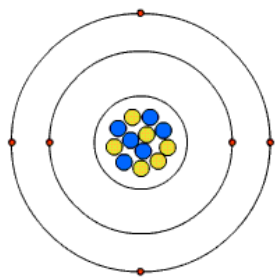


atomic structure



neutralisation reactions



metal + oxygen  $\rightarrow$

metal + water  $\rightarrow$



uses of metals



carbonate + acid  $\rightarrow$

hydrogen carbonate + acid  $\rightarrow$

rusting

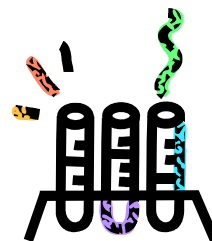


bases / alkalis

A base is a chemical opposite of an acid.

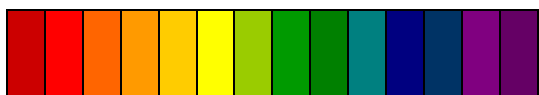
A base that dissolves in water is called an *alkali*.

reactivity of metals



pH scale

The pH scale is a measure of the relative acidity or alkalinity of a solution



Colours with UI solution (approx)

chemical properties of metals





acids

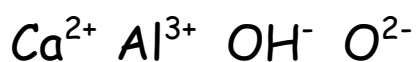
physical properties of metals

Malleable



ductile

ions



indicators



Colours with UI solution (approx)

acid + metal →

acid + base →

metal oxides and metal hydroxides



testing for hydrogen gas



test for carbon dioxide gas



mass number

27

**Al**

13

atomic number



chemical formulae



balancing equations



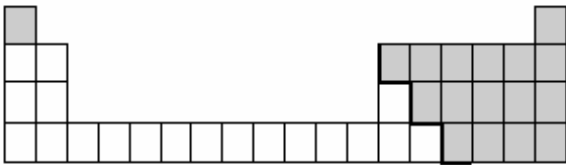
copper & sodium

**Cu** Copper  
 Atomic Number: 29  
 Atomic Mass: 63.55

**Na** Sodium  
 Atomic Number: 11  
 Atomic Mass: 22.99

metals

(white)

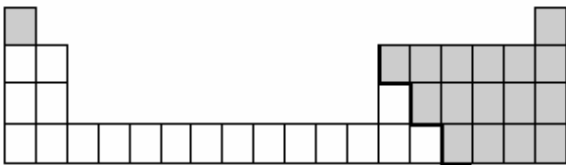


carbonates & hydrogen carbonates



non-metals

(shaded grey)



|    |    |    |  |  |  |
|----|----|----|--|--|--|
| H  |    |    |  |  |  |
| Li | Be |    |  |  |  |
| Na | Mg |    |  |  |  |
| K  | Ca | Sc |  |  |  |
| Rb | Sr | Y  |  |  |  |
| Cs | Ba | La |  |  |  |
| Fr | Ra | Ac |  |  |  |

groups in the Periodic Table of elements

iron & zinc

**Fe** Iron  
 Atomic Number: 26  
 Atomic Mass: 55.85

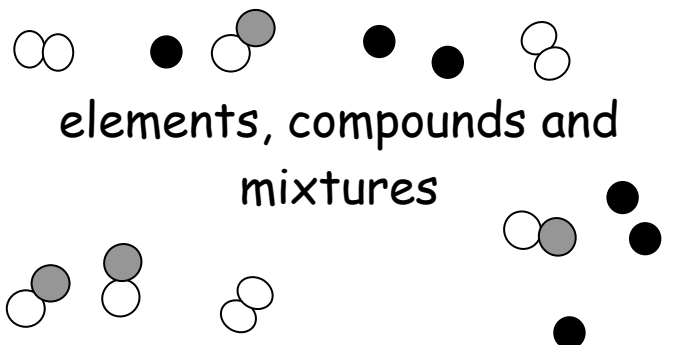
**Zn** Zinc  
 Atomic Number: 30  
 Atomic Mass: 65.39

periods in the periodic table

|    |    |   |  |    |    |    |    |    |    |
|----|----|---|--|----|----|----|----|----|----|
|    | 1  | 2 |  | 13 | 14 | 15 | 16 | 17 | 18 |
| H  |    |   |  |    |    |    |    |    | He |
| Li | Be |   |  | B  | C  | N  | O  | F  | Ne |
| Na | Mg |   |  | Al | Si | P  | S  | Cl | Ar |
| K  | Ca |   |  | Ga | Ge | As | Se | Br | Kr |
| Rb | Sr |   |  | In | Sn | Sb | Te | I  | Xe |

aluminium

**Al** Aluminium  
 Atomic Number: 13  
 Atomic Mass: 26.98



## Neutralisation

Neutralisation means cancelling out the acidity of an acid with an alkali (or cancelling out the alkalinity of an alkali with an acid). pH 7 is neutral.

Alkaline lime (calcium oxide) is put on soil that is too acid for healthy plant growth. Antacid indigestion tablets are weak alkalis that neutralise excess stomach acid.

