Chemistry - Metals and Reactivity

Metals and Water

Water + Metal —> Metal Hydroxide + Hydrogen

More reactive Metal + Less Reactive Compound —> More reactive metal compound + Less reactive metal

Less reactive metal + More reactive metal compound —> No reaction

Testing for Hydrogen —> Pop when ignited
Testing for Hydroxide —> Universal Indicator test (Blue/Purple when Alkali or Basic)

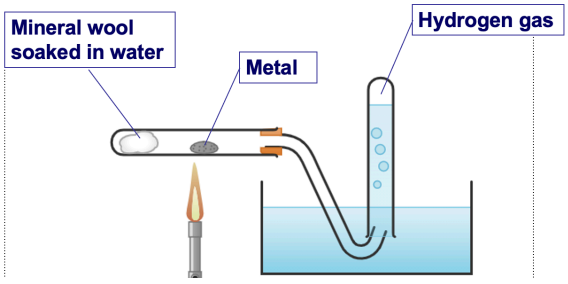
Reactivity Series:

Metal	Extraction method	Reactions
Potassium (K)	More reactive than Carbon: - Use Electrolysis	More reactive than Hydrogen: - React with acid - React with water (or steam
Sodium (Na)		
Lithium (Li)		
Calcium (Ca)		
Magnesium (Mg)		
Aluminium (Al)		
Carbon (C)		
Zinc (Zn)	Less reactive than Carbon: - Can be extracted by heating with Carbon (Coal or charcoal) - Done in a Blast Furnance	
Iron (Fe)		
Hydrogen (H)		
Copper (Cu)		Native Metals - Can be found unreacted or pure
Silver (Ag)		
Gold (Au)		

<u>Magnesium</u> —> A small reaction coats it with a surface of thin layer of insoluble Magnesium hydroxide. Therefore it does not react much.

<u>Aluminium</u> —> Has a very thin but strong layer of aluminium oxide on the surface and slows the reaction. Even with aluminium powder, only a small production of hydrogen.

<u>Steam reaction Setup:</u>



Corrosion:

- Metal corrode when in contact with air - rusting.
- Most metals found in Earth's crust is combined with other elements.

- For Iron to rust:
  - Needs contact with oxygen
  - Needs water (salty water makes process faster)

Methods/Ways to prevent rusting	

Painting (Barrier Method)	- Greasing or electroplating with less reactive metal —> Aluminium has an oxide coating
	
	- Also include:
	  - Plastic Coating
	  - Oiling

Galvanizing	- Coated in Zinc (often iron or steel) - Zinc has an insoluble layer of zinc oxide ex. Zn + Fe (2+) —> Zn (2+) + Fe
Sacrificial Method	- Attach blocks of magnesium or zinc to iron (often ships or water pipes) - Magnesium is more reactive, and therefor corrodes (oxidizes) first before the iron can corrode

Oxidation and Reduction

- Redox: When a reaction both oxidize and reduce.

Oxidation	**Reduction**
When a substance gains oxygen. Or When a substance loses electrons.	When a substance loses oxygen. Or When a substance gains electrons.
Reducing agent - causes reduction by losing electrons. This element gains oxidation state.	Oxidizing agent - causes oxidation by accepting electrons. This electron loses oxidation state.

Half Equations: Show gains/loss of electrons of individual element in a redox reaction.

- look at result side of reaction equation (to see if an element is oxidized or reduced)

ex. $Cu(2+) + 2e(-) \longrightarrow Cu$

  - In this case, Copper gains electrons, and is reduced

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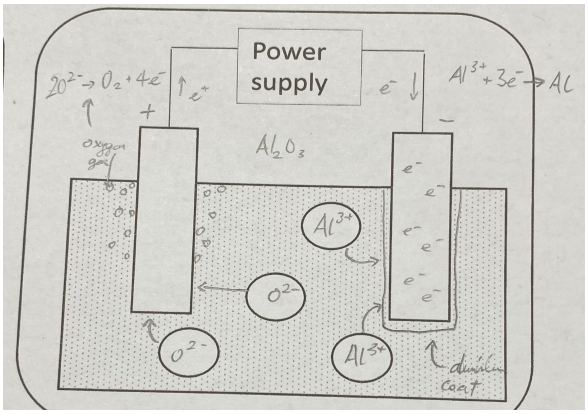
Electrolysis:

Ex. Aluminium



Positive Electrode	Negative Electrode
• Attracts Negative Ions - Anions • Called Anodes • The anions lose electrons • Anions oxidized	- Attract Positive Ions - Cations (usually metal being extracted) - Called Cathodes - The cations gain electrons - Cations reduced

Alloys

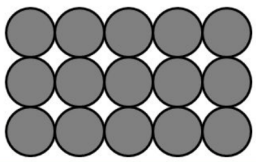
- Metallic Bonding: Electrostatic force of attraction between metal ions and delocalized electrons

- Alloys - a mixture of metal with at least one other element.
  - Final alloy may have very different properties compared to the original metal.
  - Examples include:
    - Bronze (Copper + Tin)
    - Brass (Copper + Zinc)
    - Solder (Zinc + Lead)
    - Amalgam (Mercury + Silver or Tin)
- Gold is often mixed with other elements
  - Yellow Gold —> Copper and Silver
  - White Gold —> Nickel and Zinc

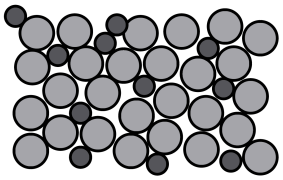
Steel - Alloy of Iron with Carbon, Nickel, Chromium (can have up to 2%)
  - Stronger than pure iron

Why Alloys are Stronger:

- In pure metals:
  - Ions are the same size.
  - Layers can easily slide over each other.



- In Alloys:
  - Different size ions (atoms) distort the layers.
  - They cannot slide over each other easily.



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Properties of Metals and Alloys:

Metal/Alloy	Made from:	Properties:	Uses:
Copper	Copper (pure)	- Ductile - Good Corrosion resistance - Good electrical and thermal conductor - Malleable, easy to work with and shape	- Jewelry - Door Knobs/handles - Tools, wire - Coins
Iron	Iron (pure)	- Easily corrodes - Malleable, easy to work with and shape - Ductile - Good electrical and thermal conductor - Heavy and Dense	- Used to make Steel - Magnets - Heavy pans
Aluminium	Aluminium (Pure)	- Lightweight (low density) - Electrical and thermal conductor - Ductile - Non-Corrosive - Malleable, Easy to work with and shape	- Cans, foil - Utensils - Window frames - Aeroplane parts
High Carbon Steel	Iron + More than 0.5% of Carbon	- Very Strong - Brittle - Hard to Shape	- Tools - Knife/Knives - Swords
Low Carbon Steel	Iron + Less than 0.25% of Carbon	- Strong - Malleable, Easy to work with and shape	- Car Bodies - Buildings - Bridges
Stainless Steel	Iron, Chromium, Nickel, Carbon	- Shiny Appearance - Does not corrode	- Cutlery and pans - Medical Instruments