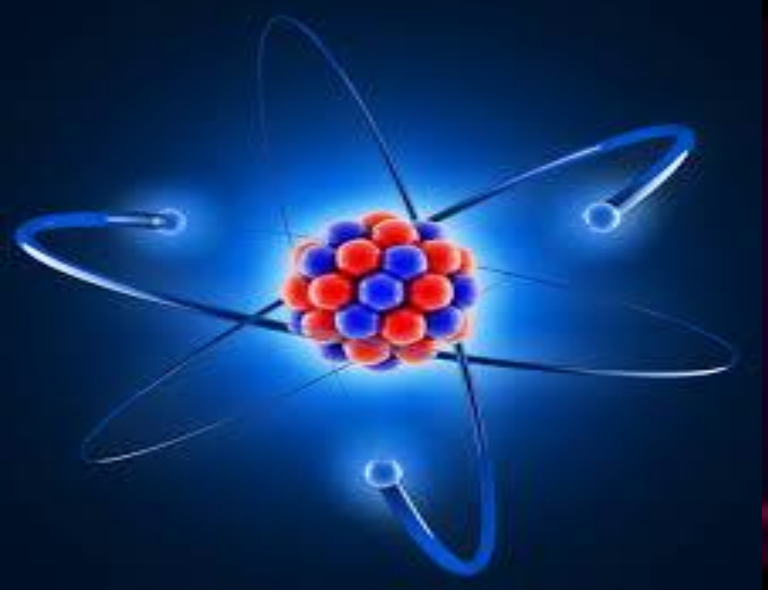
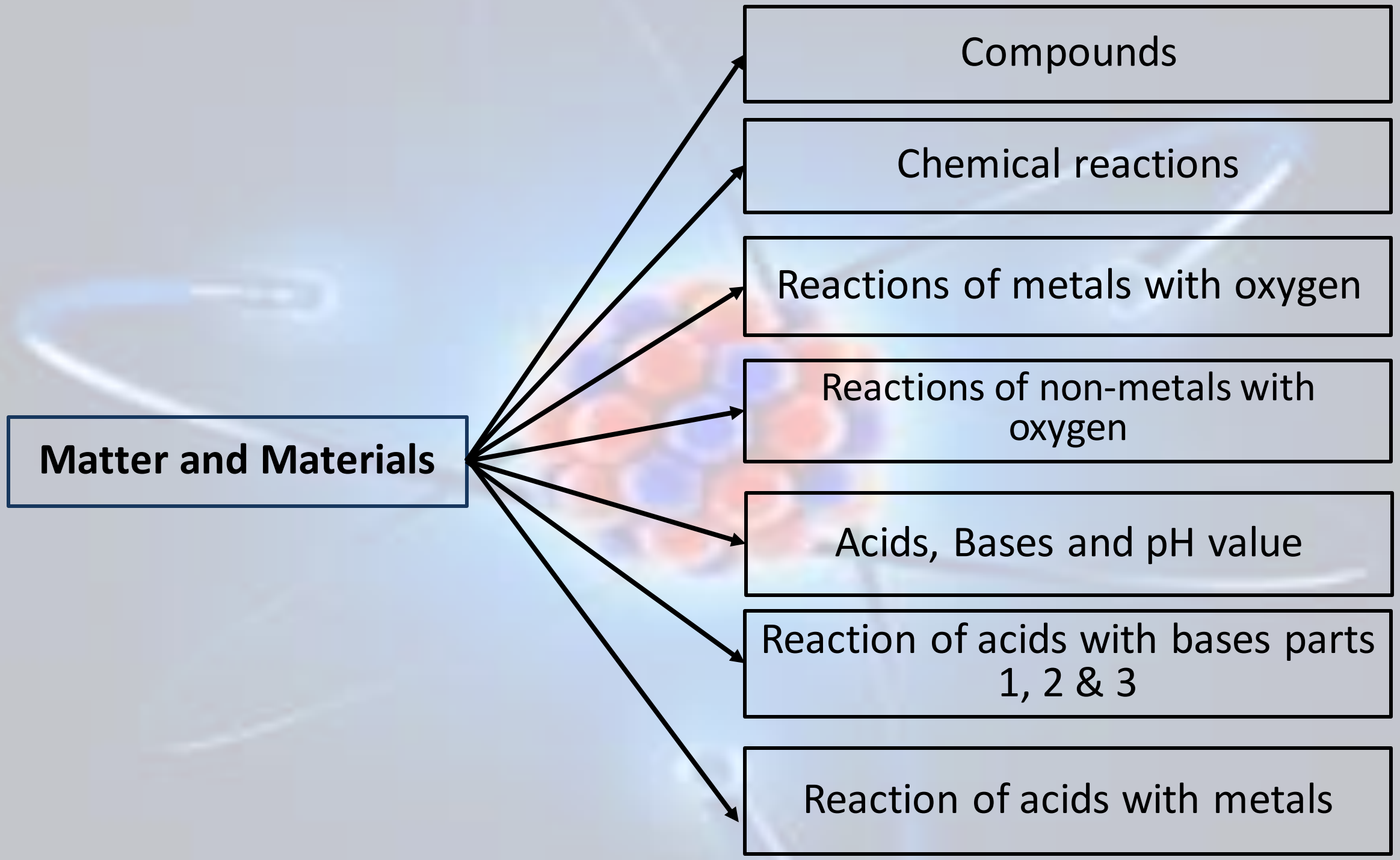
