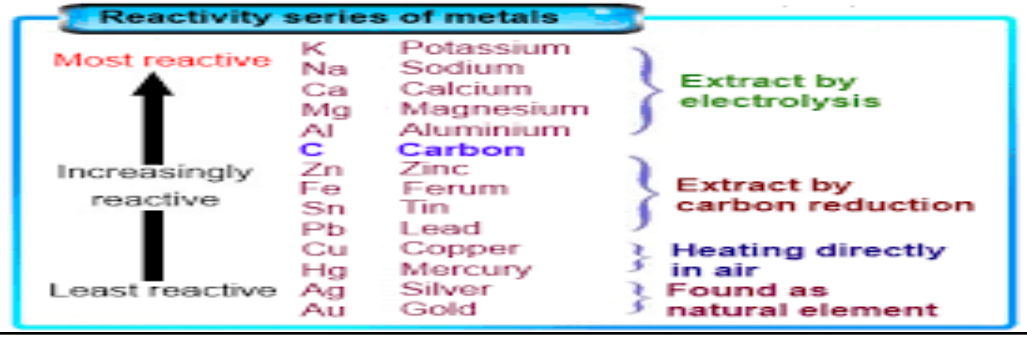
# Chemistry 5: Chemical Changes KNOWLEDGE ORGANISER (triple)

## KPI:1 (p55)
**Describe the reactivity of metals and explain how metals are extracted by reduction reactions**




## KPI:2 (p57)
**Write ionic equations and describe changes in terms of loss or gain of electrons**

When iron(III) nitrate reacts with sodium iodide, the iron(III) ions are reduced to iron(II) ions, and the iodide ions are oxidised to iodine molecules (the nitrate and sodium ions are spectator ions).

$Fe^{3+}(aq) + e^- \rightarrow Fe^{2+}(aq)$
$2I^-(aq) \rightarrow I_2(s) + 2e^-$
$2Fe^{3+}(aq) + 2e^- \rightarrow 2Fe^{2+}(aq)$
The balanced reduction and oxidation equations can now be added to give the redox equation.
$2I^-(aq) \rightarrow I_2(s) + 2e^-$ **oxidation**
$2Fe^{3+}(aq) + 2e^- \rightarrow 2Fe^{2+}(aq)$ **reduction**
Add: $2I^-(aq) + 2Fe^{3+}(aq) \rightarrow I_2(s) + 2Fe^{2+}(aq)$
**redox**

## KPI:3 (p54)
**Describe the production of salts from reactions of acid with metals, metal oxides, metal hydroxides and metal carbonates**

Acid + metal oxides ⟶ Metal hydroxide + base
Acid + metal hydroxides ⟶ Salt + Water
Acid + metal carbonate ⟶ Salt + Water + CO2

## KPI:8 (p58 - 59)
**Describe the use of electrolysis to extract metals and predict the products of electrolysis of solutions**

A molten ionic compound can be electrolysed because the ions can move freely and conduct electricity. Electrolysis is used to extract reactive metals. Aluminium bauxite contains Al2O3, so at the negative electrode: reduction – a gain of electrons – Al3+ + 3e- + Al. At the positive electrode: oxidation – loss of electrons – 2O2- + O2 + 4e- .

## KPI:4 (p51 & 53)
**Explain acidity, alkalinity and the pH scale in terms of hydrogen and hydroxide ions**

In chemistry, **acids and bases** have been **defined** differently by three sets of theories. One is the Arrhenius **definition**, which revolves around the idea that **acids** are substances that ionise (break off) in an aqueous solution to produce hydrogen ($H^+$) ions while **bases** produce hydroxide ($OH^-$) ions in solution

## KPI:7 (p58 - 59)
**Explain the process of electrolysis in terms of movement of ions and the gain or loss of electrons**

Ionic substances contain charged particles called ions. For example, lead bromide contains positively charged lead ions and negatively charged bromide ions.
**Electrolysis** is the process by which ionic substances are decomposed (broken down) into simpler substances when an electric current is passed through them.
For electrolysis to work, the ions must be free to move.

## KPI:5 (p53)
**Explain the difference between strong and weak acids**

**Strong and weak acids**
Acids ionise in water to produce **hydrogen ions**, $H^+$.
Strong acids fully ionise. For example:
hydrochloric acid: $HCl \rightarrow H^+ + Cl^-$
nitric acid: $HNO_3 \rightarrow H^+ + NO^{3-}$
sulfuric acid: $H_2SO_4 \rightarrow 2H^+ + SO_4^{2}$
Weak acids **do not** fully ionise. Instead, they form an equilibrium mixture. For example:
ethanoic acid: $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$
At the same concentration, strong acids have lower pH than weak acids.

## KPI:6 (p52)
**Titration calculations**

27.5 $cm^3$ of 0.2 mol/$dm^3$ hydrochloric acid is needed to titrate 25.0 $cm^3$ of sodium hydroxide solution.
What is the concentration of the sodium hydroxide solution?
**Step 1: Convert all volumes to $dm^3$**
27.5 $cm^3$ = 27.5 ÷ 1000 = 0.0275 $dm^3$
25.0 $cm^3$ = 25.0 ÷ 1000 = 0.025 $dm^3$
**Step 2: Calculate the number of moles of the substance where the volume and concentration are known**
number of moles = concentration × volume
number of moles of hydrochloric acid = 0.2 × 0.0275 = 0.0055 mol ($5.5 \times 10^{-3}$ mol)
**Step 3: Calculate the unknown concentration**
We can say that 0.0055 mol of acid will react with 0.0055 mol of alkali
concentration of alkali = moles ÷ volume = 0.0055 ÷ 0.025 = **0.22 mol/$dm^3$**
**A quick check**
unknown concentration = known concentration × $^{\text{volume of known}}/_{\text{volume of unknown}}$
In the example above, this would be:
unknown concentration = 0.2 × $^{27.5}/_{25.0}$ = **0.22 mol/$dm^3$**