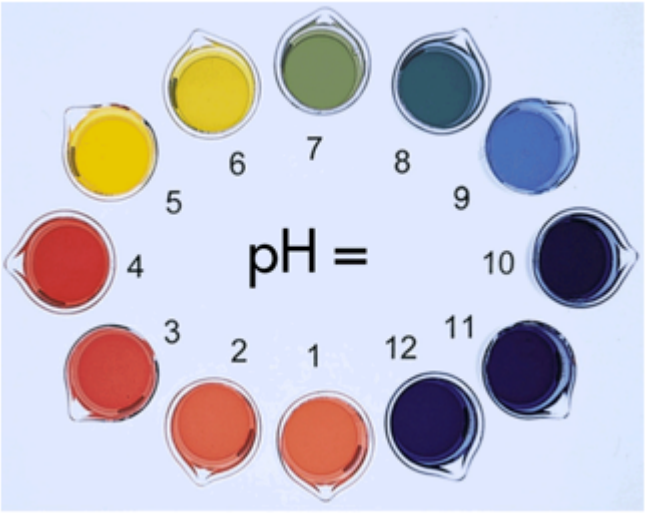
4. Acids and Bases

2.28

The colours of indicators in acidic and basic solutions

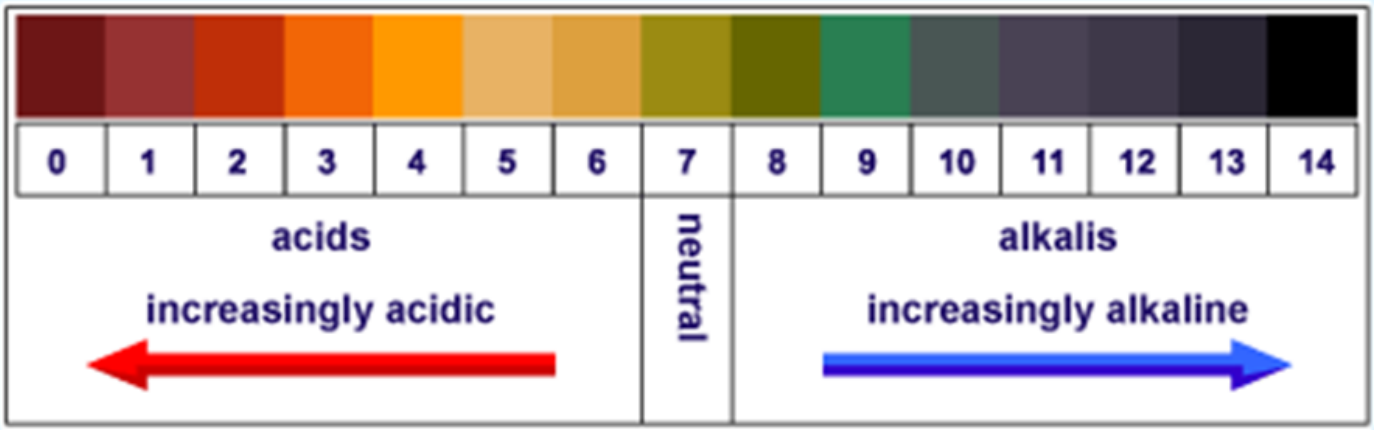
Indicator	Colour on acid side	pH at colour change	Colour on basic side
methyl orange	red	3–5	yellow
litmus	red	5–8	blue
phenolphthalein	colourless	8–10	pink

