Name:

Volumetric Analysis	**Objectives**
2. Acids and Bases	-relate the properties of acids and bases to their household applications -recall that neutralisation is the formation of a salt from an acid and a base -relate their knowledge of neutralisation to everyday examples e.g. use of lime in agriculture , use of stomach powders -state the Arrhenius theory of acids and bases -apply the Arrhenius theory of acids and bases for aqueous solutions only

ARRHENIUS THEORY

Def^{n}: An **Arrhenius acid** is a substance that dissociates in water to produce H^+ ions.

e.g. $HCl \rightarrow H^+ + Cl^-$ (monobasic as one H^+ produced)

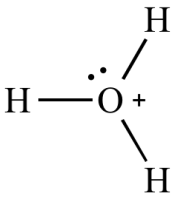
$H_2SO_4 \rightarrow 2H^+ + SO_4^{2-}$ (dibasic as two H^+ produced)

$H_3PO_4 \rightarrow 3H^+ + PO_4^{3-}$ (tribasic as three H^+ produced)

Strong Arrhenius acids dissociate *fully* in water. e.g. HCl

Weak Arrhenius acids dissociate *partially* in water. e.g. Ethanoic acid, CH_3COOH

Note: H^+ ions (which are just protons) cannot exist on their own in water. They bond with a water molecule to form a **hydronium ion, H_3O^+**, as seen in the picture to the right.



Def^{n}: An **Arrhenius base** is a substance that dissociates in water to produce OH^- ions.

e.g. $NaOH \rightarrow Na^+ + OH^-$

$Mg(OH)_2 \rightarrow Mg^{2+} + 2OH^-$

$Ca(OH)_2 \rightarrow Ca^{2+} + 2OH^-$

Strong Arrhenius bases dissociate *fully* in water. e.g. NaOH

Weak Arrhenius bases dissociate *partially* in water. e.g. Na_2CO_3

Note: Arrhenius's theory of acids and bases is limited to solutions dissolved in water. In reality, not all acid-base reactions need water, or even involve OH^- ions. Today, we have a more modern theory for how acids and bases work.

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NEUTRALISATION

A **salt** is the substance formed when the H^+ from an acid is replaced with a metal or ammonium (NH_4^+) ion.

e.g. when the H^+ in HCl is replaced with sodium, we form the salt NaCl, sodium chloride.

when the H^+ in HCl is replaced with ammonium, we form the salt NH_4Cl, ammonium chloride.

Def^n: **Neutralisation** is the reaction between an acid and a base to form a salt and water.

Types of neutralisation reactions:

1. Acid + Metal → Salt + Hydrogen

   e.g. $2HCl + Zn \rightarrow ZnCl_2 + H_2$

2. Acid + Base → Salt + Water

   e.g. $HCl + NaOH \rightarrow NaCl + H_2O$

3. Acid + Carbonate → Salt + Water + Carbon Dioxide

   e.g. $2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$

   Examples of neutralisation in everyday life:

   1. **Medicine:**
      Excess HCl in the stomach causes heartburn.
      Gaviscon contains sodium hydrogencarbonate (a base) to neutralise the acid.

      $$HCl + NaHCO_3 \rightarrow NaCl + H_2O + CO_2$$

   2. **Agriculture:**
      If soil is too acidic, lime (CaO, calcium oxide) is added to neutralise the acidity.

      $$CaO + H_2O \rightarrow Ca(OH)_2$$

      Lime and water make calcium hydroxide, a base. This base reacts with the acid in the soil.

      $$H_2SO_4 + Ca(OH)_2 \rightarrow CaSO_4 + 2H_2O$$

   3. **Environmental Protection:**
      Some areas receive high amounts of acid rain, making lakes very acidic. Limestone is added to to these lakes to neutralise the acid.

      $$H_2SO_4 + CaCO_3 \rightarrow CaSO_4 + CO_2 + H_2O$$

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