

## Metals and Reactivity

### Alloys

|           |                |    |
|-----------|----------------|----|
| potassium | most reactive  | K  |
| sodium    |                | Na |
| calcium   |                | Ca |
| magnesium |                | Mg |
| aluminium |                | Al |
| carbon    |                | C  |
| zinc      |                | Zn |
| iron      |                | Fe |
| tin       |                | Sn |
| lead      |                | Pb |
| hydrogen  |                | H  |
| copper    |                | Cu |
| silver    |                | Ag |
| gold      |                | Au |
| platinum  | least reactive | Pt |

- We can change the properties of a metal to make it harder or more resistant to corrosion. This is done by mixing it with another metal or with a non-metal.

- A mixture of two or metals, or one or more metals with a non-metal is called an alloy

- Atoms in a pure metal are arranged in regular layers, when a force is applied the layers are able to slide over each other. This explains why metals are malleable and ductile

- When a metal is alloyed with a second metal, the different sized metal atoms make the arrangement of the lattice less regular. We say they disrupt the crystal lattice. This stops the layers of metal atoms sliding over each other when a force is applied. This

is why an alloy is stronger and harder than a pure metal

- Some alloys are known to have properties of memory as they are able to resume their original shape when straitened and then placed in hot water. These are called shape memory alloys.

### The metal reactivity series

- Metals can be arranged in a reactivity series by comparing how easily they react with water, steam and hydrochloric acid
- Only metals above hydrogen in the reactivity series will react with hydrochloric acid
- Only metals above hydrogen in the reactivity series will react with water or steam

### Reacting metals with oxygen

- Copper: does not burn but turns black on its surface
- Iron: only burns when in powder form or as iron wool
- Gold: does not burn at all, even as a powder
- Magnesium: burns rapidly with a bright white light

### Reacting metals with steam or water

- All the metals above hydrogen react with oxygen to form a metal oxide
- Iron and lead only oxidize in powder form
- Only the surface of copper reacts to form black copper oxide
- If a metal does not react with cold water it may react with steam
- If a metal reacts with cold water, a metal hydroxide and hydrogen are formed
- If a metal only reacts with steam, a metal oxide is formed
- Group I metals are very reactive, on reaction with water they produce hydroxide and hydrogen
- Group II metals are less reactive they produce an oxide and hydrogen

|                  |  |
|------------------|--|
| <b>Calcium</b>   | Reacts rapidly with water  |
| <b>Copper</b>    | No reaction with cold water or steam                             |
| <b>Magnesium</b> | Reacts very slowly with cold water but reacts rapidly with steam |
| <b>Sodium</b>    | Reacts violently with cold water                                 |
| <b>Zinc</b>      | Only reacts when powdered and heated strongly in steam           |

- Metals below hydrogen do not react with cold water or steam. They do not release hydrogen from hydrochloric acid either. So copper, silver and gold are unreactive
- A more reactive metal displaces a less reactive metal from a solution of its salt
- A more reactive metal loses its valency electrons more easily than a less reactive metal
- The ease with which a metal loses its valency electrons to form ions depends on the distance of the valency electrons from the nucleus, the nuclear charge and the number of electron shells

### Reacting metals with acid

- Only metals above hydrogen react with dilute acid
- A metal reacts with an acid to form a metal salt and hydrogen

### Reducing metal oxides

- Metal oxides below carbon in the reactivity series are reduced by carbon when heated
- When a more reactive metal is heated with the oxide of a less reactive metal, the more reactive metal acts as a reductant
- The apparent lack of reactivity of aluminum is due to an unreactive oxide layer that forms on its surface

### Thermal Decomposition

- Thermal decomposition is the breakdown of a compound into two or more products by heat

- The more reactive the metal, the more stable its compounds
- Most metal hydroxides decompose to form a metal oxide and water
- All metal nitrates decompose:
  - i. Group I metals form a nitrite and oxygen
  - ii. Other metals form a metal oxide, nitrogen dioxide and oxygen
- Nitrites of very unreactive metals decompose to form the metal, nitrogen dioxide and oxygen
- The more reactive the metal, the more stable its hydroxide, carbonate or nitrate
- When you burn Sulphur in oxygen it burns with a blue flame
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