# Reaction of Metals

Limited to

- Acid
- Cold water and Steam
- Oxygen



# Metal reaction with Oxygen



- Unreactive metals such as gold and platinum do not react with oxygen
- Some reactive metals such as the alkali metals react easily with oxygen
- Copper and iron can also react with oxygen although much more slowly
- When metals react with oxygen a metal oxide is formed,for example copper:

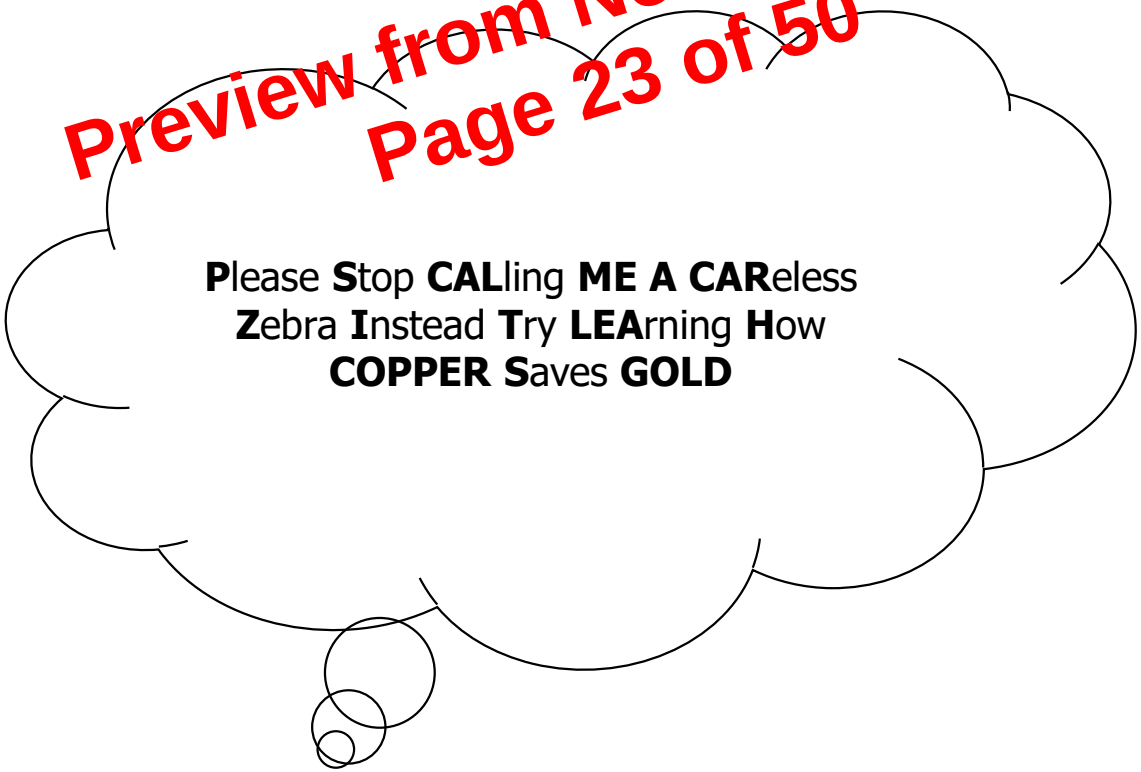
metal + oxygen → metal oxide

$2Cu\ (s) + O\ (g) \rightarrow 2CuO\ (s)$

- **Observations during the reaction:**
- Heat is often released (**exothermic reaction**).
- Flames or sparks may be seen, depending on the metal.
- A solid product (metal oxide) is usually formed.
- **Properties of Metal Oxides:**
- Usually **basic** in nature.
  - React with acids to form **salt and water**.
  - Some are **amphoteric** (e.g., aluminum oxide).

