***Periodic Table Blocks***

|  |
| --- |
| The long form of [periodic table](http://chemistry.tutorcircle.com/inorganic-chemistry/periodic-table.html) is based upon modern periodic law. Elements are arranged in the increasing order of their atomic numbers in such a way so that elements with similar properties fall under same vertical column.  The importance of the outermost shell, the different regions of the periodic table are sometimes referred to as periodic table blocks, named according to the sub shell in which the "last" electron resides. **The elements are classified into four blocks depending on the type of atomic orbitals which are being filled with electrons.** |

***Periodic Table Building Blocks***  
The periodic table is divided into four blocks - s, p, d and f block. s-block consists of elements of groups 1 and 2 while p-block consists of elements of groups 13 to 18. The [d-block elements](http://chemistry.tutorcircle.com/inorganic-chemistry/d-block-elements.html) lie between the s and p block elements. d-block consists of elements of groups 3 to 12. The two rows of elements placed at the bottom of the periodic table constitute the f-block. All the elements belonging to d and f-block are metals.

The s-block comprises the first two groups as well as hydrogen and helium.

The p-block comprises the last six groups and contains among others all of the semi metals.

The d-block comprises groups 3 through 12 and contains all of the [transition metals](http://chemistry.tutorcircle.com/inorganic-chemistry/transition-metals.html).

The f-block usually offset below the rest of the periodic table comprises the rare earth metals.

***Periodic Table s p d f Blocks***

**s block periodic table**

s-orbital can accommodate a maximum of two electrons.

Their general formula are ns1 and ns2 respectively.

The total number of s block elements are 13.

The elements of the periodic table in which last electron enters in s-orbital are called s-block elements.

**p block elements**

A p-orbital can accommodate a maximum of six electrons.

The general formula of p block elements are ns2p1-6

The total number of p block elements in the periodic table is 30.

There are nine gaseous elements belonging to p-block. Gallium and bromine are liquids.

**d-block elements**

The elements of the periodic table in which the last electron gets filled up in the d orbital called d block elements.

The general formula of these elements is (n-1)s2, p6, d1-10ns1-2 where n=4 to 7.

All of these elements are metals.

Out of all d block elements mercury is the only liquid element.

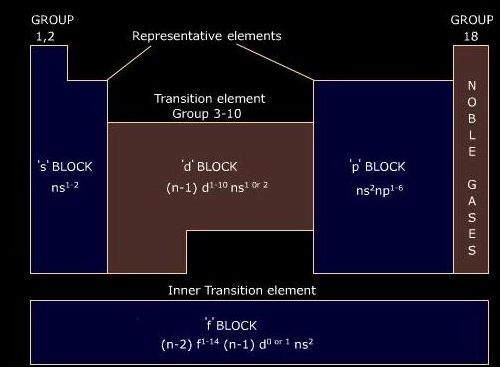
**f-block element**

The element of the periodic table in the last electron gets filled up in the f-orbital, called f-block elements.

The f-block elements are from atomic number 58 to 71and from 90 to 103.

There are 28 f block elements in the periodic table.

The elements from atomic number 58 to 71 are called lanthanides because they come after lanthanum (57). The elements from 90 to 103 are called actinides because they come after actinium (89).



***Blocks of the Periodic Table***

Elements are grouped into four blocks s-block, p-block, d-block and f-block depends upon the type of atomic orbital that is being filled with electrons.

[**s-block elements**](http://chemistry.tutorcircle.com/inorganic-chemistry/s-block-elements.html)

The elements of Group 1 and Group 2 belongs to s-block elements. Group 1 elements are known as "Alkali metals" and group 2 elements are known as "Alkaline metals".

**d-block elements**

Elements of group 3 to 12 in the center of the periodic table belongs to d-block. These elements are called transition elements. The 10 groups of elements after s-block are covered by d-block elements.

[**p-block elements**](http://chemistry.tutorcircle.com/inorganic-chemistry/p-block-elements.html)

Remaining groups belong to p-block. The first group 1 and group 2 are s-block and the next 10 groups are called d-block. So we can calculate the remaining groups from 13 to 18 belongs to p-block elements.

**f-block elements**

The two rows at the bottom of the periodic table comes under f-block elements. These elements are named as actinides and lanthanides.

