Notes: THE PROPERTIES OF ACIDS AND BASE

SNC2D_06 - 07

Arrhenius Definition:

an acid is a substance which produces H^{+}(hydrogen ion) in water, and a base produces OH^{-1} (hydroxide) ions in water.

Property	Hydrochloric acid, $HCl_{(aq)}$	Sodium Hydroxide, $NaOH_{(aq)}$
Taste		
Feel		
Red Litmus		
Blue Litmus		
Bromothymol blue (BTB)		
Phenolphthalein		
$Mg_{(s)}$		
Sodium hydrogen carbonate, $NaHCO_{3(s)}$		
Conductivity		
Types of ions in solution		

Characteristic Properties of Acids and Bases:

ACIDS

- acids can be detected by our taste buds. The taste is that of something sour (lemon, squished ants)
- cause indicators (chemical dyes) to change colour: blue litmus ⟶ red
- react with many metals to produce hydrogen gas, (test for $H_{2(g)}$?):

Magnesium + Hydrochloric acid ⟶
Mg + $HCl_{(aq)}$ ⟶

Zinc + Sulphuric acid ⟶
Zn + $H_2SO_{4\,(aq)}$ ⟶

- conduct an electric current, (as demonstrated by the use of the electrical conductivity apparatus, the bulb glowed brightly)

- react with metal carbonates or (metal hydrogen carbonate) to produce carbon dioxide gas, (test for CO_2?) .

  Sodium hydrogen carbonate + Hydrochloric acid $\longrightarrow$
  $NaHCO_{3(s)}$ + $HCl_{(aq)}$ $\longrightarrow$

- react with bases to neutralise them (i.e. form water)

  Sodium Hydroxide + Hydrochloric acid $\longrightarrow$
  $NaOH_{(aq)}$ + $HCl_{(aq)}$ $\longrightarrow$

- acids have a pH of less than 7

BASES

★ Bases are bitter and not pleasant to the taste. Evolution has taught to spit out things that are bitter. Some poisons are bitter.

★ have a slippery feeling (bases react with the fat in the skin to form a layer of soap, base solutions are used to dissolve fats, oils, paints, and used to unclog drains containing food products.)

★ cause indicators (chemical dyes) to change colour: red litmus $\longrightarrow$ blue

★ conduct an electric current

★ react with acids to neutralise them:
  sodium hydroxide + hydrochloric acid $\longrightarrow$
  $NaOH_{(aq)}$ + $HCl_{(aq)}$ $\longrightarrow$

★ bases have a pH of greater than 7

The Making of Acids and Bases

Burning metals in oxygen always produces an _____
When metal oxides dissolve in water, the solution produced is a _____

Hence, when magnesium burns in oxygen, _____ _____ is produced, adding water to this produces _____ _____.

Magnesium + $oxygen_{(g)}$ $\longrightarrow$ $\xrightarrow{H_2O}$

Burning a non-metal in oxygen will also always produce an _____.

When non-metal oxides dissolve in water , the resulting solution produced is an _____.
Hence, when sulphur burns in oxygen, _____ _____ is produced, adding water to this produces _____ _____.

Sulphur + $oxygen_{(g)}$ $\longrightarrow$ $\xrightarrow{H_2O}$

Neutralization

A double displacement reaction where an acid and a base combine to produce water and a salt.

SALT: a compound made up of a metal and a non-metal, also defined as a compound made up of a positive ion, (cation), and a negative ion, (either an anion or a polyatomic ion).

Salts can be defined as compounds that do not produce neither hydrogen ions, H^{+1} , nor hydroxide ions in an aqueous solution, OH^{-1}.

Example of a neutralisation reaction:

Acid + **Base** ⟶ **Salt** + **Water**

Hydrochloric acid + Sodium hydroxide ⟶ sodium chloride + water

The salt can be obtained from this reaction by evaporating the solution obtained from the neutralization reaction.

If a solution conducts electricity, but does not feel slippery to the touch and does not liberate hydrogen when in contact with a metal, then it is a neutral salt.

Salts are used to flavour our food, to help melt ice, (lowering the fusion temperature), plaster to build homes, etc.

The pH Scale

The **pH** — of a solution indicates the concentration of the hydrogen ions, that is the acid strength in a solution.

The pH scale ranges from 1 -----> 14

A pH value of **< 7** indicates an **acid** solution, the lower the pH number, the stronger the acid.

A pH value of **> 7** indicates a **basic** solution, the higher the pH value, the stronger the base.

A **neutral** solution is indicated by a pH value of **7**.

1 2 3 4 5 6 7 8 9 10 11 12 13 14

<---------- Neutral----------> <----------Increasing Acid Strength----------Neutral----------Increasing Base Strength----------> One unit on the pH scale represents a tenfold (x10) effect.

For example:

pH 3 is 10 x more acidic than pH 4
pH 12 is 1000 x more basic than pH 9
pH 4 is 100 x more acidic than pH 6

A **pH indicator** is a substance that changes colour over some narrow range of pH values.

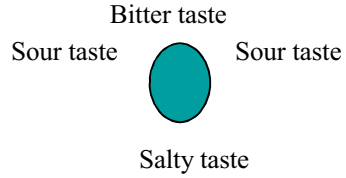
Some indicators:

Methyl orange	red to yellow	pH 3 — > 5
Bromothymol blue	yellow to blue	pH 6 — > 8
Phenolphthalein	colourless to magenta	pH 8 — > 10

Assignment

1. page 295 # 3,4, page 299 # 1 – 6

2. Three areas of the diagram of a tongue have been shaded in the following diagram. One part of the tongue has sensors of acids, another for bases, and another for salts. Enter the words acid, base and salt into the appropriate boxes provided.



3. Enter a number from the tongue diagram into each box provided to the left of each substance:
☐sea water ☐gastric juice ☐Vinegar ☐tears ☐Soap suds

4. Identify the acids, bases, and salts among the following list:

pH paper	**Aqueous solution of the substance**	**Category (acid, base, salt)**
red	Vitamin C	
blue	Windex	
red	carbonated drink (7-UP)	
dark blue	Tums antacid	
green	table salt	
blue	oven cleaner	
green	Miracle Grow (sodium nitrate)	
blue	baking soda	
red	Javex	

5. The following substances, in solution, were used for some experiments:
(i) acetic acid (ii) sodium chloride (iii) hydrochloric acid
(iv) potassium hydroxide (v) sodium hydroxide (vi) sulphuric acid
(vii) sodium hydrogen carbonate

a) Pair each substances with its formula by entering the matching number from the above list in the box on the left. Enter an **A, B or S** in the boxes to the right for acid, base or salt.

☐ ☐ $Ca(OH)_2$ ☐ ☐ CH_3COOH ☐ ☐ NaCl ☐ ☐ NaOH
☐ ☐ HCl ☐ ☐ KOH ☐ ☐ $NaHCO_3$

b) What is in the formula for acids that identifies them? _____

c) What is in the formula for bases that identifies them? _____

d) How is the formulae for salts different? _____

e) If the electrical conductivity apparatus was placed in each of the solutions above, what would be observed? _____. Explain why? _____.

f) If equal volumes and equal concentrations of (iii) and (v) were to be mixed, what name is given to this type of reaction? _____. Name the substance formed and write a balanced equation.