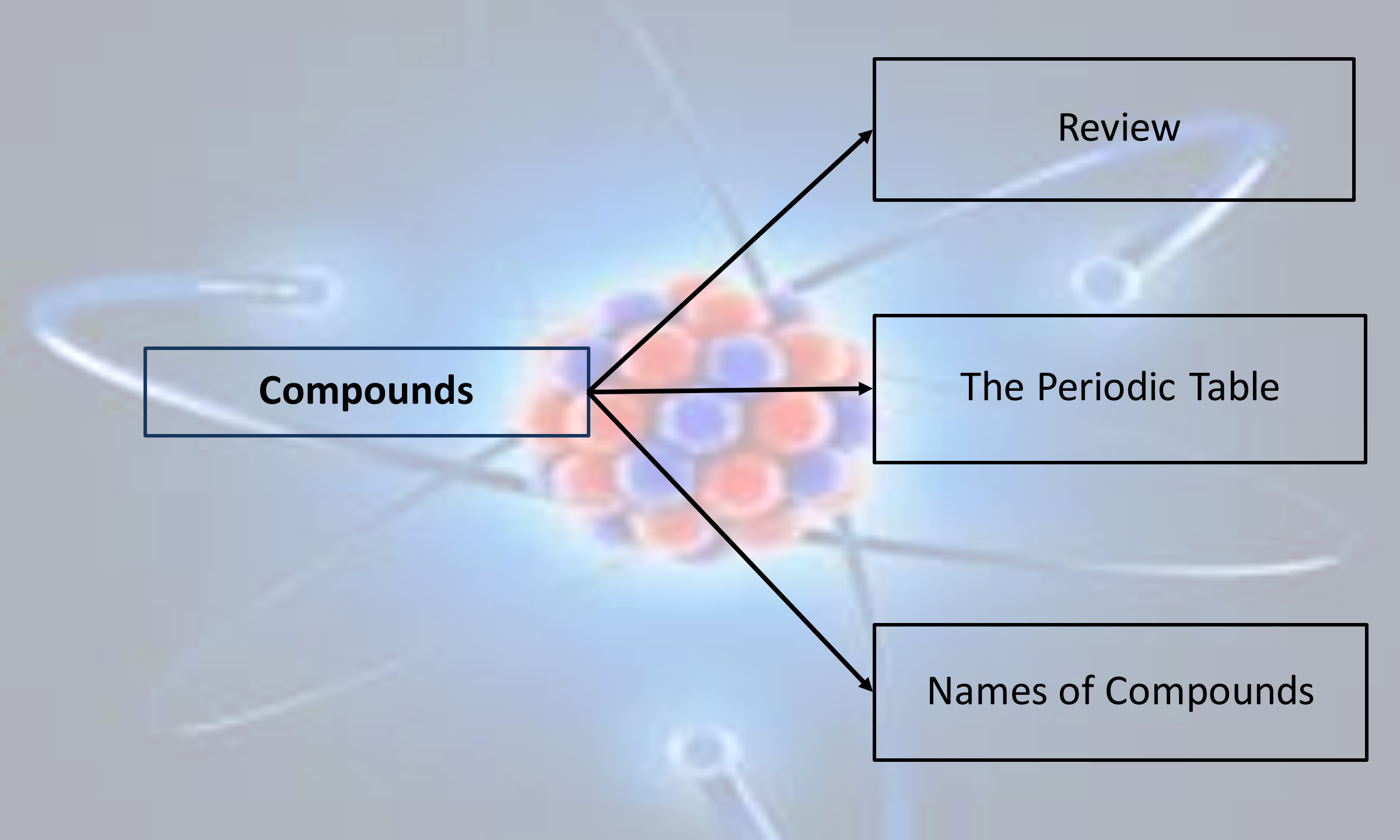
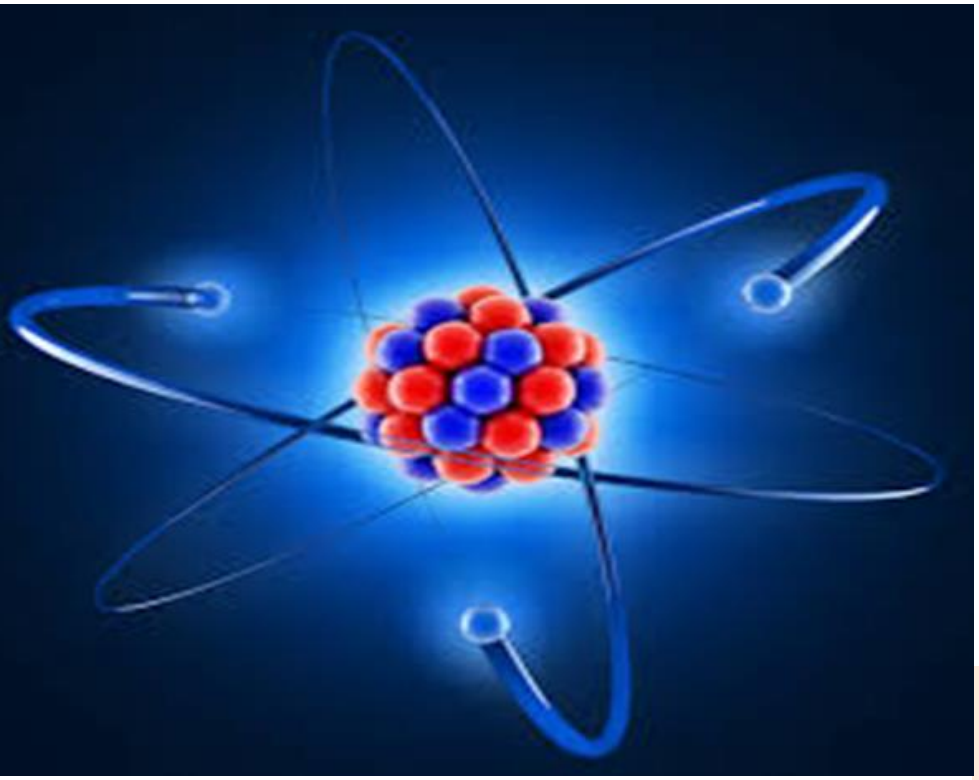


