

## A2 Chemistry: F325 – Equilibria, Energetics and Elements

### 5.1.3 – Acids, bases and Buffers.

#### Lesson 1 - Brønsted–Lowry Acids and Bases

##### Learning Outcomes:

###### All

- State the meaning of the term acid and base (5.1.3 a)

###### Most

- Write an ionic equation for the reaction of an acid with metals, carbonates, bases and alkalis (5.1.3 b)

###### Some

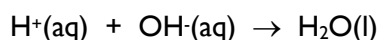
- Describe and use the term *conjugate acid– base pairs* and label them in an equation (5.1.3 c)

#### Background Information

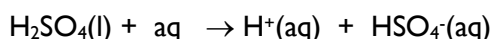
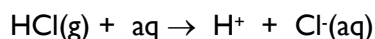
The H<sup>+</sup> ion is the active species in acids and is always involved in acid-base reactions.

- Bases are substances which react with and neutralise acids
- Alkalis are water-soluble bases which produce OH<sup>-</sup> ions in aqueous solution. They
  - turn red litmus blue or UI paper blue
  - have a pH greater than 7
  - react with acids to form a salt and water only
  - NaOH(aq) + HCl(aq) → NaCl(aq) + H<sub>2</sub>O(l)
  - form weak or strong alkalis depending on the equilibrium position
- Acids produce 'H<sup>+</sup>' ions in aqueous solution. They
  - turn blue litmus red or UI paper red
  - have a pH of less than 7
  - react with bases or alkalis to form a salt and water only
  - react with a metal carbonate to form a salt, carbon dioxide and water
  - 2HCl(aq) + CaCO<sub>3</sub>(s) → CaCl<sub>2</sub>(aq) + CO<sub>2</sub>(g) + H<sub>2</sub>O(l)
  - react with metals to form a salt and hydrogen
  - 2HNO<sub>3</sub>(aq) + Mg(s) → Mg(NO<sub>3</sub>)<sub>2</sub>(aq) + H<sub>2</sub>(g)  
(The metal must be above hydrogen in the Reactivity Series)

- The reaction between an acid and an alkali is called neutralisation:



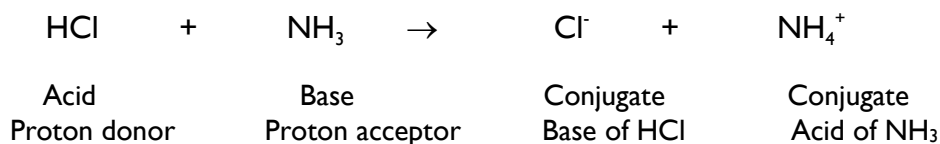
When an acid is added to water it dissociates releasing H<sup>+</sup>, hydrogen ions which is commonly called a proton as the hydrogen atom has lost an electron.



aq = excess  
water

Different acids release different numbers of protons depending in their formulae. Acids that can release two protons are called di-basic acids, and those that can liberate three protons are called tri-basic acids.

- (a) The Bronsted-Lowry theory of acids and bases defines an acid as a proton donor and it may only function as such when in the presence of a proton acceptor – a base e.g.



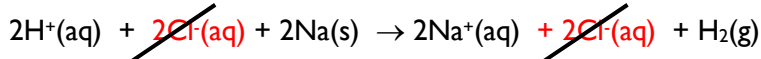
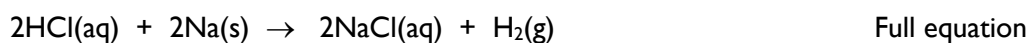
Explain the meaning of the terms conjugate acid and conjugate base and how an acid-base pair are linked together.

## (b) Reactions with Acids

### (i) Acids Reacting with Metals

When an aqueous acid reacts with a metal a salt and hydrogen gas is produced. You must be able to write a balanced full equation and an ionic equation for these reactions involving common mineral acids such as sulfuric acid (H<sub>2</sub>SO<sub>4</sub>), nitric acid HNO<sub>3</sub>, hydrochloric acid HCl and phosphoric acid (H<sub>3</sub>PO<sub>4</sub>)

#### ACID + METAL → SALT + HYDROGEN



The spectator ions are removed from the equation. These are the ions that do not change their oxidation states during the reaction.



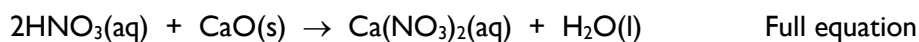
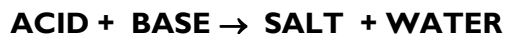
(ii) **Acids Reacting with Carbonates**



Ionic equation

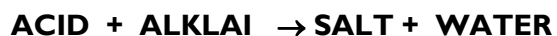
(iii) **Acids Reacting with Bases**

A base is a soluble metal oxide.



Ionic equation

(iv) **Acids Reacting with Alkalis**



Ionic equation

Answer questions 1 and 2 on page 137.

Answer the questions on Acids, bases and Buffers 1.