***Periodic Table with Orbital Blocks***

An important feature of the long form of the periodic table is that it can be divided into four general sections known as s, p, d and f-blocks. The division is based upon the type of atomic orbital which receives the last electron in an atom. The elements belonging to the different blocks are known as s, p, d and [f block elements](http://chemistry.tutorcircle.com/inorganic-chemistry/f-block-elements.html) respectively.

s-block elements in which the last electron enters the s orbital of the outermost energy level. They have the configuration ns1 and ns2 where n represents the last energy level.

p-block elements having the outermost energy level configuration ns2, np1-6. The p-block consists of six groups of elements.

The ten groups of d-block elements have the configuration (n-1)d1-10ns2 or (n-1)d1-10ns1. These elements lie between s and p-block elements.

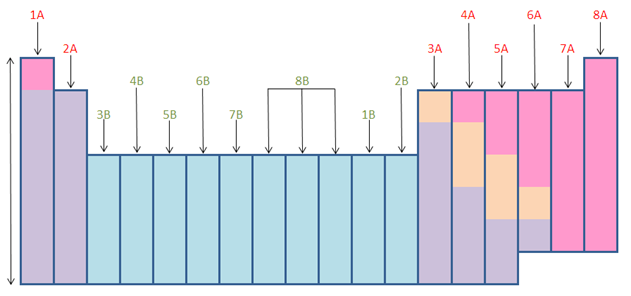
f-block elements have the general configuration of (n-2)f1-14ns2 or (n-2)f1-14 (n-1)d1ns2. There are two rows of these elements placed separately outside the main table; the first series (4f) of elements is known as lanthanides and the second series (5f) of elements is known as actinides.

***Modern Periodic Law***

Mendeleev periodic table misfits because of the problem of isotopes. Mendeleev's periodic table disappeared when the basis of classification of elements was change to atomic number instead of atomic masses. In 1912 it was Mosley showed that the position of an element in the periodic table depends on its atomic number and not on the atomic mass.   
  
According to Mosley the properties of the elements are better co-related with their atomic numbers and on this basis a new periodic law was given called Modern periodic law. It state that **"the properties of the elements are periodic functions of their atomic numbers".**   
  
The elements are arranged according to this Modern periodic law and a new table is formed which is named as Modern periodic table or long form of periodic table.

***Periods and Groups***

Elements in the modern periodic table are arranged sequentially by atomic number in rows and columns. Moseley s work established the concept of atomic number the number of protons in the nucleus as the key for determining an elements position in the periodic table. Rows in the periodic table are referred to as periods and columns are called groups.  
  
The periods run left to right, and the groups from top to bottom. A group may also comprise a chemical family. The first and second groups are the alkali metals and alkaline earth metals respectively. The group starts with fluorine is called halogen family. The last group on the extreme right are called noble gases family.



[Periodic Table of Elements](http://chemistry.tutorcircle.com/inorganic-chemistry/periodic-table-of-elements.html)

[Periodic Table Groups](http://chemistry.tutorcircle.com/inorganic-chemistry/periodic-table-groups.html)

**Metals Nonmetals Metalloids**

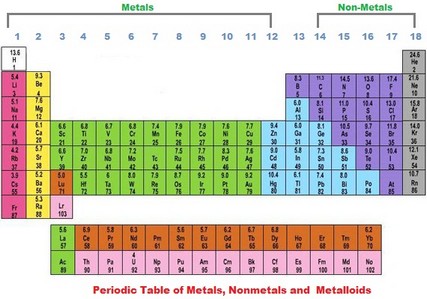
Metals are elements that conduct heat and electricity. They are malleable and ductile. Metals are also lustrous, hard, strong, heavy and sonorous. Some of the metals are Iron, Aluminum, Copper, Silver, Gold, Platinum, Zinc, Tin, Lead, Mercury, Sodium, Potassium and Magnesium.All the metals are solids, except mercury which is a liquid at room temperature. During chemical reactions, metals can form positive ions by losing electrons. Based on this observation, we can write another definition of metals.**"Metals are the elements which form positive ions by losing electrons."**

They are also known as **electropositive elements.** The most abundant metal in the earth’s crust is aluminium. The second most abundant metal in the earth's crust is iron. Metals are present on the left side of the periodic table. They have a number of uses in our daily life. The cooking utensils, electric wires, sewing machines, cars, trains, ships and aeroplanes are all made up of metals or a mixture of metals called alloys.

