



Chem!stry

Name: ()

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Revision Notes for Secondary Two – Acids, Bases and Salts

1. Acids are chemicals that dissolve in water to produce hydrogen ions as the only positive ion.
2. Examples of acids include:

Name	Formula	Strong or Weak	Basicity
hydrochloric acid	<u>H</u> Cl	strong acid	monobasic
nitric acid	<u>H</u> NO ₃	strong acid	monobasic
sulfuric acid	<u>H</u> ₂ SO ₄	strong acid	dibasic
phosphoric acid	<u>H</u> ₃ PO ₄	weak acid	tribasic
ethanoic acid	CH ₃ COO <u>H</u>	weak acid	monobasic

*The hydrogen atom(s) that have been underlined represent the hydrogen of the acid that can be replaced by a metal when the acid reacts to form a salt.

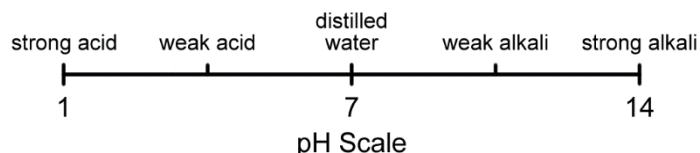
3.
 - a) *Strong acids* completely / fully ionise when dissolved in water to produce hydrogen ions as the only positive ion.
 - b) *Weak acids* only partially ionise when dissolved in water to produce hydrogen ions as the only positive ion.
4.
 - a) *Monobasic acids* produce a maximum number of *one* hydrogen ion per molecule of acid when dissolved in water (1 H can be replaced by a metal), e.g. $\text{HNO}_3(l) \rightarrow \text{H}^+(aq) + \text{NO}_3^-(aq)$
 - b) *Dibasic acids* produce a maximum number of *two* hydrogen ions per molecule of acid when dissolved in water (2 H can be replaced by a metal), e.g. $\text{H}_2\text{SO}_4(l) \rightarrow 2\text{H}^+(aq) + \text{SO}_4^{2-}(aq)$
 - c) *Tribasic acids* produce a maximum number of *three* hydrogen ions per molecule of acid when dissolved in water (3 H can be replaced by a metal), e.g. $\text{H}_3\text{PO}_4(l) \rightarrow 3\text{H}^+(aq) + \text{PO}_4^{3-}(aq)$
5. *Bases* are usually *metal oxides* or *metal hydroxides*, e.g. magnesium oxide (formula – MgO), copper(II) oxide (formula – CuO), iron (III) oxide (formula – Fe₂O₃), sodium hydroxide (formula – NaOH) and calcium hydroxide (formula – Ca(OH)₂).

If a base can be dissolved in water to form an aqueous solution, then the base can be further referred to as an *alkali*, and the solution that has been formed can be further referred to as an *alkaline solution*. The alkaline solution will contain hydroxide ions, e.g.



Ammonia is considered to be a *weak alkali*, e.g. $\text{NH}_3(g) + \text{H}_2\text{O}(l) \rightarrow \text{NH}_4^+(aq) + \text{OH}^-(aq)$

6. The pH scale indicates the degree / extent of acidity or alkalinity of a solution.

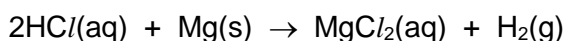


Acids have pH values less than 7. A relatively strong acid may have a pH value of 1 – 3, while a relatively weak acid may have a pH value of 4 – 6. Distilled (pure) water will have a pH value of exactly 7. Alkalis have pH values greater than 7. A relatively weak alkali may have a pH value of 8 – 11, while a relatively strong alkali may have a pH value of 12 – 14.

7. The various reactions of acids and bases typically produce salts as one of the reaction products. A salt is an ionic compound, composed of a positive cation and negative anion. A salt is produced when a metal replaces the hydrogen of an acid.

- a) acid + metal → salt + hydrogen

hydrochloric acid + magnesium → magnesium chloride + hydrogen

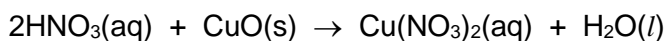


Note: Metals such as copper, gold, platinum and silver do *not* react directly with acids.

Note: Test for hydrogen gas – extinguishes a burning splint with a squeaky “pop” sound.

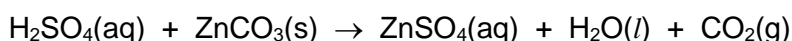
- b) acid + base → salt + water

nitric acid + copper(II) oxide → copper(II) nitrate + water



- c) acid + metal carbonate → salt + water + carbon dioxide

sulfuric acid + zinc carbonate → zinc sulfate + water + carbon dioxide



Note: Test for carbon dioxide gas – white precipitate when bubbled through limewater.

- d) ammonium salt + base → salt + water + ammonia

ammonium chloride + magnesium oxide → magnesium chloride + water + ammonia



Note: Test for ammonia gas – turns damp red litmus paper blue.

8. It is important to use the correct valencies in order to obtain the correct formulae when writing balanced chemical equations.

- Valency = 1: hydrogen, silver, Group 1 elements, Group 17 elements, NH_4^+ , OH^- , NO_3^- .
- Valency = 2: zinc, copper(II), iron(II), Group 2 elements, Group 16 elements, CO_3^{2-} , SO_4^{2-} .
- Valency = 3: iron(III), Group 13 elements, Group 15 elements, PO_4^{3-} .
- Valency = 4: Group 14 elements, specifically carbon and silicon.

9. It is important to know the solubility rules in order to write the correct state symbols when writing balanced chemical equations.
- All sodium salts, potassium salts and ammonium salts are *soluble* in water.
 - All nitrates are *soluble* in water.
 - All chlorides are *soluble* in water, except AgCl & PbCl_2 which are insoluble.
 - All sulfates are *soluble* in water, except BaSO_4 , CaSO_4 & PbSO_4 which are insoluble.
 - All carbonates are *insoluble* in water, except Na_2CO_3 , K_2CO_3 & $(\text{NH}_4)_2\text{CO}_3$ which are soluble.
 - All hydroxides are *insoluble* in water, except NaOH , KOH & NH_4OH which are soluble.
10. Oxides of the chemical elements (compounds formed when a chemical element has reacted with oxygen) can be classified as being either *acidic*, *basic*, *neutral* or *amphoteric*.
- Acidic oxides (react with bases) – oxides of non-metallic elements, e.g. CO_2 and SO_2 .
 - Basic oxides (react with acids) – oxides of metallic elements, e.g. CuO and MgO .
 - Neutral oxides (do not react with either acids or bases) – e.g. carbon monoxide (CO), nitrogen monoxide (NO), dinitrogen monoxide (N_2O) and water (H_2O).
 - Amphoteric oxides (react with both acids and bases) – e.g. aluminium oxide (Al_2O_3), lead(II) oxide (PbO) and zinc oxide (ZnO).

