

General properties Transition Metals

- The transition metals lie between groups 2A and 3A of the periodic table.
- They are malleable and ductile
- They are good conductors of heat and electricity
- Transition metals are less reactive but melting and boiling points are higher than 1A and 2A group elements

I R O N

- Its density is 7.87 g/cm^3
- Melting point is $1538 \text{ }^\circ\text{C}$
- Boiling point is $2861 \text{ }^\circ\text{C}$
- Pure iron is a silvery white colored, lustrous, soft metal with important magnetic properties. It is malleable and ductile.

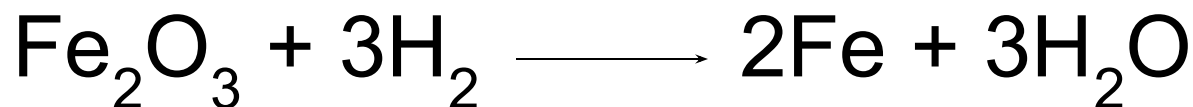
Occurrence of iron

- Iron is second most abundant metal (6%) in the earth's crust. But it is not found in elemental form in nature.
 - Iron is found in most clays, sandstones and granites.
 - Hematite Fe_2O_3 Pyrite FeS_2
 - Magnetite Fe_3O_4 Siderite FeCO_3
- are common ores of iron

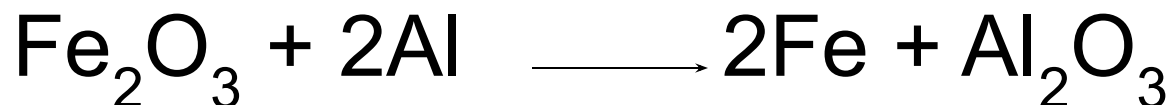
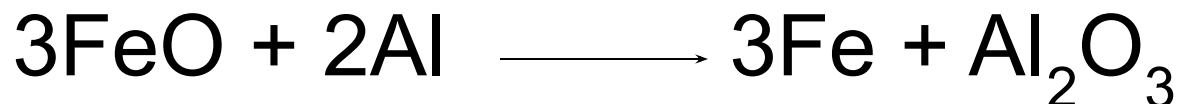
Preparation of Iron

In the laboratory

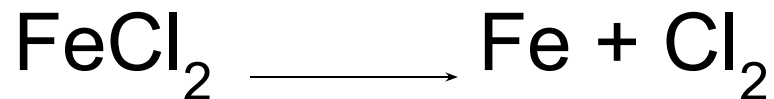
1. H_2 gas is added to iron oxide



2. Iron oxides are reduced by more active metals



3. By the electrolysis of solutions of iron salts

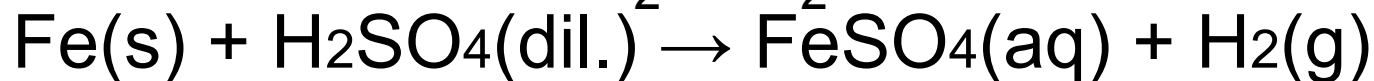
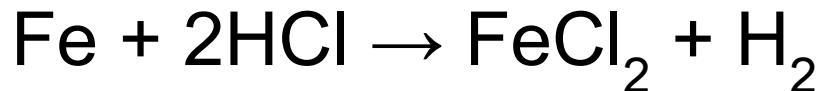


Chemical Properties of Iron

- Iron has $_{26}\text{Fe}$: $[_{18}\text{Ar}]4s^23d^6$ electron configuration
- In compounds, iron takes +2 and +3 Oxidation states (charges)

Reactions of Iron

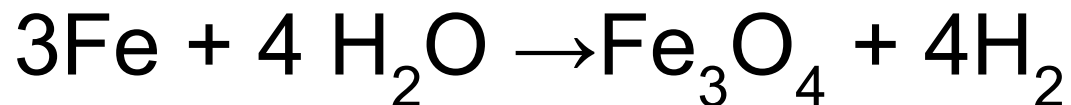
1) Iron reacts with dilute solutions of strong acids.



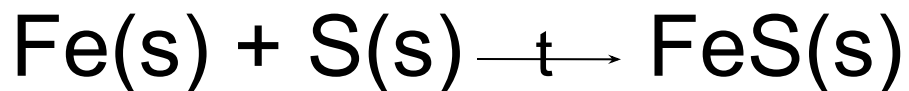
- The reactions of iron with oxidizing acids form its salts, containing Fe^{3+} ions



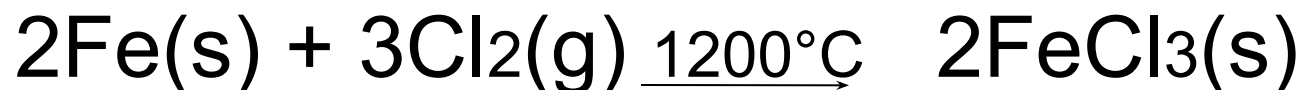
2) Iron produces mixed oxides by water



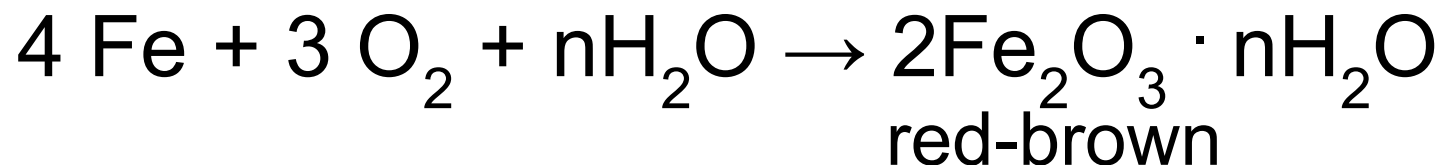
3) When iron is heated with sulfur iron sulfide, FeS forms



4) At high temperature, it reacts with halogens.



