



Dr. Bbosa Science

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Based on, best for sciences

Iron and its compound

Electron configuration of Iron

$[\text{Ar}]3d^64s^2$

Properties of iron as a transition element

- a) Forms colored compounds; for instance Fe^{2+} is green
- b) Has variable oxidation states; +2, +3,
- c) Forms complexes, e.g. $\text{Fe}(\text{CN})_6^{3-}$.
- d) Has catalytic properties, e.g., iron catalyze formation of ammonia from nitrogen and hydrogen.

Extraction of iron

Iron, which is the second most abundant metal occurring in the earth's crust, is extracted from its ores which are;

haematite,	Fe_2O_3
magnetite,	Fe_3O_4 ,
siderite,	FeCO_3 .

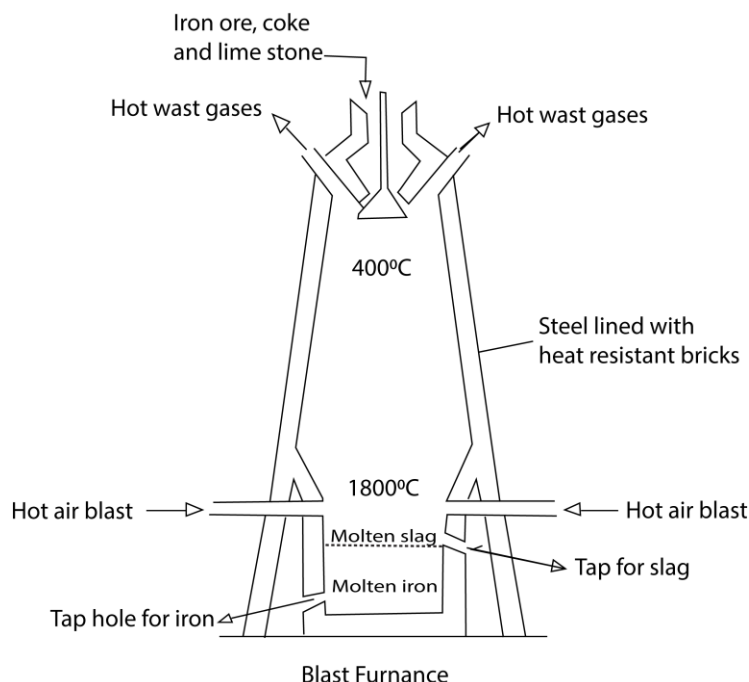
Extraction of iron from hematite

Main Impurities

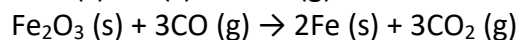
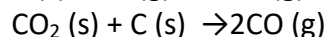
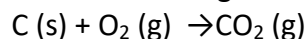
Silica, SiO_2

Procedure

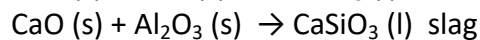
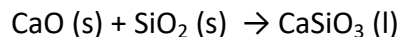
Iron ore, lime stone and coke in the correct proportions are reacted with Preheated air in a blast furnace.



Reactions leading to reduction of iron oxide are



Reactions leading to removal of impurities



Molten iron and slag percolate to the bottom of the furnace and tapped of through different taps.

Trial 1

In the production of iron metal, haematite, Fe_2O_3 , is mixed with coke and lime stone and heated in a blast furnace.

(a) What is the purpose of adding

(i) lime stone (1 mark)

(i) coke? (1 mark)

(b) Write three different equations for the reaction in which haematite are converted into iron in the blast furnace. (3marks)

(c) Explain why it is possible to extract iron by the method described above. (2 marks)

(i) Name one other method that can be used to extract iron from its ore. (1 marks)

(ii) Suggest a reason why the method you have named in d(i) is not used commonly in the production of iron.

Oxidation states of Iron

Iron has oxidation states +2 and +3

Oxidation state Fe^{3+} ($[\text{Ar}]3d^5$) is more stable than Fe^{2+} ($[\text{Ar}]4s^13d^5$) because Fe^{3+} has stable half full electron configuration.

Trial 19

This explains why green iron II compounds rapidly turn into brown iron III compounds.

Properties of iron

Pure iron is a silvery colored metal with a melting point of 1535°C and boiling point 3000°C .