**Characteristics of Metals Nonmetals and Metalloids**

An element is a pure chemical substance consisting of the same type of atom. The periodic table is the latest arrangement of all the discovered elements on the basis of their atomic number. As of November 2011, 118 elements have been identified and placed in the periodic table. Out of these 118 elements, 98 are present naturally on earth in the form of their different compounds. Out of these elements, 80 elements are stable and 18 are unstable & radioactive in nature.

**Periodic Table Metals Nonmetals Metalloids**

  
  
All elements show specific chemical and physical properties. Briefly all elements can be classified as metals, non-metals and metalloids. In a periodic table, metals are arranged on the left side and non-metal on the right side, while metalloids are present as a connecting line between metals and non-metals. Boron, silicon, germanium, arsenic, antimony and tellurium are included among the metalloid category. Metalloids are also known as semi metals. Out of all the known elements, more than 75% elements are metallic in nature.

|  |  |  |  |
| --- | --- | --- | --- |
| **S.No** | **Metal** | **Metalloid** | **Non-metal** |
| 1 | Have lustrous surface | Some have luster | Dull appearance |
| 2 | Have high melting point | Intermediate value | Low melting point |
| 3 | High density | Intermediate value | Low density |
| 4 | Solid at room temperature | Generally solid | Solid , liquid and gas form |
| 5 | Good conductor of heat and electricity | Become conductor at certain temperature | Insulator |
| 6 | Can be drawn in sheet (malleable) | Non malleable | Non malleable |
| 7 | Can be drawn in wired(Ductile) | Brittle in nature | Brittle in nature |
| 8 | Opaque in nature | Vary from element to element | transparent (can see through non-metal) |
| 9 | Sonorous | Non- sonorous | Non- sonorous |

## Is Silicon a Metal-Nonmetal or Metalloid



Silicon is a gray color solid at room temperature with a very high melting point and boiling point and metallic luster. Under normal conditions, its a good conductor of heat, and hence cannot be used to insulate hot objects. All these features make it closer to metals.   
Since the valence shell electronic configuration of silicon is 3s2, 3p2, hence it can readily accept or lose four electrons to get a noble gas configuration. This character gives a non-metallic nature to silicon. Silicon makes a cubic crystal structure after crystallization just like diamonds. Hence silicon is a metalloid with intermediate features.

**Is Calcium a Metal-Nonmetal or Metalloid**

Calcium is a dull gray solid element with a silver appearance, which exists in the solid state. It has a high melting point (1115 K) and boiling point (1757 K). All these features make it related to metals. The valence electron configuration of calcium is 4s2, hence it has a tendency to loose two electrons to get a **Noble gas** configuration.   
Since it can lose electrons, it can be used in **ionic bonding** and can form ionic compounds. Like other metals, calcium also reacts vigorously with dilute acids like hydrochloric acid and produce large amounts of heat, forms calcium chloride (CaCl2) and hydrogen gas. All these properties of calcium prove that calcium is a metal.

**Is Sodium a Metal-Nonmetal or Metalloid**

Sodium is a silvery white solid element with silvery luster. Sodium is a soft element that can be easily cut with a knife.

Its a very good conductor of electricity and heat. It shows very low electronegativity (0.93 (Pauling scale)) and low first ionization energy (495.8 kJ-mol-1). But the second ionization energy is very high (4562 kJ·mol-1), which proves that its easy for sodium to lose one electron and form a sodium ion. But removal of a second electron requires a high amount of energy, as the second ionization energy for sodium is 4562 kJ·mol-1.   
Sodium metal reacts with water to produce sodium hydroxide (NaOH) and hydrogen gas. By adding Phenolphthalein to the same solution, it turns purple in color. It proves that sodium hydroxide is a strong alkali.

**2Na + 2H2O 2NaOH + H2**

All features like low ionization energy, low electronegativity, solid state & conductivity prove that sodium is a metal.

## Is Gold a Metal-Nonmetal or Metalloid

We are familiar with gold jewellery and utensils. Gold is an element with the atomic number 79. It's a d-block element in the periodic table.