Term 2: Matter and Materials

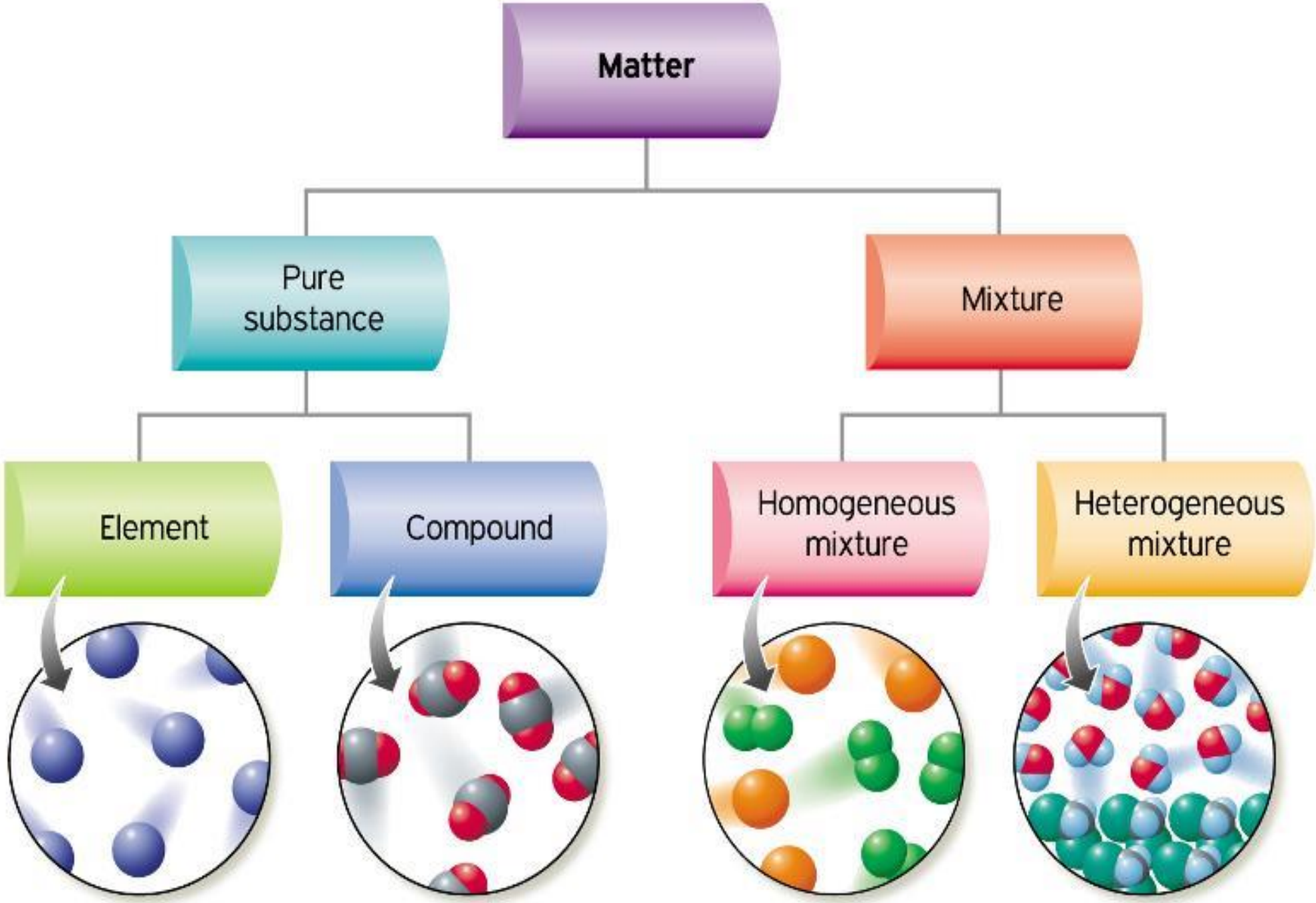
Ms Mpofu


Matter and Materials
Compounds
Chemical reactions
Reactions of metals with oxygen
Reactions of non-metals with oxygen
Acids, Bases and pH value
Reaction of acids with bases parts 1, 2 & 3
Reaction of acids with metals


Compounds
Review
The Periodic Table
Names of Compounds