- Universal Indicator

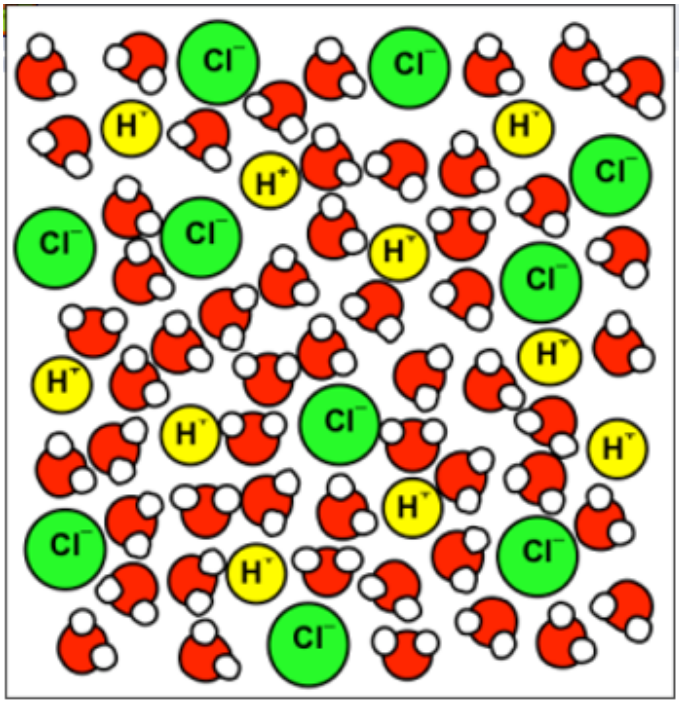


2.29

pH scale



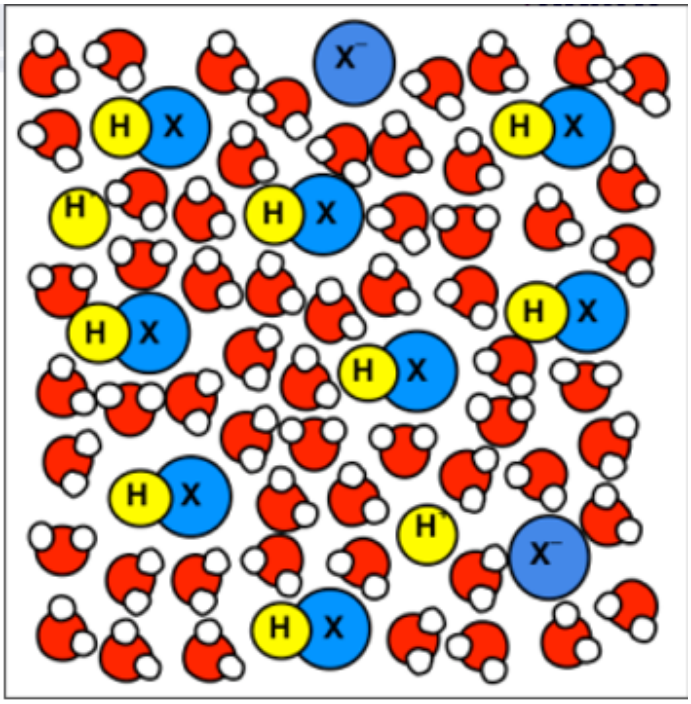
- acidic 0-3
- weakly acidic 4-6
- neutral 7
- weakly alkaline 8-10
- strongly alkaline 10-14



STRONG acid

$HCl \rightarrow H^+ + Cl^-$

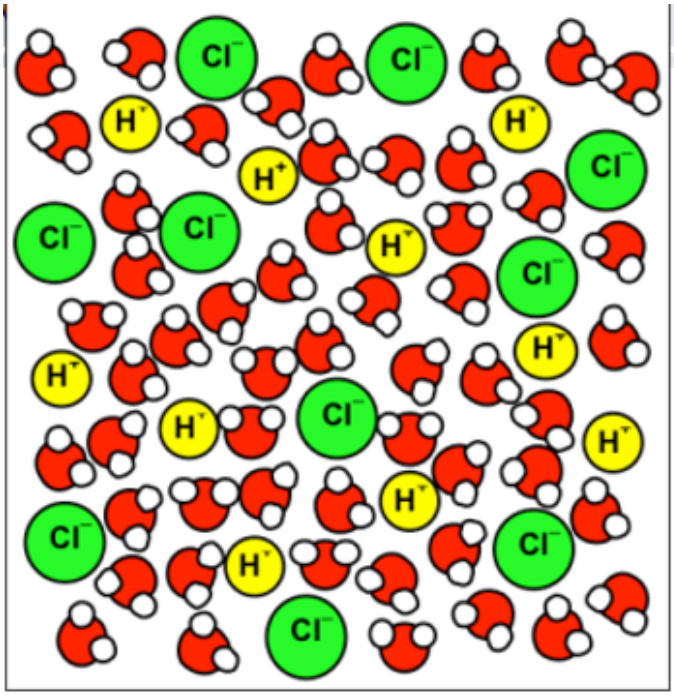
All molecules ionise



WEAK acid

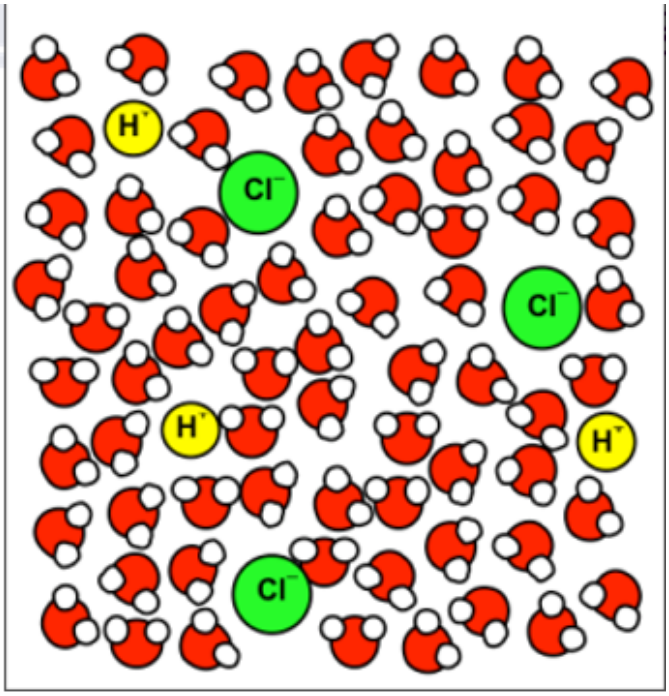
$HX \rightleftharpoons H^+ + X^-$

Only a small fraction of the molecules ionise



CONCENTRATED acid

Lots dissolved



DILUTE acid

Small amount dissolved

2.30

Use of universal indicator to measure the approximate pH value of an aqueous solution