It is a soft, ductile and malleable metal, which is strongly ferromagnetic.

Rusting of iron

Iron in presence water and air form a brown coat called rust or hydrated iron (III) oxide, $\text{Fe}_2\text{O}_3 \cdot x\text{H}_2\text{O}$,

Disadvantage of rusting

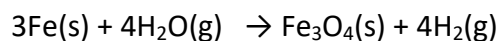
- (i) Weaken tools
- (ii) Makes objects look ugly

Methods of preventing rusting

- (a) Keeping objects in dry places.
- (b) Painting
- (c) Oiling
- (d) Greasing
- (e) Coating with another metal.
- (f) Zinc plating

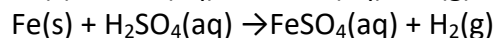
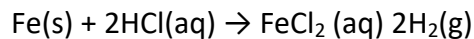
Reaction of iron with water

Iron does not react with cold water but with steam to form blue-black tri-iron trioxide oxide

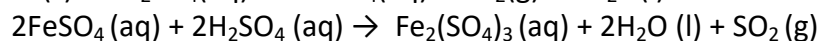


Reaction of iron with acids

Iron displaces hydrogen readily from dilute hydrochloric acid and sulphuric acids, forming iron (II) salts. Dilute nitric acid forms iron (II) nitrate and oxides of nitrogen.



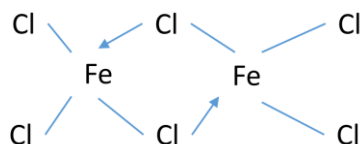
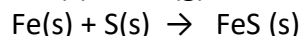
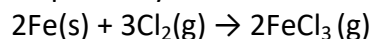
Concentrated H_2SO_4 gives a mixture of ferrous and ferric sulphates.



Action of alkalis, halogen and sulphur on iron

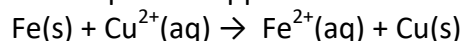
Iron does not react with alkalis.

Halogens and sulphur combine with the heated metal forming halides and sulphide respectively.



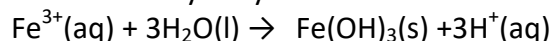
Displacement of less electropositive metals

Iron displaces copper from a solution of copper sulphate.



Hydrolysis of Iron III salts in water

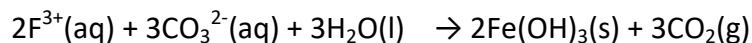
Iron III salts hydrolyze in water to form acidic solution



Consequently, Iron III solution

- turns blue litmus paper red.
- Liberate carbon dioxide from carbonates with formation of brown precipitate
- Has pH less than 7

Reaction iron III solution with sodium carbonate solution



Observation

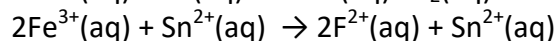
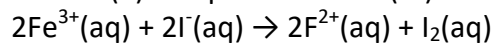
A brown ppt. formed with effervescence

Trial 21

State what would be observed and write an equation for the reaction that takes place when aqueous iron (III) chloride with sodium carbonate (3½ marks)

Reactions of iron (III) as an oxidizing agent

Iron (III) compounds are strong oxidizing agents, for instance, it oxidizes iodide ions (I^-) to iodine and tin (II) compounds to tin (IV) compounds and itself reduced to Fe^{2+} compounds.



Trial 22

A solution of Iron (III) chloride was added to an aqueous solution of tin (II) chloride acidified with hydrochloric acid and the mixture shaken.

(a) State what was observed. (1 mark)

(b) Write an equation for the reaction that took place.

Qualitative analysis of Fe^{2+} salt

Common iron II salts include

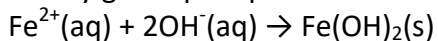
- Ferrous sulphate: $\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$
- Ammonium ferrous sulphate $(\text{NH}_4)_2\text{Fe}(\text{SO}_4)_2 \cdot 6\text{H}_2\text{O}$
- Ferrous oxalate. FeC_2O_4

Qualitative analysis of Fe^{2+} salt

- (i) Addition of dilute sodium hydroxide or ammonia solution

Observation

A dirty green precipitate insoluble in excess turn brown on standing.



- (ii) Confirming presence of Iron III ions

Forms a deep blue solution with potassium hexacyanoferrate II.

Forms a red solution with ammonium thiocyanate solution.