Gold is a dense but soft, shiny element. The properties like malleability and ductility include it in the metal class. It shows high melting point (1337.33 K) and boiling point (3129K).

The electronic configuration of gold is [Xe] 4f14 5d10 6s1 , hence its a part of the d-block elements and shows variable oxidation states, like -1, 1, 2, 3, 4, 5.

Instead of making a basic oxide like metals, oxides of gold are amphoteric in nature. It's a native & very less reactive metal. Hence it does not react with dilute acids under normal condition.

But it reacts with aqua regia. Aqua regia is formed by mixing nitric acid and sulfuric acid in 3:1 ratio. It's an extremely corrosive acid that is able to react with metals such as gold and platinum, and produce nitrate salt of metal with brown color NO2 gas.

**Au(s) + 6HNO3(aq) Au(NO3)3 (aq )+ 3NO2(g )+ 3H2O (l )**

**Properties of Metal-Nonmetals And Metalloids**

**(a) Properties of metals**

Almost all metals which have low ionization energies and low electro negativities are electropositive in nature and have a tendency to lose electrons. Hence they are a good reducing agent.   
All metals show different reactivity towards various regents. Like alkali metals, alkaline earth metals are highly reactive and react vigorously with water and dilute acids. But transition elements are less reactive compared to alkali metals.   
**Some general properties of metals are:**

**1. Metals react with air to form oxides:**

**2M + O2  2 MO**

The reactivity varies from metal to metal. Some metals, like beryllium and magnesium, react vigorously with air and form oxides. Magnesium burns with a typical intense white flame, while calcium is quite reluctant to start burning, but then bursts dramatically into flame, burning with a white flame.

**2Mg + O2 2MgO**

**Ca + O2**  **CaO**

Some metals like copper and silver do not react vigorously, but take time.

**Cu + O2**  **CuO(Black)**

**Ag + O2  Ag2O (Grey)**

Once the oxide layer coats the metal surface, it will prevent further attack of oxygen. That is the reason, some metals like aluminum are reluctant to reaction with air.

**2. Metals react with water to form hydroxides and hydrogen gas**

Alkali metals reacts vigorously with water to produce hydrogen gas and an alkaline solution.

**2Na(s) + 2H2O(l)**  **2NaOH(aq) + H2(g)**

**2Li(s) + 2H2O(l)  2LiOH(aq) + H2(g)**

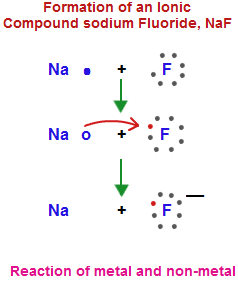
Alkaline earth metals are less reactive than alkali metals. For example, calcium reacts quickly with water to form calcium hydroxide and the bubbles you see in the beaker are because of hydrogen gas. The solution turns milky white in color because of the precipitation of calcium hydroxide.

**Ca + 2H2O**  **Ca (OH) 2 + H2**

As we move down the reactivity series of metals, their reactivity towards water decreases. Like aluminium does not react with cold water but forms aluminium oxide and hydrogen gas with steam. Less reactive metals like iron, zinc show no reaction with cold water but form oxides with steam and form oxides and hydrogen gas but reaction will be much less vigorous.

**3. Metals react with non-metals to form ionic compounds**

Since metals are electropositive in nature hence they can easily loos electron and form a metal cation. On the contrary, non-metals are electronegative and form anions. The cation and anion combine together by electrostatic force of attraction known as ionic bond and such compounds are termed as ionic compounds. For example, sodium metal reacts with fluorine to form sodium fluoride.



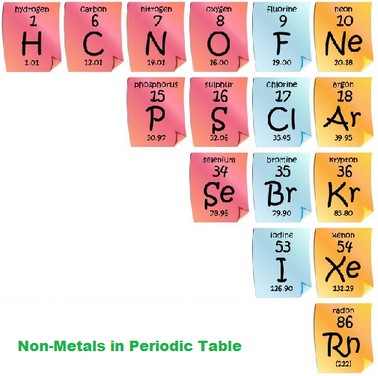
**4. Metals react with acid to form salt and hydrogen gas**

Reaction of metal with acid depends on their reactivity. Highly reactive metals can react with dilute acids and release hydrogen gas while less reactive metals react with strong acid under drastic conditions only. For example, magnesium strip reacts readily in dilute sulfuric acid and forms magnesium sulphate and hydrogen gas.