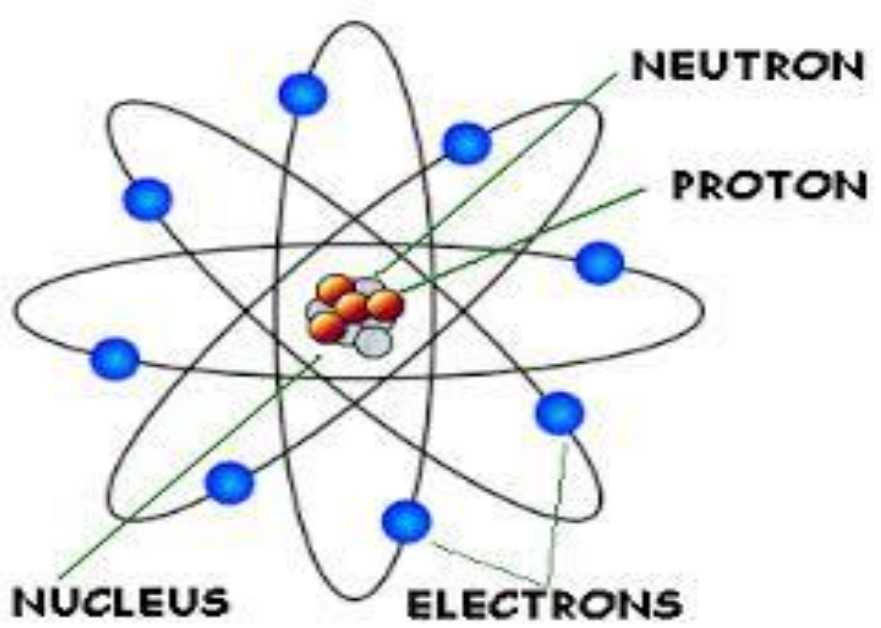
- What is matter?
- What is matter made up of?
- What are atoms?
- Differentiate between elements and compounds.


Matter
Pure substance
Mixture
Element
Compound
Homogeneous mixture
Heterogeneous mixture

Matter

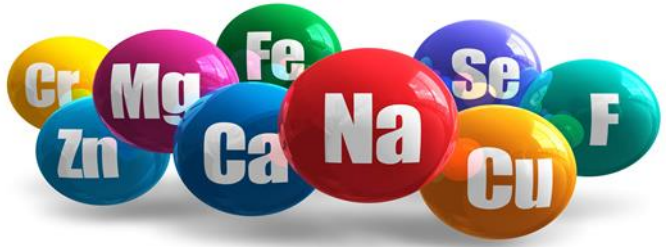
- Anything that has mass and occupies space
- Made up of atoms

