Acids and Alkalis

According to the Arrhenius theory, a substance which produces hydrogen ion (H+) in water, is called acid. A substance which produces hydroxide ion (OH-) in water, is called base. According to Bronsted-Lowry theory, an acid is proton (H+) donor and base is proton acceptor.

Common Acids and Bases

Table K
Common Acids

Formula	Name
$HCl(aq)$	hydrochloric acid
$HNO_3(aq)$	nitric acid
$H_2SO_4(aq)$	sulfuric acid
$H_3PO_4(aq)$	phosphoric acid
$H_2CO_3(aq)$ or $CO_2(aq)$	carbonic acid
$CH_3COOH(aq)$ or $HC_2H_3O_2(aq)$	ethanoic acid (acetic acid)

Table L
Common Bases

Formula	Name
$NaOH(aq)$	sodium hydroxide
$KOH(aq)$	potassium hydroxide
$Ca(OH)_2(aq)$	calcium hydroxide
$NH_3(aq)$	aqueous ammonia

Properties of acids and alkalis

Properties of Acids:

Sour taste: Many acids have a sour taste, although it is not recommended to taste acids as they can be harmful.

Reactivity with metals: Acids can react with certain metals, producing hydrogen gas and a salt.

Corrosive: Acids can corrode or damage certain materials, including metals and organic substances.

pH below 7: Acids have a pH value lower than 7 on the pH scale. The lower the pH, the stronger the acid.

Turn blue litmus paper red: Acids can change the color of blue litmus paper to red.

Conductivity: Acids, when dissolved in water, can conduct electricity due to the presence of hydrogen ions (H+).

Properties of Alkalis (Bases):

Bitter taste: Alkalis have a bitter taste, although it is not recommended to taste alkalis as they can be harmful.

Slippery or soapy feel: Alkalis have a soapy or slippery feel when touched.

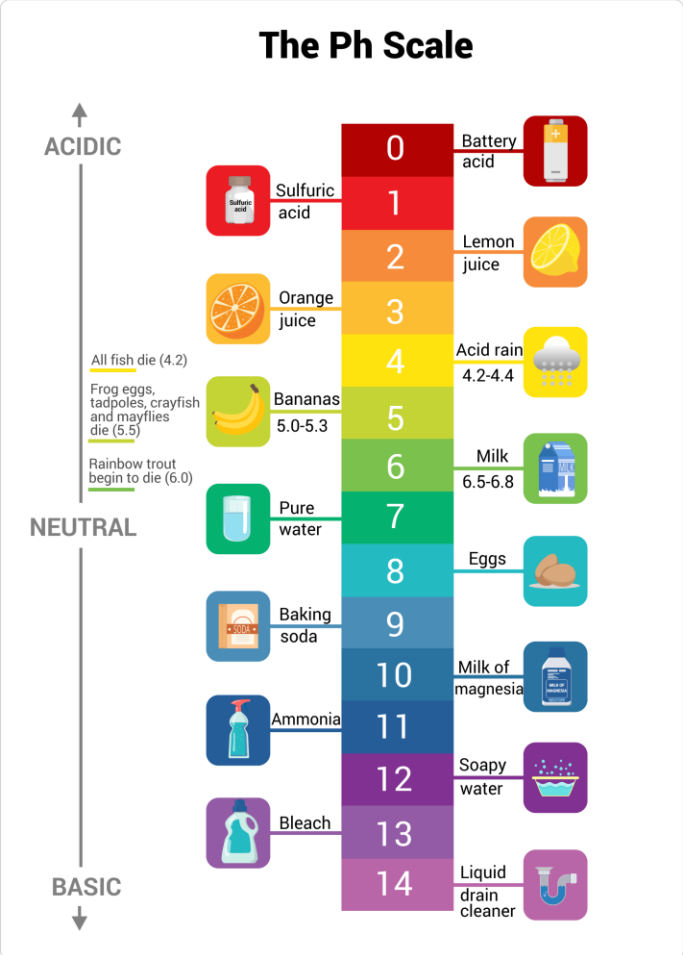
Reactivity with fats and oils: Alkalis can react with fats and oils, a process known as saponification, forming soap and glycerol.

pH above 7: Alkalis have a pH value higher than 7 on the pH scale. The higher the pH, the stronger the alkali.

