**National 4/5 Chemistry Revision Notes**

**Unit 1: Chemical Changes and Structure**

**Subsection 1: SUBSTANCES**

1. Element: is a substance that cannot be broken down into anything simpler. An element is made of the same type of atom.
2. Compound: is formed when 2 or more elements chemically join. e.g. sodium chloride

1. Naming compounds

End in “IDE” —> compound contains 2 elements

e.g. sodium chloride contains sodium + chlorine

End in “ATE” —> compound also contain OXYGEN

Or

“ITE”

e.g. potassium nitrate contains potassium, nitrogen + oxygen

1. Elements are listed in the Periodic Table

Groups

Periods

Metals

Non Metals

1. Can divide elements into METALS + NONMETALS

In the periodic table divides them.

1. Electrical conductivity distinguishes between metals and non metals.

METALS CONDUCT NON METALS DO NOT

CONDUCT

**EXCEPT CARBON**

1. Group 1 Group 7 Group 8

Alkali Metals Halogens Noble Gases

e.g. K, Na, Li e.g. Br, Cl, I e.g. He, Ne

\*stored under oil \* Very Reactive \*Very Unreactive

🡪 Very Reactive

1. Can detect a chemical reaction when one or more of the following occur:

* Colour Change
* Solid Formed (precipitate)
* Gas given off
* Heat given out
* Heat taken in
* Light given out
* Sound given out

Exothermic reaction: Heat given out to the surroundings

Endothermic reaction: Heat taken in from the surroundings

**Subsection 1 : Reaction Rates**

1. The following can affect the speed of a chemical reaction:

* Particle Size (smaller particles 🡪 faster)
* Temperature (hotter temp 🡪 faster)
* Concentration (more concentrated 🡪 faster)

1. Catalyst is a substance which speeds up a chemical reaction but remains unchanged.
2. Enzymes are biological catalysts – used to e.g. make beer, yoghurt etc.
3. Presenting results on speed of reactions:

e.g. Lump of chalk + acid A

Powdered chalk + acid B

Reaction Over

Time

Reaction slows down

Vol of gas released

\* Steeper 🡪 faster reaction

A

B

1. Average Rate of Reaction

CHANGE IN MASS/VOLUME/CONCENTRATION

Average rate = TIME INTERVAL

Eg.



**Subsection 1: Structure of the Atom**

1. Structure of an atom

Electrons outside

Nucleus contains Protons and Neutrons

2.

Particle Charge Mass

Proton 1+ 1

Neutron 0 1

Electron 1- 0

3.

Number of Neutrons = Mass Number – Atomic Number

Atomic Number = Number Protons

Mass Number = Number Protons + Number Neutrons

In a Neutral Atom,

Number of Protons = Number of Electrons

e.g.

Cl

No Protons = 17

No Electrons = 17

No Neutrons = 35 -17 = 18

Mass Number

35

17

Atomic Number

4. Outside the nucleus, the electrons fill shells, (or energy levels)

1st shell – holds 2 electrons

2nd shell – holds 8 electrons

3rd shell – holds 8 electrons

e.g. sodium, Na 🡪 11 electrons, arranged 2, 8, 1

In a group, each element has the same number of outer electrons 🡪 fixes the chemical properties of the group.

ISOTOPES – are atoms of the same element but have different mass numbers.

Cl Cl

35

17

37

17

5.

Relative Atomic Mass – is the average mass taking into account the isotopes present and the proportions of each.

\* RARELY A WHOLE NUMBER

.

6. Formation of Ions

METALS form (+) IONS

- by losing electrons in outer shell.



NON-METALS form (-) IONS

- by gaining electrons to get a full outer shell.



**Subsection 2:** **Bonding, Structure and Properties**

1. Atoms join together by forming BONDS.

When NONMETAL atoms join together, they form COVALENT bonds between the atoms by sharing electrons to obtain a full outer shell of electrons.

e.g. Fluorine

electron arrangement 2, 7

X X

X

X

X

X X

F

X X

X

X

X

X X

F

X X

X

X

X

X

X X

F

X X

X

X

X X

F

Atom

Atom

Join

Molecule

Shared Pair of electrons

(COVALENT BOND)

Written as F-F or F2 , fluorine is a DIATOMIC MOLECULE

3.

The 7 elements which exist as DIATOMIC MOLECULES are:

H2, N2, O2, F2, Cl2, Br2, I2

4. Compounds with covalent bonding

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

X

O

O

H

H

H

H

H

O

H

H2O

e.g. hydrogen oxide (water)

1. Shapes of Molecules

Molecule Hydrogen Water Ammonia Methane

Fluoride

 HF H2O NH3 CH4

O

H H

Shape H – F

Linear Bent Pyramidal Tetrahedral

6.

\*\*A Covalent bond is the electrostatic attraction between the shared pair of electrons and the positive nuclei.