Atoms

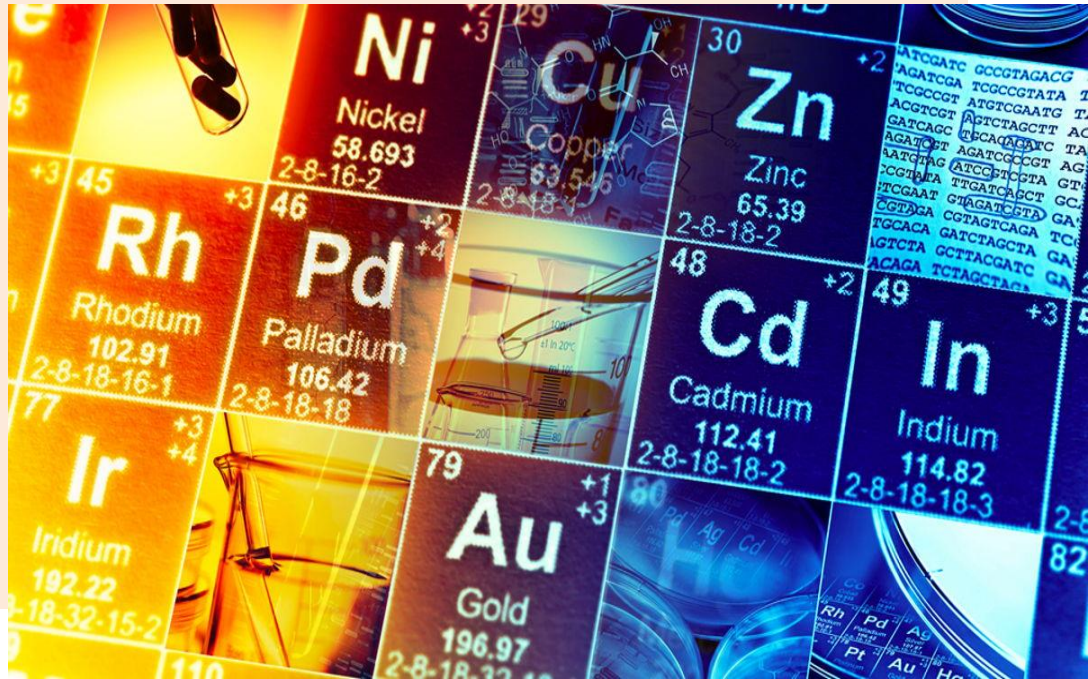


- Smallest units that make up elements
- Word atom comes from a Greek word atomos, meaning indivisible
- Indivisible – cannot be broken up

Elements

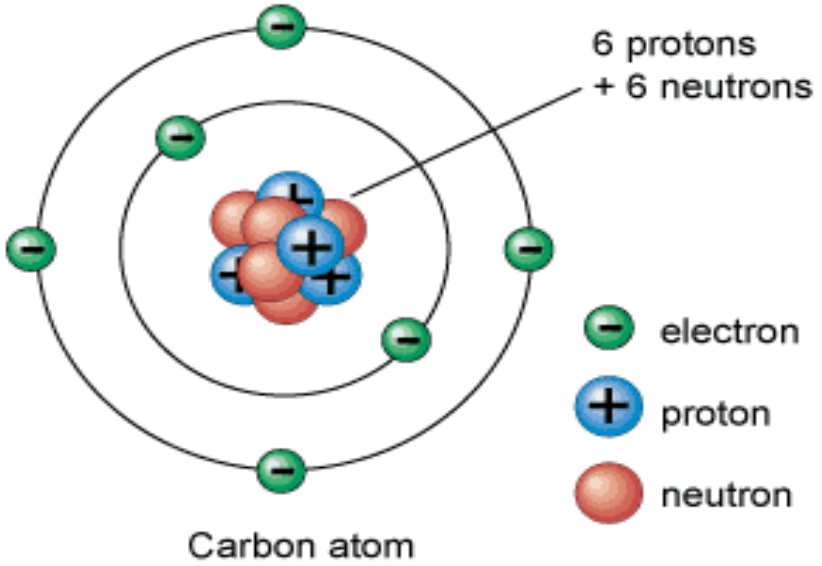


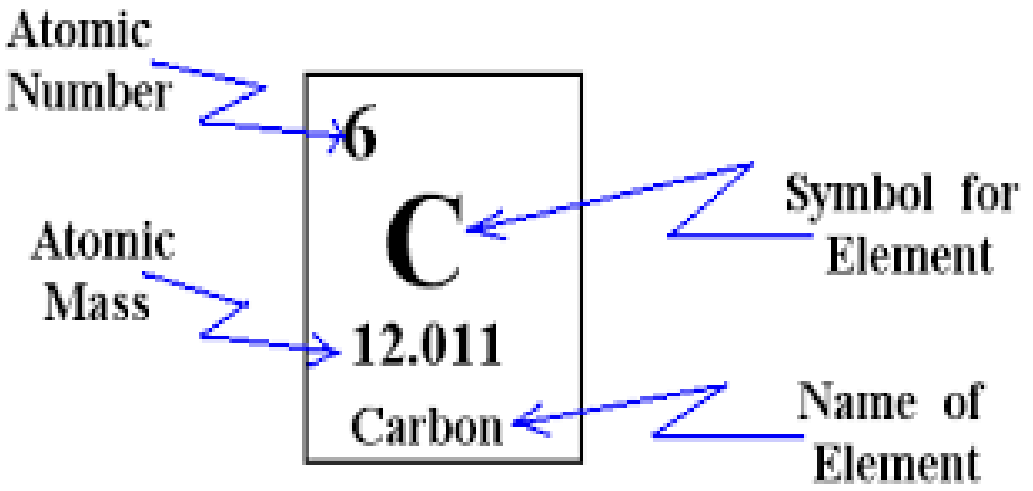
- 118 elements make up all matter on earth
- Elements are made up of atoms of the same kind
  - are pure substances
- Cannot be broken down into simpler substances by chemical reactions
- Cannot be changed into other elements
  - Chemically unique
- Organised in the periodic table
  - Dimitri Mendeleev, a Russian chemist