# Helpful Mnemonics






# Frequently asked questions



- Describe the reactions, if any, of:

(a) potassium, sodium and calcium with cold water

(b) magnesium with steam

(c) magnesium, zinc, iron, copper, silver and gold with dilute hydrochloric acid

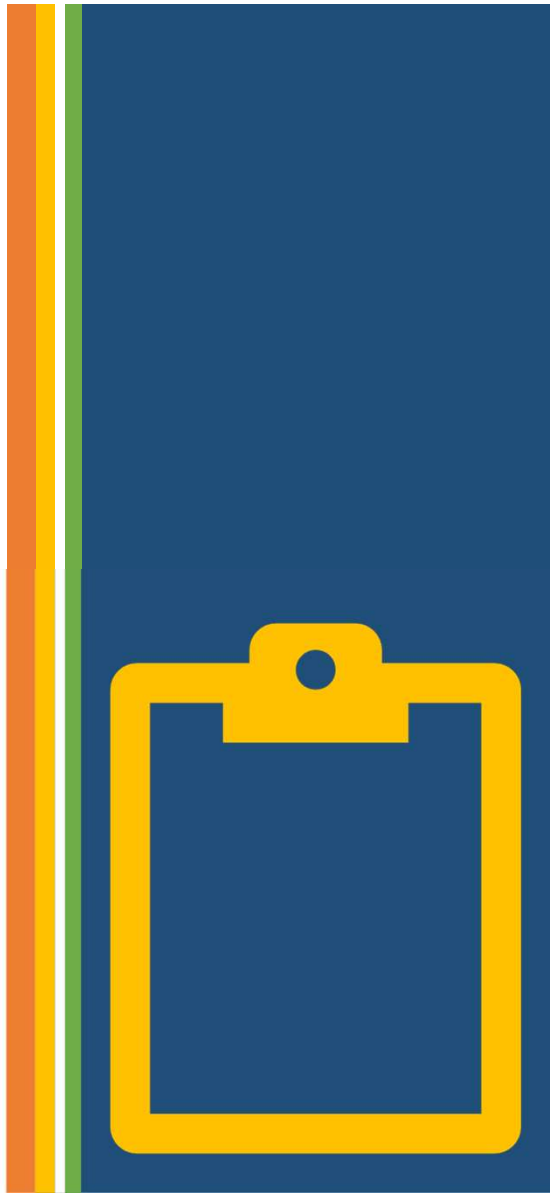
and explain these reactions in terms of the position of the metals in the reactivity series

Note: entire description about reaction is mentioned above, products  formed and observations made. However in part C dilute hydrochloric acid does not react with copper, silver and gold because Hydrogen can not be displaced during reaction.

# Investigating Rusting



- To investigate the conditions required for rusting, prepare three test tubes as shown in the diagram
- The oil in the 2nd tube keeps out air and the water has been boiled so that no air is left in it
- The calcium chloride in the 3rd tube is used to remove any moisture in the air
- After a few days, the iron nail in the 1st tube will be the only nail to show signs of rust



# Zinc in Galvanising: Barrier + Sacrificial Protection



- **Galvanizing:** Galvanizing is the process of **coating iron or steel with a layer of zinc**.
- **Two Types of Protection Provided:**
- **1. Barrier Method:**
- The zinc coating **physically blocks air and moisture** from reaching the iron.
- This prevents rust from forming.
- As long as the coating is intact, iron is safe.
- **2. Sacrificial Protection (if coating is damaged):**
- If the zinc coating is **scratched or damaged**, exposing the iron:
    - **Zinc is more reactive** than iron (higher in reactivity series).
    - Zinc **corrodes (oxidizes)** instead of iron.
    - Zinc acts as a **sacrificial anode**.

  $Zn \rightarrow Zu^{2+} + 2e^{-}$
- These electrons flow to the iron, **protecting it from rusting**.

# Extraction Of Metals



- The Earth's crust contains metals and metal compounds such as gold, copper, iron oxide and aluminium oxide
- Useful metals are often chemically combined with other substances forming ores
- A metal ore is a rock that contains enough of the metal to make it worthwhile extracting
- They have to be extracted from their ores through processes such as electrolysis, using a blast furnace or by reacting with more reactive material
- In many cases the ore is an oxide of the metal, therefore the extraction of these metals is a reduction process since oxygen is being removed
- Common examples of oxide ores are iron and aluminium ores which are called hematite and bauxite respectively

# Extraction of Iron from Hematite

- Iron is extracted in a large container called a blast furnace from its ore, hematite
- Modern blast furnaces produce approximately 10,000 tonnes of iron per day