**Mg(s) + H2SO4 (l)**  **MgSO4(s) + H2 (g)**

**(b) Properties of non-metals**

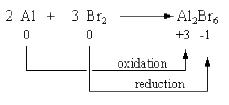
There are only 17 non-metals (excluded H) arranged at right in the periodic table. They are electronegative elements with high electronegativity and ionization energy. They have a tendency to accept electrons and form anions.



Non-metals react with oxygen to form non-metallic oxides, which are acidic in nature. Hence non-metallic oxides form an acidic solution when dissolved in water and turn litmus solution red. **For example**, carbon is oxidized to form carbon dioxide, which is acidic in nature.

**C(s) + O2 (g) CO2 (g)**

Non-metals are good oxidizing agents and are oxidized in almost all of their reactions. Like aluminum is oxidized with bromine to form aluminum bromide.



Non-metals have a tendency to oxidize metals.

**2 Mg(s)+O2(g)**  **2 MgO(s)**

They can easily oxidize those compounds with which they react.

**2H2S (g) +3O2 (g)**  **2SO2 (g) + 2 H2O (g)**

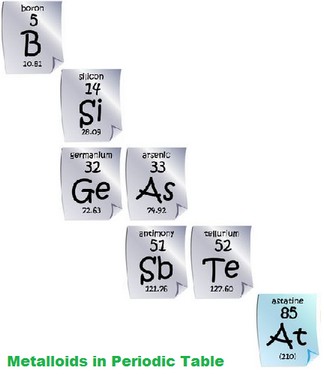
Less electronegative non-metals like carbon & hydrogen can act as a reducing agent for some compounds like ferric oxide, copper (II) oxide.

**Fe2O3(s)+3 C(s) 2 Fe(s)+3 CO(g)**

**CuO(s)+H2(g) Cu(s)+H2O(g)**

Generally, no reaction takes place between non-metals and acids. But non-metals react with bases to form salts. For example, chlorine reacts with calcium hydroxide to form bleaching powder.

**(c) Properties of metalloids**



Metalloids tend to show an intermediate property between metals and non-metals. Some metalloids like arsenic and antimony are crystalline solids.

However, the chemical properties of metalloids are either as metals or non-metals. They form amphoteric oxides as metals form basic oxides but non-metals are generally acidic oxides.

The most important feature of metalloids is their semi conductivity. Some metalloids like boron, silicon and germanium behave as semiconductors.

The chemical reactivity of metalloids depends on the substance they react with. For example, when boron reacts with fluorine, it acts as a metal. While in reaction with sodium, it acts as a non-metal.

Metalloids are usually brittle in nature and behave as electrical insulators at room temperature but act as a conductor at a certain temperature. They are used as do-pants in glasses in semiconductor chips.

*أسفل النموذج*

# *Hydride*

**Hydride** is the name given to the [negative](http://www.wikidoc.org/index.php/Electric_charge) [ion](http://www.wikidoc.org/index.php/Ion) of [hydrogen](http://www.wikidoc.org/index.php/Hydrogen), H−. Although this ion does not exist except in extraordinary conditions, the term hydride is widely applied to describe [compounds](http://www.wikidoc.org/index.php/Chemical_compound) of hydrogen with other [elements](http://www.wikidoc.org/index.php/Chemical_element), particularly those of [groups](http://www.wikidoc.org/index.php/Periodic_table_group) 1–16. The variety of compounds formed by hydrogen is vast, arguably greater than that of any other element. Every element of the [periodic table](http://www.wikidoc.org/index.php/Periodic_table) (except some [noble gases](http://www.wikidoc.org/index.php/Noble_gas)) forms one or more hydrides. These may be classified into three main types by the predominant nature of their [bonding](http://www.wikidoc.org/index.php/Chemical_bond):

*Saline hydrides*, which have significant ionic character,

*Covalent hydrides*, which include the hydrocarbons and many other compounds.

*Interstitial hydrides*, which may be described as having [metallic bonding](http://www.wikidoc.org/index.php/Metallic_bonding).

## Hydride ion

*See also:* [hydrogen anion](http://www.wikidoc.org/index.php?title=Hydrogen_anion&action=edit&redlink=1).

