Strong & Weak Acids at a glance

When chemists refer to strong and weak acids they are referring to the degree with which the acid molecules break apart to give ions in aqueous solution (dissociation). A strong acid completely breaks apart to give ions in solution (100% dissociation) whereas a weak acid only slightly dissociates in solution (perhaps less than 1%)

Strong acids e.g. HCl, HNO_3 & H_2SO_4

e.g. hydrochloric acid HCl $HCl + H_2O \rightarrow H_3O^+ + Cl^-$ or $HCl + aq \rightarrow H^+ + Cl^-$ • Reaction with water is complete (all the HCl molecules have reacted with H_2O) • Acid, HCl is completely ionised or completely dissociated (all HCl molecules have "split" into ions) • Reaction effectively "goes to completion" / to the right	e.g. ethanoic acid CH_3COOH $CH_3COOH + H_2O \rightleftharpoons H_3O^+ + CH_3COO^-$ or $CH_3COOH + aq \rightleftharpoons H^+ + CH_3COO^-$ • Reaction with water is incomplete (NOT all the CH_3COOH molecules have reacted with H_2O) • Acid, CH_3COOH is incompletely ionised or incompletely dissociated (NOT all CH_3COOH molecules have "split" into ions) • Reaction is an equilibrium reaction; equilibrium lies towards the left, i.e. most of CH_3COOH is unionised
Properties • Low pH – because the $[H_3O^+]$ is high • Turn blue litmus red, turn UI pink/red • Fast reaction with Mg or $CaCO_3$ – because the $[H_3O^+]$ is high and so there are many collisions / second between H_3O^+ and Mg or $CaCO_3$ • Good conductor of electricity – as there are many H_3O^+ AND Cl^- ions available to carry the current	Properties • Not such a low pH (but still < 7) – because the $[H_3O^+]$ is low • Turn blue litmus red, turn UI orange • Slow reaction with Mg or $CaCO_3$ – because the $[H_3O^+]$ is low and so there are not many collisions / second between H_3O^+ and Mg or $CaCO_3$ • Poor conductor of electricity – as there are very few H_3O^+ AND CH_3COO^- ions available to carry the current
pH • Can be calculated by knowing the concentration of the acid; $pH = -\log[H_3O^+]$ • e.g. 0.500 mol L^{-1} HCl pH = -log 0.500 = 0.301 • e.g. 0.350 mol L^{-1} H_2SO_4 pH = -log 0.700 = 0.155 (Note H_2SO_4 contains 2 x H^+ so $[H^+]$ or $[H_3O^+]$ is 2 x concentration of the acid).	pH • Can NOT be calculated by knowing just the concentration of the acid as we do NOT know the extent to which ionisation occurs and therefore we can't know the $[H_3O^+]$ • To calculate, you will have to wait to level 3 Chemistry!!!
How much "stuff" will the acid react with? • Equal volumes of strong and weak acids*, of the same concentration, will react with the same amount of magnesium, for example (same mass / same amount of mol), because they both have the SAME TOTAL AMOUNT of H_3O^+ ions available, since n = cV. *monoprotic acids like HCl and CH_3COOH	Weak acids that come disguised as salts! • NH_4Cl is a salt. It is ionic and will dissolve in water and produces NH_4^+ (the conjugate acid of NH_3) and Cl^- • Dissolving: $NH_4Cl(s) + aq \rightarrow NH_4^+(aq) + Cl^-(aq)$ • The NH_4^+ will react with water to some extent to form NH_3 and H_3O^+. This makes the solution acidic. • $NH_4^+(aq) + H_2O(l) \rightleftharpoons NH_3(aq) + H_3O^+(aq)$

Weak acids e.g. carboxylic acids such as CH_3COOH

Strong & Weak Bases at a glance

When chemists refer to strong and weak bases they are referring to the degree with which the bases (ionic compounds or molecules) break apart to give ions in aqueous solution (dissociation). A strong base completely breaks apart to give ions in solution whereas a weak base only slightly dissociates in solution.

Strong bases e.g. NaOH, KOH, and $Ca(OH)_2$	Weak bases e.g. ammonia NH_3
e.g. sodium hydroxide, NaOH (an ionic solid) $NaOH + aq \rightarrow Na^+ + OH^-$ * • Reaction with water is complete • The NaOH is completely ionised or completely dissociated (the NaOH ionic lattice has "split" into ions) • Reaction effectively "goes to completion" / to the right *Don't write $NaOH + H_2O \rightarrow$ … or you will end up with problems or end up writing H_2O on both sides of the arrow!	e.g. ammonia, NH_3 $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ • Reaction with water is incomplete (NOT all the NH_3 molecules have reacted with H_2O) • Don't talk about NH_3 being incompletely ionised or dissociated (the NH_3 molecules themselves don't actually "split" into ions) • Reaction is an equilibrium reaction; equilibrium lies towards the left, i.e. most of NH_3 is unionised
Properties • High pH – because the $[OH^-]$ is high • Turn red litmus blue, turn UI purple • Good conductor of electricity – as there are many ions available to carry the current	Properties • Not such a high pH (but still > 7) – because the $[OH^-]$ is low • Turn red litmus blue, turn UI dark green-blue • Poor conductor of electricity – as there are very few ions available to carry the current
pH • Can be calculated by knowing the concentration of the base; o Find $[H_3O^+]$; $[H_3O^+] = 1 \times 10^{-14} / [OH^-]$ o Then find the pH; $pH = -\log[H_3O^+]$ • e.g. 0.800 mol L^{-1} NaOH o $[OH^-] = 0.800$ mol L^{-1} ; o $[H_3O^+] = 1 \times 10^{-14} / 0.800 = 1.25 \times 10^{-14}$ mol L^{-1} o pH = - log 1.25×10^{-14} and so pH = 13.9	pH • Can NOT be calculated by knowing just the concentration of the base as we do NOT know the extent to which ionisation occurs and therefore we can't know the $[OH^-]$ • To calculate, you will have to wait to level 3 Chemistry!!!
NOTE: There are usually less questions comparing strong and weak bases as the bases don't have such visible reactions with other substances. E.g. when base + acid → salt + water there is no visible sign of reaction, no bubbles of any gas etc, so it is hard to compare any "rate of reaction".	Weak bases that come disguised as salts! • $NaHCO_3$ is a salt. It is ionic and will dissolve in water and produces Na^+ and HCO_3^- • Dissolving: $NaHCO_3(s) + aq \rightarrow Na^+(aq) + HCO_3^-(aq)$ • The HCO_3^- will react with water to some extent to form H_2CO_3 and OH^-. This makes the solution alkaline/basic. • $HCO_3^-(aq) + H_2O(l) \rightleftharpoons H_2CO_3(aq) + OH^-(aq)$