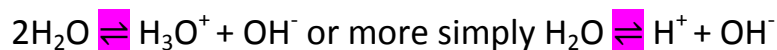


## Species in solution

### Don't forget the water

(After all these are aqueous solutions.....)



- This is called the self-ionisation of water **AND**  $K_w = [\text{H}^+][\text{OH}^-]$
- If the solution is neutral  $[\text{H}^+] = [\text{OH}^-]$
- If the solution is acidic  $[\text{H}^+] > [\text{OH}^-]$
- If the solution is basic/alkaline  $[\text{H}^+] < [\text{OH}^-]$
  
- Since  $[\text{H}^+][\text{OH}^-] = 10^{-14}$  if  $[\text{H}^+] \uparrow$  then the  $[\text{OH}^-] \downarrow$
- (so that  $[\text{H}^+] \times [\text{OH}^-] = 10^{-14}$ )
  
- Since  $[\text{H}^+][\text{OH}^-] = 10^{-14}$  if  $[\text{H}^+] \downarrow$  then the  $[\text{OH}^-] \uparrow$
- (so that  $[\text{H}^+] \times [\text{OH}^-] = 10^{-14}$ )

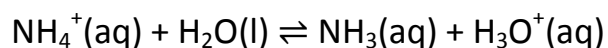
**Salts** e.g. NaCl, KCl, MgCl<sub>2</sub>, MgSO<sub>4</sub>, CH<sub>3</sub>COONa, NH<sub>4</sub>Cl; these dissolve completely in water and ionise completely



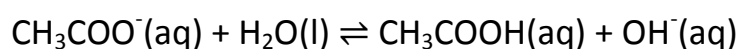
- $[\text{Na}^+] = [\text{Cl}^-] > [\text{H}_3\text{O}^+] = [\text{OH}^-]$
- pH will be 7 ( $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ )
- will be a good conductor of electricity / good electrolyte as lots of Na<sup>+</sup> & Cl<sup>-</sup>



- $[\text{Cl}^-] > [\text{Mg}^{2+}] > [\text{H}_3\text{O}^+] = [\text{OH}^-]$
- pH will be 7 ( $[\text{H}_3\text{O}^+] = [\text{OH}^-]$ )
- will be a good conductor of electricity / good electrolyte



- $\text{Cl}^- > \text{NH}_4^+ > \text{NH}_3 = \text{H}_3\text{O}^+ > \text{OH}^-$  OR
- $\text{Cl}^- \approx \text{NH}_4^+ > \text{NH}_3 = \text{H}_3\text{O}^+ > \text{OH}^-$
- pH will be less than 7 due to  $\text{H}_3\text{O}^+ > \text{OH}^-$
- will be a good conductor of electricity / good electrolyte as lots of  $\text{NH}_4^+$  &  $\text{Cl}^-$



- $\text{Na}^+ > \text{CH}_3\text{COO}^- > \text{CH}_3\text{COOH} = \text{OH}^- > \text{H}_3\text{O}^+$  OR
- $\text{Na}^+ \approx \text{CH}_3\text{COO}^- > \text{CH}_3\text{COOH} = \text{OH}^- > \text{H}_3\text{O}^+$
- pH will be more than 7 due to  $\text{OH}^- > \text{H}_3\text{O}^+$
- will be a good conductor of electricity / good electrolyte as lots of  $\text{CH}_3\text{COO}^-$  &  $\text{Na}^+$

**Strong acids** e.g. HCl, HBr, HNO<sub>3</sub>, H<sub>2</sub>SO<sub>4</sub>; react fully with water / fully ionise



- $\text{H}_3\text{O}^+ = \text{Cl}^- > \text{OH}^-$
- pH will be much much less than 7 (it's a strong acid!!)
- will be a good conductor of electricity / good electrolyte



- $\text{H}_3\text{O}^+ > \text{SO}_4^{2-} > \text{OH}^-$  (note:  $\text{H}_3\text{O}^+ > \text{SO}_4^{2-}$  since  $\text{H}_2\text{SO}_4$ )
- pH will be much much less than 7 (it's a strong acid!!)
- will be a good conductor of electricity / good electrolyte

**Strong bases** e.g. NaOH, KOH, Ca(OH)<sub>2</sub> ; fully ionise / dissociate

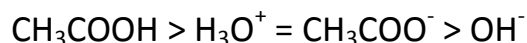


- pH will be much much more than 7 (it's a strong base!!)
- will be a good conductor of electricity / good electrolyte



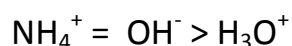
- $\text{OH}^- > \text{Ca}^{2+} > \text{H}_3\text{O}^+$
- pH will be much much more than 7 (it's a strong base!!)
- will be a good conductor of electricity / good electrolyte
- Note: Ca(OH)<sub>2</sub> is only slightly soluble in water but will still be more basic and a better conductor than a weak base.

**Weak acids** e.g. CH<sub>3</sub>COOH, HCOOH, HOBr, HF; incomplete reaction with water



- pH will be less than 7 (it's a weak acid!!)
- will be a poor conductor of electricity / poor electrolyte

**Weak bases** e.g. NH<sub>3</sub>, CH<sub>3</sub>NH<sub>2</sub>; incomplete reaction with water



- pH will be more than 7 (it's a weak base!!)
- will be a poor conductor of electricity / poor electrolyte