Aside from [electride](http://www.wikidoc.org/index.php?title=Electride&action=edit&redlink=1), the hydride ion is the simplest possible [anion](http://www.wikidoc.org/index.php/Anion), consisting of two [electrons](http://www.wikidoc.org/index.php/Electron) and a [proton](http://www.wikidoc.org/index.php/Proton). Hydrogen has a relatively low [electron affinity](http://www.wikidoc.org/index.php/Electron_affinity), 72.77 kJ/mol, thus hydride is so basic that it is unknown in solution. The reactivity of the hypothetic hydride ion is dominated by its exothermic protonation to give [dihydrogen](http://www.wikidoc.org/index.php?title=Dihydrogen&action=edit&redlink=1):

H− + H+ → H2; [Δ*H*](http://www.wikidoc.org/index.php/Enthalpy) = −1676 kJ/mol

As a result, the hydride ion is one of the strongest [bases](http://www.wikidoc.org/index.php/Base_(chemistry)) known. It would extract protons from almost any hydrogen-containing species. The low electron affinity of hydrogen and the strength of the H–H bond (436 kJ/mol) means that the hydride ion would also be a strong [reducing agent](http://www.wikidoc.org/index.php/Reducing_agent):

H2 + 2e− ⇌ 2H−; [*E*~~o~~](http://www.wikidoc.org/index.php/Standard_electrode_potential) = −2.25 V

**Covalent Hydrides**

The first major group is covalent hydrides, which is when a hydrogen atom and one or more non-metals form compounds. This occurs when hydrogen covalently bonds to a more electropositive element by sharing electron pairs. These hydrides can be volatile or non-volatile. Volatile simply means being readily able to be vaporized at low temperatures. One such example of a covalent hydride is when hydrogen bonds with chlorine and forms hydrochloric acid (HCl). Examples are listed below:

H2(g) + Cl2 (g) → 2HCl(g)

3H2(g) + N2(g) → 2NH3(g)

The hydrides of nonmetals on the periodic table become more electronegative as you move from group 13 to 17. This means that they are less capable of donating an electron, and want to keep them because their electron orbital becomes fuller. Instead of donating a H-, they would instead donate a H+ because they are more acidic.

## Ionic hydrides

The second category of hydrides are ionic hydrides, In ionic hydrides the hydrogen behaves as a [halogen](http://www.wikidoc.org/index.php/Halogen) and obtains an [electron](http://www.wikidoc.org/index.php/Electron) from the [metal](http://www.wikidoc.org/index.php/Metal) to form a hydride ion (H−), thereby attaining the stable [electron configuration](http://www.wikidoc.org/index.php/Electron_configuration) of [helium](http://www.wikidoc.org/index.php/Helium) by filling its 1s-orbital. The other element is a metal more electropositive than hydrogen, usually one of the [alkali metals](http://www.wikidoc.org/index.php/Alkali_metals) or [alkaline earth metals](http://www.wikidoc.org/index.php/Alkaline_earth_metals). The hydrides are called binary if they only involve two elements including hydrogen. [Chemical formulae](http://www.wikidoc.org/index.php/Chemical_formula) for binary ionic hydrides typically MH (as in [Li](http://www.wikidoc.org/index.php/Lithium)H). As the charge on the metal increases, the M-H bonding becomes more covalent as in [Mg](http://www.wikidoc.org/index.php/Magnesium)H2 and [Al](http://www.wikidoc.org/index.php/Aluminium)H3. Ionic hydrides are commonly encountered as basic [reagents](http://www.wikidoc.org/index.php/Reagent) in [organic synthesis](http://www.wikidoc.org/index.php/Organic_synthesis):

[C6H5C(O)CH3](http://www.wikidoc.org/index.php/Acetophenone) + [KH](http://www.wikidoc.org/index.php?title=Potassium_hydride&action=edit&redlink=1) → C6H5C(O)CH2K + H2

Such reactions are heterogeneous, the KH does not dissolve. Typical solvents for such reactions are [ethers](http://www.wikidoc.org/index.php/Ether). [Water](http://www.wikidoc.org/index.php/Water) cannot serve as a medium for pure ionic hydrides or LAH because the hydride ion is a stronger [base](http://www.wikidoc.org/index.php/Base_(chemistry)) than [hydroxide](http://www.wikidoc.org/index.php/Hydroxide). Hydrogen gas is liberated in a typical acid-base reaction.