2.31

Acids in aqueous solution are a source of hydrogen ions and alkalies in a aqueous solution are source of hydroxide ions

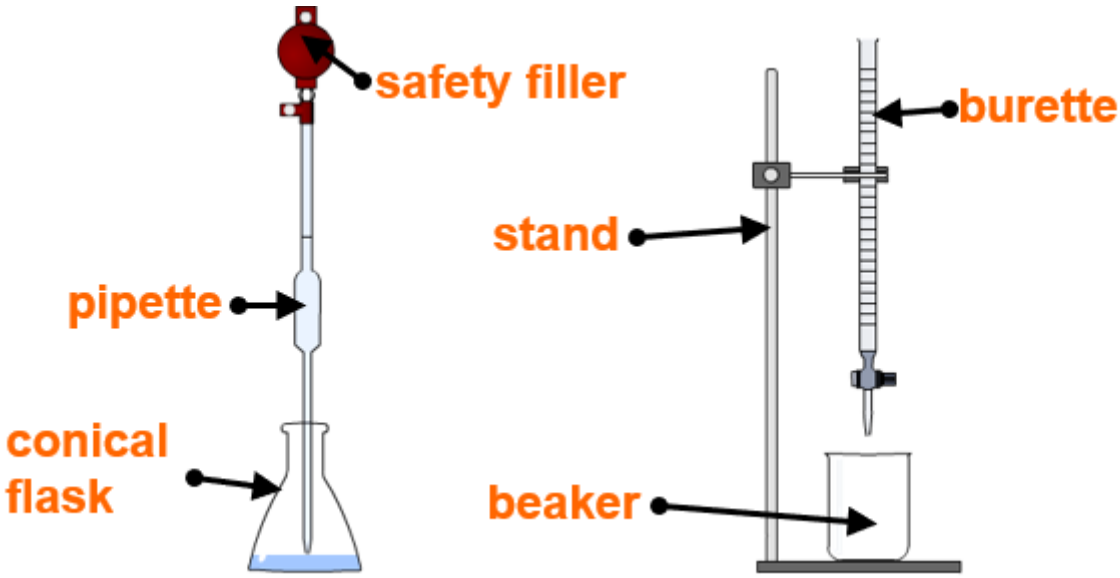
2.32

Alkalies can neutralize acids

2.33

Procedure of acid-alkali titration

$$\text{concentration} = \frac{\text{mass dissolved (g)}}{\text{volume of solution (dm}^3\text{)}}$$



2.34

General rules for predicting the solubility of ionic compounds in water:

- common sodium, potassium and ammonium compounds are soluble
- all nitrates are soluble
- common chlorides are soluble, except those of silver and lead (II)
- common sulfates are soluble, except for those of barium, calcium and lead (II)
- common carbonates are insoluble, except for those of sodium, potassium and ammonium
- common hydroxides are insoluble except for those of sodium, potassium and calcium

2.35

acids and bases proton transfer

2.36

acids are proton donor and base is proton acceptor

2.37

Reactions of hydrochloric acid, sulfuric acid and nitric acid with metals, bases and metal carbonates to form salts

Soluble	Insoluble
All common sodium, potassium and ammonium salts	
All nitrates	
Most common chlorides	Silver chloride, lead (II) chloride
Most common sulfates	Lead (II)sulfate, barium sulfate, calcium sulfate
Sodium carbonate, potassium carbonate, ammonium carbonate	Most common carbonates
Sodium hydroxide, potassium hydroxide, ammonium hydroxide	Most common hydroxides (calcium hydroxide is slightly soluble)

2.38

Metal oxides, metal hydroxides and ammonia can act as bases, and alkalis are bases that are soluble in water

2.39

Experiment to prepare a pure, dry sample of soluble salt, starting from an insolube reactant

2.40

Experiment to prepare a pure, dry sample of a soluble salt, starting from an acid and alkali

2.41

Experiment to prepare a pure, dry sample of an insoluble salt, starting from two soluble reactants

2.42

Prepare a sample of pure, dry hydrates copper (II) sulfate crystals starting from copper oxide

2.43

Prepare a sample of pure, dry lead (II) sulfate