1. Valency Rules (to work out formula)

e.g. Copper(II) oxide

1. elements
2. valency
3. cross-over
4. divide
5. formula
6. Differences between Ionic/Covalent Compounds

|  |  |  |
| --- | --- | --- |
|  | Covalent Compounds | Ionic Compounds |
| How to Recognise  e.g. | Non-Metal + Non-Metal(s)  hydrogen oxide | Metal + Non-Metal(s)  Sodium chloride |
| Particles | Molecules  (which are NEUTRAL) | Ions  (charged particles + or -) |
| Forces of attraction between particles | Weak forces between molecules | Ions attract strongly (held in a rigid IONIC LATTICE) |
| Melting + Boiling Points | \*Low  LOVALENT | \*High  HIONIC |
| Solubility | Dissolve in NON-AQUEOUS SOLVENTS e.g. ethanol | Dissolve in WATER |
| Conductivity | NEVER | Only when dissolved in WATER or MOLTEN 🡪 Ions Are Free To Move |

\*\*\* EXCEPTION: COVALENT NETWORK SUBSTANCES

e.g. silicon dioxide (sand)

1. Electrolysis

Electrolysis is to split up a compound using electricity

Electrolytes are solutions or melts of ionic compounds which DECOMPOSE when electricity passes through them

e.g.



(-) Electrode (+) Electrode

\* METAL FORMS \* NON-METAL FORMS

\* EQUATION FROM PG 7 DATABOOK \* REVERSE EQUATION FROM DATABOOK

Cu 2+ + 2e- 🡪Cu 2Cl- 🡪Cl2 + 2e-

10. Colour and Migration of Ions

Most ions are coloured.



**Subsection 2 : Chemical Symbolism**

1. Writing formula for compounds with COMPLEX IONS

eg. magnesium **nitrate**

**USE PG.4 DATABOOK**

Mg ( NO3 ­­­ ) ***GET VALENCY FROM***

VALENCY 2 1 ***NUMBER OF CHARGE***

BRACKETS

around

complex ion

SWAP 1 2

FORMULA Mg( NO3 )2

2. Writing IONIC FORMULA

**SHOWS CHARGES OF BOTH IONS PRESENT!**

eg. magnesium nitride

**USE PG.4 DATABOOK**

**(**Mg 2+ ) (N3-)

VALENCY 2 3

CHARGES ***METALS +***

***NONMETALS –***

BRACKETS ***NUMBER OF CHARGE IS VALENCY***

SWAP 3 2

FORMULA (Mg2+ )3 (N3- )2

3. The Mole

One mole of a substance = formula mass in grams

e.g. H2SO4 From databook

2H 2 x 1 = 2

1S 1 x 32 = 32

4O 4 x 16 = 64

98g

Mass = number of moles x Mass of 1 mole

e.g. mass of 2 moles H2SO4 = 2 x 98g = 196g

Moles = mass given

Mass of 1 mole

e.g. how many moles present in 196g of H2SO4 ?

number of moles = 196 = 2 moles

98

**Subsection 3 : Acids and Bases**

1. pH scale measures how acidic or alkaline a substance is

Acids pH < 7

Neutral pH = 7

Alkalis pH > 7

e.g. hydrochloric acid pH = 1

water pH = 7

sodium hydroxide pH = 12

Non-Metal + Oxygen 🡪 Non-Metal Oxide

These oxides cause ACID RAIN e.g. SO2

Acidic Solution

Metal + Oxygen 🡪 Metal Oxide

Group 1 and some Gp2 metal oxides dissolve in H2O

METAL HYDROXIDE

Alkaline Solution

ACIDS contain hydrogen ions, H+

Electrolyse an ACID to get hydrogen H2 at (-) electrode

ALKALIS contain hydroxide ions, OH-

2. Forming Acids/Alkalis

When non-metals burn in oxygen

When metals burn in oxygen

3.

4.

Formula of Alkalis

Sodium Hydroxide NaOH

Potassium Hydroxide KOH

Calcium Hydroxide Ca(OH)2

Formula of Acids

Hydrochloric Acid HCl

Nitric Acid HNO3

Sulphuric Acid H2SO4

Conductivity of Water

Water conducts very slightly – this is due to the presence of FEW IONS. These come from the dissociation of water molecules i.e.

H2O 🡪 H+ + OH-

MOLECULES IONS

5.

Water is NEUTRAL because there are equal concentrations of H+ and OH- ions

6.

Dilute an ACID pH increases towards 7 +

Concentration of H+ decreases

pH decreases Dilute an ALKALI

towards 7 +

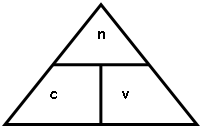
Concentration of OH- decreases

1. Concentration Calculations

Concentration tells us the number of moles of a substance dissolved in 1 litre of solvent.