Turn red litmus paper blue: Alkalis can change the color of red litmus paper to blue.

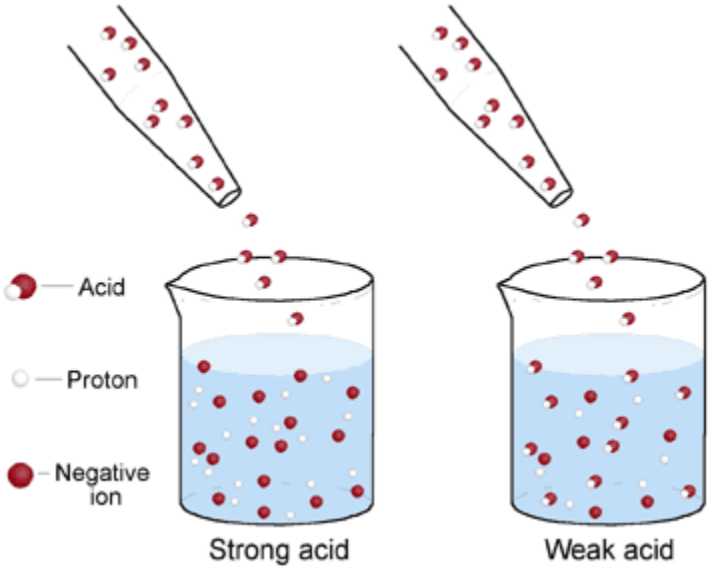
Conductivity: Alkalis, when dissolved in water, can conduct electricity due to the presence of hydroxide ions (OH-).

PH Scale:

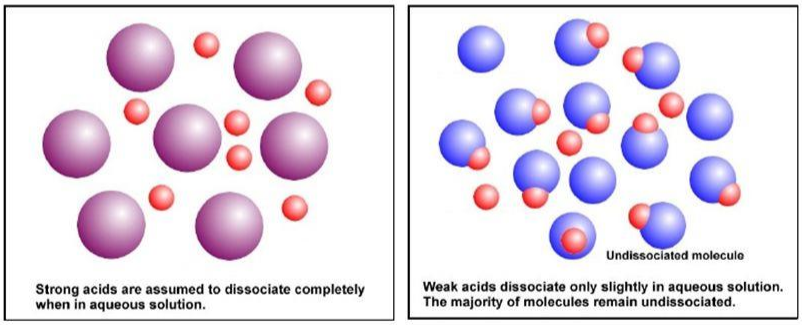


Strong and weak acids and bases

A strong acid or alkali is one that is nearly or completely ionised in water. Examples are: hydrochloric acid, nitric acid and sulphuric acid. Sodium and potassium hydroxide are examples of strong bases. A weak acid or alkali, on the other hand, is only partially ionized in water.



Strong and Weak Acids and Bases



Conductivity of strong acids and bases:

Strong acids and bases with equal concentrations will have higher conductivity than weak acids and bases because they have higher H+ ions when ionized therefore they are more conductive than weak acids and bases. The conductivity of a solution can help in giving an idea of the solutions pH

Why strong acids and bases are have a higher reactivity:
Strong acids and bases have higher reactivity due to the higher presence of Hydronium ions in the solution despite being the same concentration. Since they have higher concentrations of H+ ions, they aim to fulfill their octet rule.

Neutralization:

A neutralization reaction is a reaction in which an acid and base react to form water and a salt. The neutralization of a strong acid and weak base will have a pH of less than 7, and conversely, the resulting pH when a strong base neutralizes a weak acid will be greater than 7. The neutralization of a strong acid and a strong base will result in a pH of 7.

Example:

Antacid medication is taken to neutralize acids in people who have high acidity 3)

Aluminum Hydroxide + Hydrochloric Acid

AlOH + HCl -> 3H2O + AlCl

Al3+ + 3OH- 3H+ + 3CL-

=Al(OH)3 + 3HCl -> 3H20 + AlCl3

Identifying the products and the reactants in a reaction

The products of a reaction are on the right side of the arrow and the reactants are on the left side of the arrow, never use an equals sign when balancing equations as you might lose marks.