## Uses of metals

May depend upon the chemical (c) and/or physical (p) properties of the metal.

Eg aluminium – aircraft industry – as low density (p) & aluminium oxide layer makes it unreactive (c)

Eg copper – water pipes – because it is malleable (p) and can be made into pipe shapes but is unreactive with hot and cold water and dilute acids (c)

## Rusting

Iron (Fe) is the only metal that rusts. Rust is “hydrated iron(III) oxide”.

Rusting is a form of corrosion. Rusting is also the oxidation of iron.

For rusting to occur, need *iron*, *water* and *oxygen*. Salt solution and pollution in the air will accelerate rusting.

## Reactivity of metals

Reactivity series

most - Na Mg Al Zn Fe Pb Cu - least

Aluminium does not appear as reactive as it really is because of its protective coat of aluminium oxide.

Cu will not react at all with dilute sulfuric or hydrochloric acid.

## Chemical properties of metals

Chemical properties mean how the metals react with other substances.

In this Achievement Standard you must know about their reaction with oxygen, water & dilute acids (HCl & H<sub>2</sub>SO<sub>4</sub>)

## Atomic Structure

Nucleus – contains protons (+) & neutrons (0).

Electrons (-) arranged in energy levels or shells.

1<sup>st</sup> level holds up to 2, 2<sup>nd</sup> up to 8, & 3<sup>rd</sup> up to 8 electrons.

How electrons are arranged is called the “electron configuration” or “electron arrangement”.

## General equations (1)

metal + oxygen → metal oxide

eg magnesium + oxygen → magnesium oxide

metal\* + water → metal hydroxide + hydrogen

eg sodium + water → sodium hydroxide + hydrogen

\*reactive metals like K, Na, Li and Ca with water, and less reactive Mg and Zn (with steam)

## General equations (3)

carbonate + acid → salt + water + carbon dioxide

$\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

Hydrogen carbonate + acid → salt + water + carbon dioxide

$\text{NaHCO}_3 + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} + \text{CO}_2$

## Bases & Alkalis

Alkaline solutions have a pH > 7 and contain the **hydroxide ion OH<sup>-</sup>**

The higher the pH the stronger the alkali is. A weak alkali, ammonia, is normally pH 10-11. A strong alkali, sodium hydroxide, is pH 13-14.

ZnO, CaO and Cu(OH)<sub>2</sub> are bases. They are insoluble in water but they will neutralise acids.

## pH scale

A number scale from 0 – 14 that measures how acid or alkaline a substance is.

pH 0-2 strong acid (eg HCl), pH 3-6 weak acid (eg vinegar)

pH 7 neutral (eg water)

pH 8-11 weak alkali (eg NaHCO<sub>3</sub> or NH<sub>3</sub>), pH 12-14 strong alkali (eg NaOH)

### Physical properties of metals

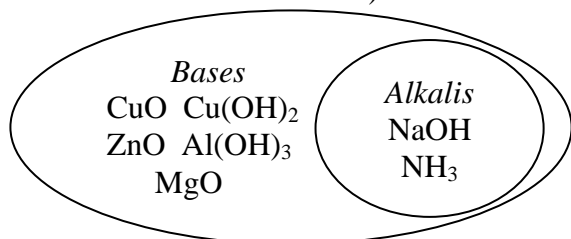
Malleable Ductile Most are dense  
Most have high melting and boiling points  
Have lustre Good conductors of heat  
Good conductors of electricity  
Some magnetic eg Fe Many are strong & hard

### Indicators

Used to decide if a substance is acidic, neutral or alkaline  
Red Litmus: stays red in acid, turns blue in alkali  
Blue Litmus: turns red in acid, stays blue in alkali  
No colour change in neutral solutions  
UI – has a range of colours from red to purple depending upon the pH

### Metal oxides and metal hydroxides

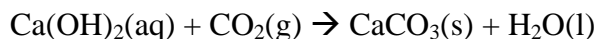
Are bases – (All alkalis are bases but not all bases are alkalis!!)



### Testing for carbon dioxide

Bubble the gas through a small quantity of lime water solution (calcium hydroxide solution).

If the gas is CO<sub>2</sub> then the lime water will go cloudy.



### Chemical formulae

ZnSO<sub>4</sub> H<sub>2</sub>O NaHCO<sub>3</sub> Cu(OH)<sub>2</sub> Al<sub>2</sub>O<sub>3</sub>

Learn some (H<sub>2</sub>SO<sub>4</sub>, HCl, H<sub>2</sub>O and CO<sub>2</sub>). Work the rest out from the table of ions. Be able to name groups OH<sup>-</sup> hydroxide, HCO<sub>3</sub><sup>-</sup> hydrogen carbonate, NO<sub>3</sub><sup>-</sup> nitrate, SO<sub>4</sub><sup>2-</sup> sulfate

Remember + and – charge must be equal when putting ions together to write a formula

### Acids

Substances with pH less than 7

Taste sour.