**Units: moles per litre**

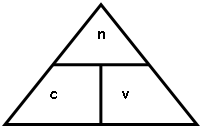
**mol/l or mol l-1**



n = number of moles

c = concentration (mol l-1)

v = volume (litres)

e.g. If 0.5 moles of Sodium Chloride is dissolved in 500ml of solution, what is the concentration?

n = 0.5

c = ?

v = 500 = 0.5l

1000 c = n

V

= 0.5 = 1 mol l-1

0.5

e.g. MORE COMPLICATED EXAMPLE!!!

If 6.9g of lithium nitrate (LiNO3) is dissolved in 500ml of solution, what is the concentration of the solution?

Need to find the number of moles before can work out concentration!

n = ?

c = ?

v = 500 = 0.5l

1000

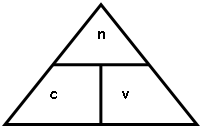
LiNO3 n = mass given

1 Li = 1 x 7 = 7 mass of 1mole

1 N = 1 x 14 = 14 = 6.9 = 0.1

3O = 3 x 16 = 48 69

69g 🡪 1 mole



C = n = 0.1 = 0.2 mol l-1

v 0.5

**Subsection 3 : Reactions of Acids**

1. Neutralisation Reactions

Neutralisation is a reaction of an acid with a NEUTRALISER which causes the pH to become 7

SALTS are the NEUTRAL substances formed when an acid is neutralised.

Hydrochloric Acid 🡪 Chloride

Nitric Acid 🡪 Nitrate

Sulphuric Acid 🡪 Sulphate

NEUTRALISERS – METALS (reactive)

ALKALIS

METAL OXIDES

METAL CARBONATES

2.Everyday Neutralisations

eg. bee sting (ACIDIC) -> use baking powder

wasp sting (ALKALINE) -> use vinegar

indigestion (too much acid) -> use indigestion remedy

acidic soil -> use lime

3. Naming Salts

SALT NAME has 2 parts to it:

(a) 1st part comes from METAL name (or ammonium) of neutraliser

(b) 2nd part comes from the ACID used

eg. sodium hydroxide + nitric acid gives SODIUM NITRATE

4. Neutralisation Reactions to make Soluble Salts

ACID + ALKALI 🡪 SALT + WATER

ACID + METAL OXIDE 🡪 SALT + WATER

ACID + METAL 🡪 SALT + HYDROGEN

ACID + METAL CARBONATE 🡪 SALT + WATER + CARBON

DIOXIDE

5. Spectator Ions

Do not take part in the reaction

i.e. SAME ON BOTH SIDES OF EQUATION

e.g. hydrochloric acid + sodium hydroxide 🡪 sodium chloride + water

HCl (aq) + NaOH (aq) 🡪 NaCl (aq) + H2O

Showing Ionic Formula

H+Cl-(aq) + Na+OH- (aq) 🡪 Na+Cl- (aq) + H2O (l)

Crossing out spectator ions, equations becomes

H+ + OH- 🡪 H2O

6. Making Insoluble Salts

These are made by Precipitation where 2 solutions of soluble salts are mixed together.

SOLUTION + SOLUTION 🡪 INSOLUBLE + NEW

**1** **2** SALT SOLUTION

Contains 1st part in name of INSOLUBLE SALT

Contains 2nd part in name of INSOLUBLE SALT

e.g. Lead Nitrate + Sodium Iodide 🡪 Lead Iodide + Sodium Nitrate

PbNO3  (aq) + NaI (aq) 🡪 PbI2 (s) + NaNO3 (aq)

Contains 2nd part in name of INSOLUBLE SALT

1. Base

A base is a substance which neutralises an acid to form a salt and water.

Bases can be soluble or insoluble.

Metal Oxides (MgO)

Metal Hydroxides (NaOH)

Metal Carbonates are examples of bases.

Bases which dissolve in water result in an alkali being formed.

1. Titration

Titration is a technique used to find the exact volume of acid (concentration unknown) needed to neutralise a certain volume of alkali of known concentration.

We can work out concentration of acid using:

PVC ACID  = PVC ALKALI

PACID = number H’s in formula of acid

PALKALI = number of OH’s in formula of alkali

V = Volume (ml)

C = concentration (mol l-1)

e.g. 20ml of sulphuric acid (H2SO4) is needed to neutralise 10ml of sodium hydroxide solution (0.5 mol l-1). What is the concentration of sulphuric acid used?

ACID (H2SO4) ALKALI (NaOH)

P = 2 P = 1

V = 20 V = 10

C = ? C = 0.5

PVCACID = PVCALKALI

2 x 20 x CACID = 1 x 10 x 0.5

40 x CACID = 5

CACID = 5

40

= 0.125 mol l-1