- Moisture and oxygen cause the formation of crystal hydrate of iron (III) oxide (corrosion)



- **Uses**

Iron is useful in our society today because iron is virtually used in everything :
building (bridge , highway , rail road ,etc.),
transportation (car , train , boats ,plane,
etc.) , tools (knife , machines , etc.)

IMPORTANT COMPOUNDS OF IRON

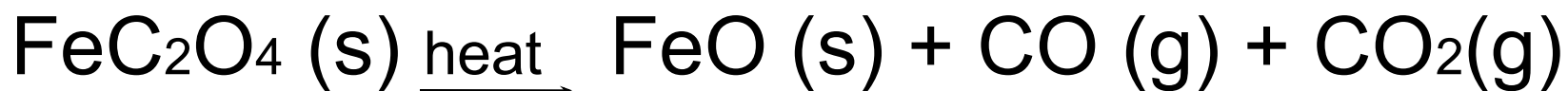
- Iron has +2 and +3 oxidation states in its compounds. Fe^{2+} ion is called ferrous and compounds that contain Fe^{2+} ion are called ferrous compounds,
- Fe^{3+} ion is called ferric and Fe^{3+} compounds are called ferric compounds

Iron (II) compounds (Ferro Compounds)

- **1. Iron (II) chloride, FeCl₂**
- It is obtained by passing hydrogen chloride gas over heated iron. FeCl₂ is a white colored crystal.
- $\text{Fe (s)} + 2\text{HCl (g)} \rightarrow \text{FeCl}_2 \text{ (s)} + \text{H}_2 \text{ (g)}$

- **2. Iron (II) oxide, FeO**

- This compound is produced by decomposition of iron (II) oxalate.

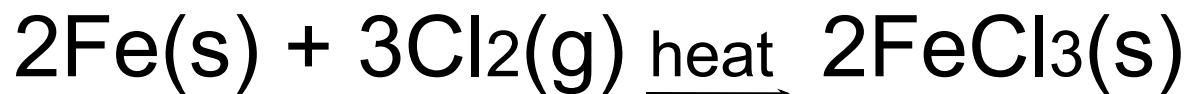


- FeO is also unstable in air.



Iron (III) Compounds (Ferric Compounds)

- **1. Iron(III) chloride, FeCl₃**
- When iron is reacted with chlorine gas, it produces iron(III) chloride.



- **2. Iron (III) hydroxide, $\text{Fe}(\text{OH})_3$**
- It is obtained by the reaction of Fe^{3+} with a base or carbonates. It is similar to gelatin. $\text{Fe}(\text{OH})_3$ is a reddish-brown colored precipitate which shows amphoteric property.
- $\text{Fe}^{3+}(\text{aq}) + 3\text{KOH}(\text{aq}) \rightarrow \text{Fe}(\text{OH})_3(\text{s}) + 3\text{K}^+(\text{aq})$

3. Iron (III) oxide, Fe₂O₃

In nature Fe₂O₃ is found in hematite and limonite minerals.

It can be obtained by several methods.

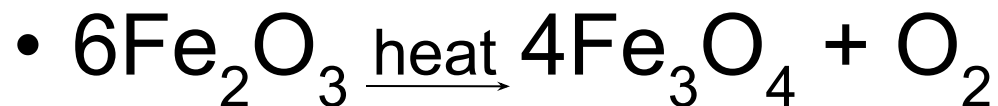
- $2\text{FeCl}_3 + 3\text{H}_2\text{O} \xrightarrow{\text{heat}} \text{Fe}_2\text{O}_3 + 6\text{HCl}$
- $4\text{FeO} + \text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3$
- $2\text{Fe}(\text{OH})_3 \rightarrow \text{Fe}_2\text{O}_3 + 3\text{H}_2\text{O}$
- $4\text{Fe}(\text{OH})_2 + \text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 4\text{H}_2\text{O}$

The most common preparation method of Fe₂O₃ is the burning of pyrite, FeS₂ mineral.

- $4\text{FeS}_2 + 11\text{O}_2 \rightarrow 2\text{Fe}_2\text{O}_3 + 8\text{SO}_2$

- **Iron(II, III) oxide, Fe₃O₄**

- Fe₃O₄, mixed oxide, is obtained by passing heated steam over iron metal or heating Fe₂O₃



- Fe₃O₄ is found in nature as black colored magnetite.

Compounds of Iron

- Ferro Compounds; Iron(II) compounds
 1. Iron (II) chloride, FeCl_2
 2. Iron (II) sulfate ; $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
 3. Iron (II) oxide; FeO
- Ferric Compounds; Iron (III) compounds
 1. Iron (III) chloride; FeCl_3
 2. Iron (III) oxide; Fe_2O_3
 3. Iron (III) hydroxide $\text{Fe}(\text{OH})_3$
- Iron (II, III) oxide, Fe_3O_4