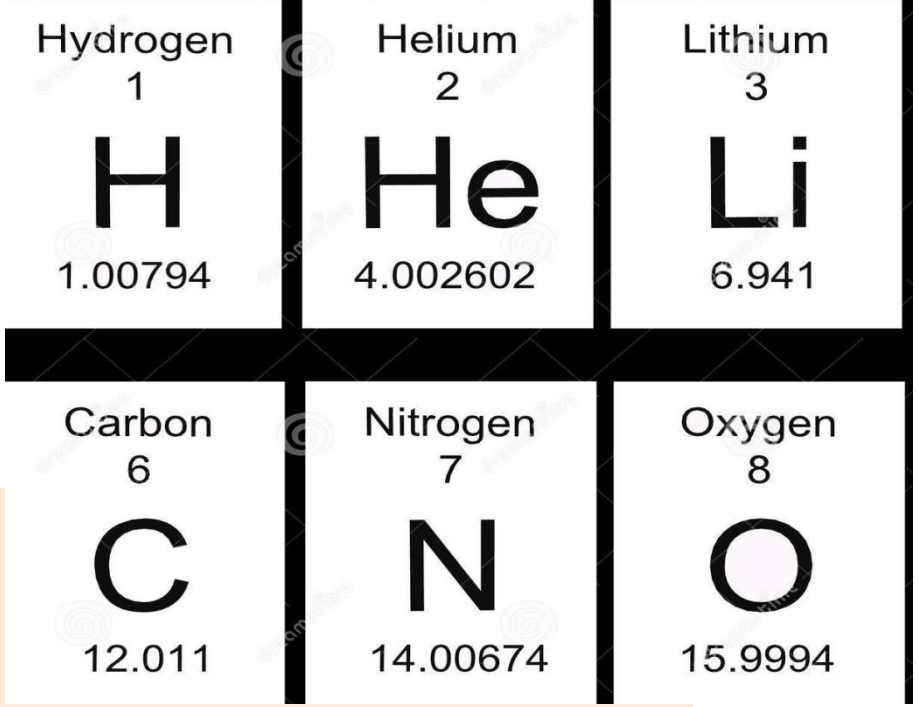
Representing elements

- **atomic number** = number of protons
- **atomic mass or mass number** = Number of particles in the nucleus
  = Number of protons + neutrons
- Number of protons equals the number of electrons
- Number of neutrons = mass number – atomic number

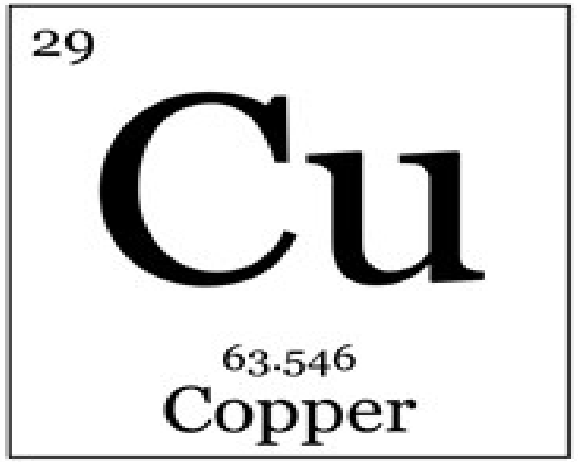




Names and Symbols of Elements



- Some element's symbols match their names
  - Hydrogen (H), Helium (He), Oxygen (O)
- Some match old names in Latin and Greek
  - Iron (Fe) – Ferrum
  - Copper (Cu) –Cuprum



QUESTIONS:

1. What does the atomic number tell us about the atoms of an element?

2. How many protons are there in oxygen atoms?

3. In most oxygen atoms, how many neutrons are there?

4. In a neutral oxygen atom, how many electrons will there be?

5. What is the charge on protons and electrons?

6. How are the protons, neutrons and electrons (the sub-atomic particles) arranged in an atom?

1. What does the atomic number tell us about the atoms of an element?
   It tells us how many protons are in the atoms.
2. How many protons are there in oxygen atoms?
   There are 8 protons (atomic number is 8).
3. In most oxygen atoms, how many neutrons are there?
   There are also 8 neutrons.
4. In a neutral oxygen atom, how many electrons will there be?
   There will be 8 electrons.
5. What is the charge on protons and electrons?
   Electrons are negatively charged and protons are positively charged.
6. How are the protons, neutrons and electrons (the sub-atomic particles) arranged in an atom?
   The protons and neutrons are clustered together in the centre, forming the nucleus, and the electrons occupy a much large space/cloud/area around the nucleus.