NaH + H2[O](http://www.wikidoc.org/index.php/Oxygen) → H2 (gas) + NaOH Δ*H* = −83.6 kJ/mol, [Δ*G*](http://www.wikidoc.org/index.php/Gibbs_free_energy) = −109.0 kJ/mol

Alkali metal hydrides react with metal halides. [Lithium aluminium hydride](http://www.wikidoc.org/index.php/Lithium_aluminium_hydride) (often abbreviated as LAH) arises from reactions with [aluminium chloride](http://www.wikidoc.org/index.php/Aluminium_chloride).

4 [LiH](http://www.wikidoc.org/index.php/Lithium_hydride) + AlCl3 → LiAlH4 + 3 LiCl

**Metallic Hydrides**

The third category of hydrides are metallic hydrides, also known as interstitial hydrides. Hydrogen bonds with transition metals. One interesting and unique characteristic of these hydrides are that they can be nonstoichiometric, meaning basically that the fraction of H atoms to the metals are not fixed. Nonstoichiometric compounds have a variable composition. The idea and basis for this is that with metal and hydrogen bonding there is a crystal lattice that H atoms can and may fill in between the lattice while some might, and is not a definite ordered filling. Thus it is not a fixed ratio of H atoms to the metals. Even so, metallic hydrides consist of more basic stoichiometric compounds as well.

Interstitial hydrides show certain promise as a way for safe hydrogen storage. During last 25 years many interstitial hydrides were developed that readily absorb and discharge hydrogen at room temperature and atmospheric pressure. They are usually based on [intermetallic](http://www.wikidoc.org/index.php/Intermetallic) compounds and solid-solution alloys. However, their application is still limited, as they are capable of storing only about 2 weight percent of hydrogen, which is not enough for automotive applications.

***Oxides***

Oxides are chemical compounds with one or more [oxygen](http://chemwiki.ucdavis.edu/Inorganic_Chemistry/Descriptive_Chemistry/Main_Group_Elements/Group_16%3A_The_Oxygen_Family/Chemistry_of_Oxygen) atoms combined with another element (e.g. Li2O).

Introduction

Some oxides can react directly with water to form an acidic, basic, or amphoteric solution. An amphoteric solution is a substance that can chemically react as either acid or base. However, it is also possible for an oxide to be neither acidic nor basic. There are different properties which help distinguish between the three types of oxides. The term anhydride ("without water") refers to compounds that assimilate H2O to form either an acid or a base upon the addition of water.

Oxides are binary compounds of oxygen with another element, e.g., CO2, SO2, CaO, CO, ZnO, BaO2, H2O, etc. These are termed as oxides because here, oxygen is in combination with only one element. Based on their acid-base characteristics oxides are classified as acidic or basic. An oxide that combines with water to give an acid is termed as an acidic oxide. The oxide that gives a base in water is known as a basic oxide.

### 

### Acidic oxides

Acidic oxides are the oxides of non-metals are usually covalent and acidic. When combined with water, they produce acids, e.g.,

formation of sulphurous acid

formation of carbonic acid

##### formation of sulphuric acid

Acidic oxides are, therefore, known as acid anhydrides, e.g., sulphur dioxide is sulphurous anhydride; sulphur trioxide is sulphuric anhydride.

When these oxides combine with bases, they produce salts, e.g.,

##### formation of Na2SO3

http://content.tutorvista.com/chemistry_11/content/us/class11chemistry/chapter13/images/img549.gif

### Basic oxides

Basic oxides are the oxides of metals are generally basic. Most metal oxides are ionic and contain the O2- ion. Some oxides dissolve in water and form alkaline solution..e.g.,

##### formation of calcium hydroxide from calcium oxide

##### formation of magnesium hydroxide from magnesium oxide

##### formation of sodium hydroxide from sodium oxide

These metallic oxides are therefore, known as basic anhydrides. They react with acids to produce salts, e.g.,

##### formation of MgCl2 from MgO

##### formation of Na2SO4 from sulphuric acid

### Amphoteric oxides

Amphoteric oxides are metallic oxides, which show both basic as well as acidic properties. When they react with an acid, they produce salt and water, showing basic properties. While reacting with alkalies they form salt and water showing acidic properties, e.g.,

##### formation of zinc chloride from zinc oxide

##### formation of sodium zincate from zincoxide

##### Al2O3 as basic nature

##### Al2O3 as acid

### 

### Neutral oxides

These are the oxides, which show neither basic nor acidic properties, that is, they do not form salts when reacted with acids or bases, e.g., carbon monoxide (CO); nitrous oxide (N2O); nitric oxide (NO), etc., are neutral oxides.