Are corrosive

Contain the **hydrogen ion H<sup>+</sup>**

Sulfuric acid **H<sub>2</sub>SO<sub>4</sub>** Hydrochloric acid **HCl**

### Ions

Formed when atoms lose or gain electrons to achieve a full valence shell (a stable arrangement)

Metals form + ions (cations) and Non metals form – ions (anions)

Eg Na atom (2.8.1) Na<sup>+</sup> ion (2.8)

O atom (2.6) O<sup>2-</sup> ion (2.8)

### General equations (2)

Acid + metal → salt + hydrogen

Acid + base → salt + water

With sulfuric acid the salt is a metal sulfate; with hydrochloric acid the salt is a metal chloride.

Eg. Mg + H<sub>2</sub>SO<sub>4</sub> → MgSO<sub>4</sub> + H<sub>2</sub>

### Testing for hydrogen gas

Trap the gas in the tube with a thumb.

Bring a LIT splint to the mouth of the tube.

The H<sub>2</sub> gas ignites and burns with a squeaky pop.

(Don't say "the splint pops" or "do the pop test"!) )

### Mass and atomic number

27

**Al**

13

Mass number = number of protons PLUS number of neutrons. Atomic number = number of protons. Al has 13 protons & 14 neutrons.

### copper Cu

hard pinkish orange metal, unreactive with water & dil. acids

Good conductor of heat (pan bottoms) and electricity (cables/wiring)

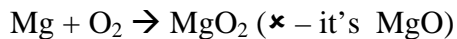
### sodium Na

soft silvery grey metal – can cut with knife & floats on water, very reactive

Stored in oil to keep away from air & moisture

### Balancing equations

A balanced equation has the same number of atoms on each side of the  $\rightarrow$ . You can only balance equations by adding numbers in front of formulae and NEVER by changing the formula of a substance.



### Carbonates & hydrogen carbonates

carbonate + acid  $\rightarrow$  salt + water + carbon dioxide

hydrogen carbonate + acid  $\rightarrow$  salt + water +  $\text{CO}_2$

The visible sign of these reactions is bubbles – fizz – due to the release of  $\text{CO}_2$  gas.

Baking soda is used with sour milk (acidic) for raising action in baking. Acidic milk reacts with the  $\text{NaHCO}_3$  to form carbon dioxide gas to give the rising action.

### Metals

(white)

Most elements are metals. 88 elements to the left and middle of the PT and left of the “stair step line” are metals or metal like elements. NB – only a portion of the periodic table is shown here.

*Elements on both sides of the zigzag line have properties of both metals and non-metals. These elements are called metalloids or semimetals eg silicon Si.*

### Groups

A group is vertical column in the Periodic Table.

There are 18 groups. Elements in a group have similar configurations of the outermost electron shells of their atoms.

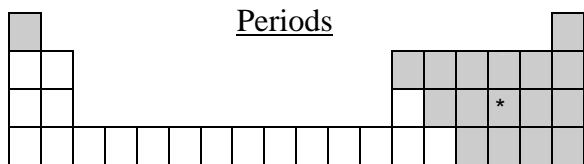
Eg Li, Na, K (in group 1) all have 1 electron in their valence shell. F, Cl and Br (group 17) all have 7 electrons in their valence shell.

### Non metals

(shaded grey)

Most are dull, brittle (eg S), poor conductors of heat/electricity, low mpt and bpt – many are gases @ room temperature (eg  $\text{Cl}_2$ ,  $\text{H}_2$ ,  $\text{O}_2$ , He).

*Exceptions – C (graphite conducts electricity) & Si (semiconductor). C (diamond) has a high mpt & bpt*



A period is a horizontal row in the Periodic Table. Across a period change is from metal to non metal.

Period 1 has 2 elements; Periods 2 & 3 have 8, Period 4 has 18. \* is in Group 16, Period 3.

### iron Fe

Shiny grey metal, magnetic. High mpt and bpt. Strong (as alloy). Used in many structures.

Only metal that RUSTS.

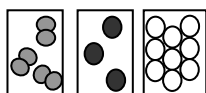
### zinc Zn

Pale bluish grey metal

Coating thin layers of zinc onto iron is galvanising and protects iron from corrosion

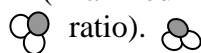
### Element

only one type of atom.



### Compound

two or more elements chemically combined (in a fixed ratio).



### Mixture

no fixed proportions – is a mix of elements OR mix of compounds OR mix of elements and compounds.

### aluminium Al

Silvery metal - strong as alloy. Uses: aircraft (low density); drinks cans (low density & non toxic); window frames (unreactive); overhead cables (unreactive & good electrical conductor)

Aluminium is actually much more reactive than it appears because it has *already reacted with oxygen* and formed a *protective layer of aluminium oxide* which covers its surface.

## Instructions

Print pages 1-3 on card / thick paper

Put paper back in the printer & then print pages 4-6 on the back.

It'll work :)

(Okay you might get it upside down and back to front if you aren't thinking but you are intelligent and will work it out for sure)