

# Acids and Bases Introduction

## Definitions

Firstly, you need to know what a Bronsted-Lowry acid or base is:

*acids **donate** protons ( $H^+$ ) and bases **accept** protons*

[Strong Acids](#)  
[Weak Acids](#)  
[pH Curves](#)  
[Buffer Theory](#)  
[Buffer Calculations](#)

**Strong acids:** an acid that **completely dissociates** (or ionises) in water



Examples: Hydrochloric acid (HCl), Sulphuric acid (H<sub>2</sub>SO<sub>4</sub>), Nitric acid (HNO<sub>3</sub>)

- ✓ **monobasic** (or monoprotic) refers to an acid that can only donate **one proton** e.g. HCl. A **dibasic** acid donates **two protons** e.g. H<sub>2</sub>SO<sub>4</sub> and a **tribasic** donates **three protons** e.g. H<sub>3</sub>PO<sub>4</sub>.

**Weak acids: incomplete dissociation** in water



Examples: any carboxylic acid, they commonly use ethanoic acid (shown in the equation above).

- ✓ the main difference in the equations for strong and weak acids/bases is the equilibrium arrow for weak acids/bases compared with the normal reaction arrow for the strong acids/bases.

You can write similar equations to those above for bases.

**Strong Bases:** sodium hydroxide (NaOH) or another metal hydroxide is used almost exclusively:



**Weak bases:** ammonia (NH<sub>3</sub>) and sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>)



- ✓ Note that water is required as a source of 'O' in this equation.

- ✓ The important point for bases is that you have OH<sup>-</sup> ions in solution.

## Conjugate Acid-Base

This is very easy. In conjugate pair questions you will see an equilibrium set up similarly to that shown below:

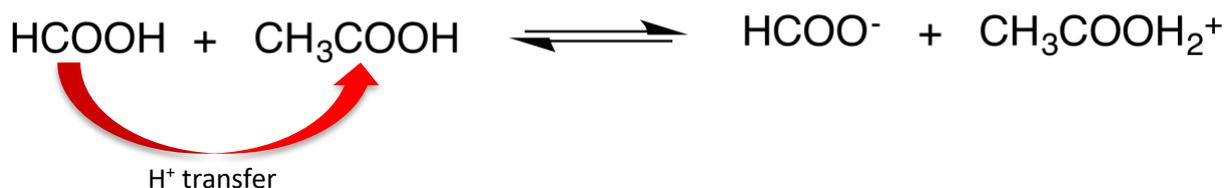


There is an **acid and base** on the **left** side of the arrow and an **acid and base** on the **right** side of the arrow.

Your task is to identify which are the acids and which are the bases.

It might not be obvious at first in the example above, as there are two carboxylic acids on the left hand side BUT one of them is acting as a **base**! This means that one of the acids is stronger than the other.

All that happens in these reactions is the reactant acting as an acid **donates an H<sup>+</sup>** to the other reactant....a simple **proton transfer**.



The end result is that the HCOOH has lost an H<sup>+</sup> and The CH<sub>3</sub>COOH has gained an H<sup>+</sup>...very simple stuff.

### The conjugate pairs

In the example above, the CH<sub>3</sub>COOH and CH<sub>3</sub>COOH<sub>2</sub><sup>+</sup> are a conjugate pair. This means that one of them is an acid and the other is a base. Similarly, HCOOH and HCOO<sup>-</sup> are a pair.



conjugate pair 1



conjugate pair 2

- ✓ Always “pair up” the two molecules on opposite sides of the equation that “look” similar to each other. The only difference between them is one will have an extra ‘H’.

But in each pair, how do you know which is the acid?

the acid is the molecule of the pair with the **most** hydrogens

Using this rule, we can say that  $\text{CH}_3\text{COOH}_2^+$  is the acid and  $\text{CH}_3\text{COOH}$  is the base. And  $\text{HCOOH}$  is the acid and  $\text{HCOO}^-$  is the base. Therefore we can also say that  $\text{HCOOH}$  is a stronger acid than  $\text{CH}_3\text{COOH}$ .



In the example above the equation is given, but in some examples they may ask you to predict the products.

To do this, **you must know which is the stronger acid** out of the two compounds on the left hand side of the equation. This can be identified through the  **$K_a$  values** i.e. the larger the  $K_a$  value, the stronger the acid. In the example above,  $\text{HCOOH}$  must have a larger  $K_a$  value than  $\text{CH}_3\text{COOH}$ .

✓  $K_a$  values are discussed in the [weak acid](#) tutorial.

## Calculations introduction

Most of this topic is calculation based. I would recommend splitting the whole topic into 4 sections:

- strong acids/bases
- weak acids/bases
- pH curves
- buffer solutions

When beginning calculations, it is always a good idea to write down an equation (or anything else) that might help. The worst thing you can do is to sit staring at a blank page. Once you have something on the paper it can lead you towards the answer.

Please remember the old equation from GCSE and AS, you will need it....a lot:

$$\text{number of moles} = \text{concentration} \times \text{volume}$$

[Strong Acids](#)  
[Weak Acids](#)  
[pH Curves](#)  
[Buffer Theory](#)  
[Buffer Calculations](#)