### Peroxides and dioxides

A peroxide is a metallic oxide which gives hydrogen peroxide by the action of dilute acids. They contain more oxygen than the corresponding basic oxide, e.g., sodium, calcium and barium peroxides.

##### action of dilute acids on peroxides

##### action of sodium peroxide with sulphuric acid

Dioxides like PbO2 and MnO2 also contain higher percentage of oxygen like peroxides and have similar molecular formulae. These oxides, however, do not give hydrogen peroxide by action with dilute acids. Dioxides on reaction with concentrated HCl yield Cl2 and on reacting with concentrated H2SO4 yield O2.

##### Dioxides on reaction with concentrated HCl

###### Dioxides on reaction with concentrated HCl

### Compound oxides

Compound oxides are metallic oxides and they behave as if they are made up of two oxides, lower and higher oxides of the same metal, e.g.,

Red lead: Pb3O4 = PbO2 + 2PbO

Ferro-ferric oxide: Fe3O4 = Fe2O3 + FeO

On treatment with an acid, compound oxides give a mixture of salts.

##### action of Ferro-ferric oxide with HCl

http://content.tutorvista.com/chemistry_11/content/us/class11chemistry/chapter13/images/img564.gif

## Acidic - Basic Nature of Oxides in a Period

The oxides of elements in a period become progressively more acidic as one goes from left to right in a period of the periodic table. For example, in third period, the behavior of oxides changes as follows:

##### behavior of oxides

## Preparation of Oxides

### By direct heating of an element with oxygen

Many metals and non-metals burn rapidly when heated in oxygen or air, producing their oxides, e.g.,

##### action of magnesium on oxygen

##### action of calcium on oxygen

##### action of sulphur on oxygen

##### action of lead on oxygen

### By reaction of oxygen with compounds at higher temperatures

At higher temperatures, oxygen also reacts with many compounds forming oxides, e.g.,

Sulphides are usually oxidized when heated with oxygen.

##### Sulphides are usually oxidized when heated with oxygen

##### Sulphides are usually oxidized when heated with oxygen

When heated with oxygen, compounds containing carbon and hydrogen are oxidized.

##### action of ethanol with oxygen

By thermal decomposition of certain compounds like hydroxides,

carbonates, and nitrates

##### thermal decomposition of carbonates

##### thermal decomposition of nitrates

##### thermal decomposition of hydroxides

### By oxidation of some metals with nitric acid

##### oxidation of some metals with nitric acid

##### oxidation of some metals with nitric acid

### By oxidation of some non-metals with nitric acid

##### oxidation of some non-metals with nitric acid

**Trends of oxides in the periodic Table :**On moving from left to the right in periodic table, the nature of the oxides change from basic to amphoteric and then to acidic. For example, the oxides of third period has the following behaviour,

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Na2O  strongly basic | MgO   basic | Al2O3  amphoteric | SiO2   weakly acidic | P4O10   acidic | SO2   strongly acidic | Cl2O7  very strongly acidic |

Basic to acidic character increases.JPG

However, on moving down a group, acidic character of the oxides decreases. For example in the third group, the acidic character of oxides decreases as:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| |  | | --- | | **B2O3**  **acidic** | | Al2O3   amphoteric | Ga2O3  (weakly basic) | In2O3.Tl2O3    basic |

Acidic  to basic character increases.JPG

On the basis of oxygen content the oxides may be classified into the folloiwng types,

**Peroxides :**These contains O22– ion having oxidation number of oxygen as –1. For example,

          H2O2, Na2O2, BaO2, PbO2 etc.

**Superoxides :**These contains O2– ion having oxidation number of oxygen as –1/2. For example, KO2, PbO2 etc.