

WASHINGTON LATIN PUBLIC CHARTER SCHOOL
HONORS CHEMISTRY 2019-20

CLASS WORKSHEET 5.1
ACIDS, BASES AND SALTS

“Little Billie used to drink
but he doesn't drink no more
for what he thought was H₂O
was H₂SO₄”

1) Review of Cations, Anions and Molecules

CATIONS	ANIONS	MOLECULES
Give the formulae of the following cations:	Give the formulae of the following anions:	Give the formulae of the following molecules:
ammonium	bromide	ammonia
aluminium	carbonate	carbon dioxide
barium	chloride	water
calcium	fluoride	
hydrogen	hydroxide	
lithium	iodide	
magnesium	nitrate	
potassium	oxide	
sodium	sulfate	
strontium		

2) Formulae of Ionic Compounds

Deduce the formulae of the following compounds:

Name	Formula	Name	Formula
sodium oxide		hydrogen chloride	
calcium hydroxide		rubidium hydroxide	
ammonium nitrate		magnesium carbonate	
potassium carbonate		calcium nitrate	
strontium sulfate		hydrogen sulfate	
ammonium sulfate		ammonium chloride	
hydrogen nitrate		caesium bromide	
potassium sulfate		barium sulphate	
magnesium oxide		strontium nitrate	

3) Definitions of acids, bases and salts

(i) Acids

An acid is a substance which dissolves in water to release H⁺ ions (Arrhenius definition)

H⁺ ions cannot exist in pure compounds but become stable when then compound is dissolved in water:



A mixture of HCl and water contains H⁺ ions and is known as _____



A mixture of H₂SO₄ and water contains H⁺ ions and is known as _____



A mixture of HNO₃ and water contains H⁺ ions and is known as _____

These are the three most common laboratory acids.

A solution containing H⁺ ions is said to be "acidic".

The H⁺ ions can react with other ions and molecules and change the color of indicators.

H⁺ ions can also be referred to as _____.

Acids can therefore be described as _____ . This is the **Bronsted-Lowry** definition of an acid; it can be used to describe a number of substances which do not dissolve in water.

(ii) bases and alkalis

A base is a substance which can accept a H⁺ ion from an acid. Bases can therefore be described as _____ (Bronsted-Lowry definition)

There are four common types of base:

Hydroxide ions can accept H^+ ions to form H_2O : _____

Oxide ions can accept H^+ ions to form H_2O : _____

Carbonate ions can accept H^+ ions to form CO_2 and H_2O : _____

Ammonia can accept H^+ ions to form NH_4^+ ions: _____

Ammonia is soluble in water. Some ionic hydroxides, oxides and carbonates are also soluble in water. Most bases are not soluble in water. Bases which dissolve in water tend to release **OH^- ions**.

A substance which dissolves in water to give a solution containing OH^- ions is called an _____. An alkali is therefore a _____.

OH^- ions react with other ions and molecules and change the color of indicators.

All alkalis are bases. Many bases are not alkalis. Here are some examples:

Alkalis (soluble bases)	Bases which are not alkalis because they are insoluble in water:
Sodium hydroxide, NaOH Potassium hydroxide, KOH Barium hydroxide, $Ba(OH)_2$ Sodium carbonate, Na_2CO_3 Potassium carbonate, K_2CO_3 Ammonia, NH_3	calcium carbonate, $CaCO_3$ copper oxide, CuO copper carbonate, $CuCO_3$ magnesium oxide, MgO magnesium hydroxide, $Mg(OH)_2$

(iii) salts

When an acid reacts with a base, it loses its H^+ ion. The H^+ ion is replaced either with the metal ion from the base or with an ammonium ion. The resulting compound is called a **salt**.

A salt is the product formed when the H^+ ion from an acid is replaced by a metal or ammonium ion.

Salts are usually soluble in water. There are some exceptions but these will be discussed later in the course.

4) Classifying substances as acids, bases and salts

Classify all the compounds from part 2 as acids, bases or salts:

ACIDS	BASES	SALTS

5) Neutralization Reactions

A reaction between an acid and a base to make a salt is called a neutralisation reaction.

There are therefore four different reactions in which a salt can be made from an acid and a base:

Acid + metal hydroxide → metal salt + water

Eg hydrochloric acid + sodium hydroxide → sodium chloride + water

Symbol equation: _____

Acid + metal oxide → metal salt + water

Eg nitric acid + calcium oxide → calcium nitrate + water

Symbol equation: _____

Acid + metal carbonate → metal salt + carbon dioxide + water

Eg sulphuric acid + potassium carbonate → potassium sulphate + carbon dioxide + water

Symbol equation: _____

Acid + ammonia → ammonium salt

Eg hydrochloric acid + ammonia → ammonium chloride

Symbol equation: _____

Write balanced symbol equations, with state symbols, for the following neutralisation reactions; in each case, name the salt produced:

a) Nitric acid with potassium hydroxide solution

Equation:

Name of salt:

b) Sulfuric acid with sodium hydroxide solution

Equation:

Name of salt:

c) Hydrochloric acid with calcium hydroxide powder

Equation:

Name of salt:

d) Nitric acid with calcium oxide powder

Equation:

Name of salt:

e) Hydrochloric acid with barium oxide powder

Equation:

Name of salt:

f) Sulfuric acid with magnesium oxide powder

Equation:

Name of salt:

g) Nitric acid with calcium carbonate powder

Equation:

Name of salt:

h) Hydrochloric acid with barium carbonate powder

Equation:

Name of salt:

i) Sulphuric acid with sodium carbonate solution

Equation:

Name of salt:

j) Nitric acid with ammonia solution

Equation:

Name of salt:

k) Sulfuric acid with ammonia solution

Equation:

Name of salt:

l) Hydrochloric acid with ammonia solution

Equation:

Name of salt:

OBSERVING NEUTRALISATION REACTIONS

When an acid reacts with a soluble metal hydroxide or ammonia there is no visible change (except for a small temperature increase) as all the reactants and products are colourless solutions. You need an indicator to determine that a reaction is taking place.

When an acid reacts with a solid metal hydroxide or oxide, the solid

When an acid reacts with a solid metal carbonate, the solid and

..... will also be observed

When an acid reacts with an aqueous metal carbonate, will be observed