Periodic Table of the Elements

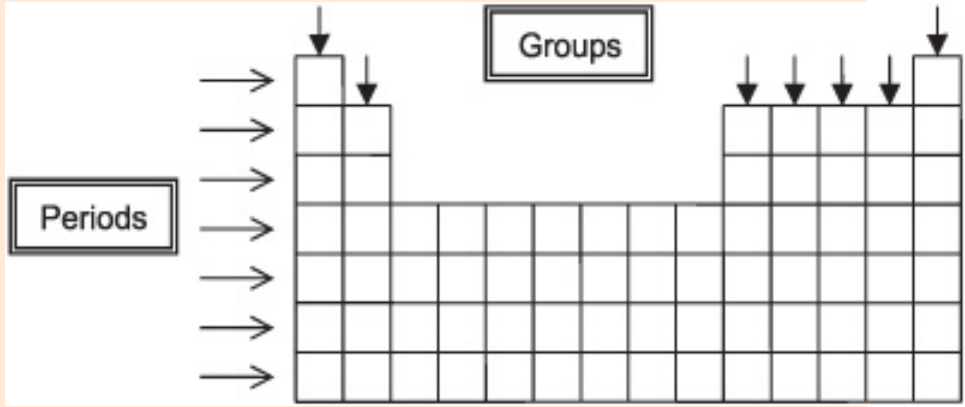
1 1IA 11A	2 IIA 2A	3 IIIB 3B	4 IVB 4B	5 VB 5B	6 VIB 6B	7 VIIB 7B	8	9 VIII 8	10	11 IB 1B	12 IIB 2B	13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A
1 H Hydrogen 1.0079																	2 He Helium 4.00260
3 Li Lithium 6.941	4 Be Beryllium 9.01218											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.00674	8 O Oxygen 15.9994	9 F Fluorine 18.998403	10 Ne Neon 20.1797
11 Na Sodium 22.989768	12 Mg Magnesium 24.305											13 Al Aluminum 26.981539	14 Si Silicon 28.0855	15 P Phosphorus 30.973762	16 S Sulfur 32.066	17 Cl Chlorine 35.4527	18 Ar Argon 39.948
19 K Potassium 39.0983	20 Ca Calcium 40.078	21 Sc Scandium 44.95591	22 Ti Titanium 47.88	23 V Vanadium 50.9415	24 Cr Chromium 51.9961	25 Mn Manganese 54.938	26 Fe Iron 55.847	27 Co Cobalt 58.9332	28 Ni Nickel 58.6934	29 Cu Copper 63.546	30 Zn Zinc 65.39	31 Ga Gallium 69.732	32 Ge Germanium 72.64	33 As Arsenic 74.92159	34 Se Selenium 78.96	35 Br Bromine 79.904	36 Kr Krypton 83.80
37 Rb Rubidium 85.4678	38 Sr Strontium 87.62	39 Y Yttrium 88.90585	40 Zr Zirconium 91.224	41 Nb Niobium 92.90638	42 Mo Molybdenum 95.94	43 Tc Technetium 98.9072	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.9055	46 Pd Palladium 106.42	47 Ag Silver 107.8682	48 Cd Cadmium 112.411	49 In Indium 114.818	50 Sn Tin 118.71	51 Sb Antimony 121.760	52 Te Tellurium 127.6	53 I Iodine 126.90447	54 Xe Xenon 131.29
55 Cs Cesium 132.90543	56 Ba Barium 137.327	57-71	72 Hf Hafnium 178.49	73 Ta Tantalum 180.9479	74 W Tungsten 183.85	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.22	78 Pt Platinum 195.08	79 Au Gold 196.9665	80 Hg Mercury 200.59	81 Tl Thallium 204.3833	82 Pb Lead 207.2	83 Bi Bismuth 208.98037	84 Po Polonium [208.9824]	85 At Astatine 209.9871	86 Rn Radon 222.0176
87 Fr Francium 223.0197	88 Ra Radium 226.0254	89-103	104 Rf Rutherfordium [261]	105 Db Dubnium [262]	106 Sg Seaborgium [266]	107 Bh Bohrium [264]	108 Hs Hassium [269]	109 Mt Meitnerium [268]	110 Ds Darmstadtium [269]	111 Rg Roentgenium [272]	112 Cn Copernicium [277]	113 Uut Ununtrium unknown	114 Uuq Ununquadium [289]	115 Uup Ununpentium unknown	116 Uuh Ununhexium [298]	117 Uus Ununseptium unknown	118 Uuo Ununoctium unknown