Classifying Substances using state symbols:

S: This denotes that the substance is a solid, it could be a powder, foil, ribbon, these are words to help you understand what the substance is, if you see this in a question, know that the state symbol is a solid.

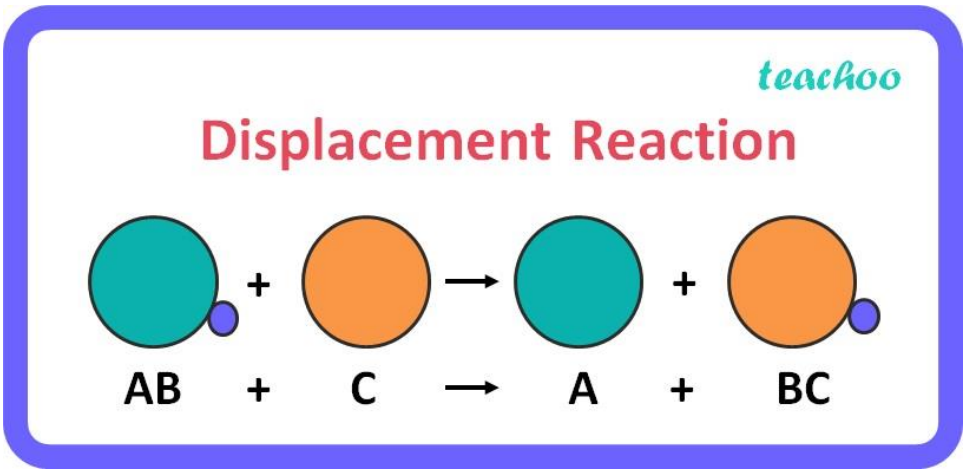
Aq: Aq means aqueous which means that the substance is dissolved in water.

G: G means gas which you need to put right beside the chemical formula when writing an equation, when a question says a certain chemical is released, you know to write g under that chemical in the products.

L: L is a substance that is a liquid, the difference between l and aq is that the substance is a liquid not dissolved in water.

Identify Different reactions:

Displacement: A displacement reaction is when a chemical replaces another chemical in the products.



Precipitate: A precipitate reaction is when a solid is formed after the two reactants react with each other.

Chemical Equations

Acid + Metal Hydroxide --> salt + water

Metal Carbonate + Acid --> salt + carbon dioxide + water

Metal + Acid --> salt + hydrogen

Metal Oxide + Acid --> salt + water

Metal hydrogencarbonate + Acid --> salt + carbon dioxide + water

Practice Questions

Complete the word equations. Then convert into balanced chemical equations.

1. Ammonia + _____nitric acid_____ → ammonium nitrate NH3+HNO3->NH4NO3

2. Calcium oxide + ___Hydrochloric Acid_____ → calcium chloride + _____water_____ Ca(OH)2 + 2HCl -> CaCl2 + H2O

3. Aluminium hydroxide + nitric acid → ___Aluminum nitrate_____ + water Al(OH)3 + 3HNO3 -> Al(NO3)3 + 3H2O

4. Calcium carbonate + _____Ethanoic Acid_____ → calcium ethanoate + ____Carbon dioxide_____ + _____Water_____ $Ca(CO3) + 2CH3OOH \rightarrow Ca(CH3OO)2 + CO2 + H2O$

5. Ethanoic acid + magnesium → _____Magnesium Ethanoate_____ + hydrogen $2CH3COOH + Mg \rightarrow Mg(CH3OO)2 + H2$

6. ____Ethanoic acid_____ + magnesium oxide → magnesium ethanoate + __water_____ $2CH3COOH + Mg2O \rightarrow Mg(CH3COO)2 + H2O$

7. Sodium hydroxide + ___Ethanoic acid_____ → _Sodium_____ ethanoate + ____water_____ $Na(OH) + CH3COOH \rightarrow Na(CH3COO) + H2O$