) If both Assertion and Reason are correct and Reason is the correct explanation of Assertion.
(b) If both Assertion and Reason are correct, but Reason is not the correct explanation of Assertion.
(c) If Assertion is correct but Reason is incorrect.
(d) If Assertion is incorrect but Reason is correct.
(e) If Assertion & Reason both are incorrect.

Q.4 Assertion : $Fe2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

The above chemical equation is an example of displacement reaction.

Reason : Aluminium being more reactive than iron, displaces Fe from its oxide.

Q.5 Assertion The reaction in which two compounds exchange their ions to form two new compounds is a double displacement reaction.

Reason : One of the salt produced is insoluble in water.

Home assignment

1. A solution of a substance 'X' is used for white washing. (i) Name the substance 'X' and write its formula. (ii) Write the reaction of the substance 'X' named in (i) above with water.
2. Why is the amount of gas collected in one of the test tubes during electrolysis of water is double of the amount collected in the other? Name this gas.

3.Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

4. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.

5. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

6. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

7. What do you mean by a precipitation reaction? Explain by giving examples.

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

9. Write two observations each for the following chemical reactions :

(i) Dilute sulphuric acid is poured over zinc granules

(ii) Potassium iodide solution is added to lead nitrate solution

(iii) Lead nitrate is strongly heated in a hard glass test take