Lanthanide Series	57 La Lanthanum 138.9055	58 Ce Cerium 140.115	59 Pr Praseodymium 140.90765	60 Nd Neodymium 144.24	61 Pm Promethium 144.9127	62 Sm Samarium 150.36	63 Eu Europium 151.9655	64 Gd Gadolinium 157.25	65 Tb Terbium 158.92534	66 Dy Dysprosium 162.50	67 Ho Holmium 164.93032	68 Er Erbium 167.26	69 Tm Thulium 168.93421	70 Yb Ytterbium 173.04	71 Lu Lutetium 174.967
Actinide Series	89 Ac Actinium 227.0278	90 Th Thorium 232.0381	91 Pa Protactinium 231.03588	92 U Uranium 238.0289	93 Np Neptunium 237.0482	94 Pu Plutonium 244.0642	95 Am Americium 243.0614	96 Cm Curium 247.0703	97 Bk Berkelium 247.0703	98 Cf Californium 251.0796	99 Es Einsteinium [254]	100 Fm Fermium 257.0951	101 Md Mendelevium 258.1	102 No Nobelium 259.1009	103 Lr Lawrencium [262]

Alkali Metal | Alkaline Earth | Transition Metal | Basic Metal | Semimetals | Nonmetals | Halogens | Noble Gas | Lanthanides | Actinides

Arrangement of elements

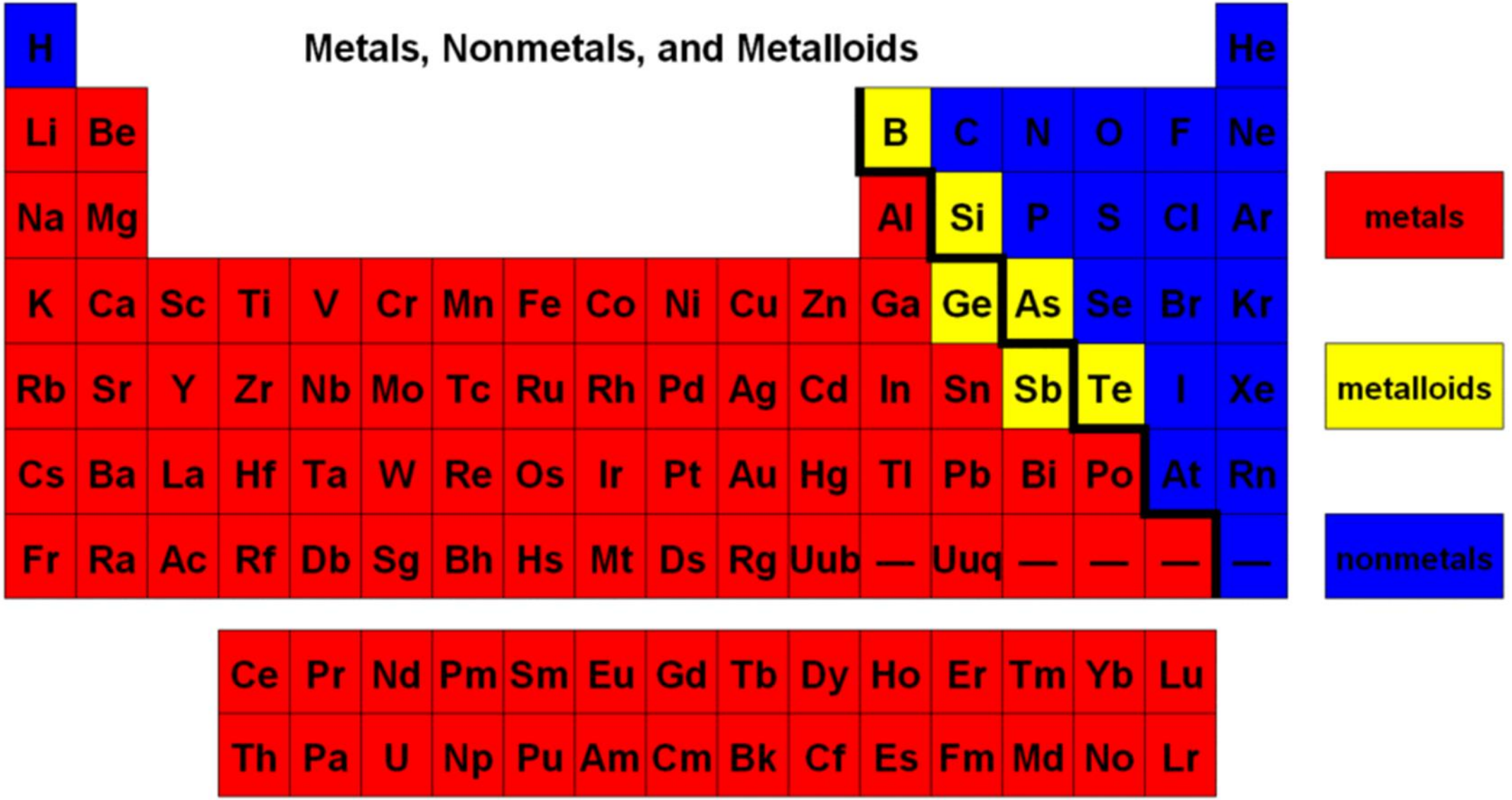
- Elements are arranged into groups and periods
- 18 vertical columns: groups
  - Same electron configuration in their valence shell
  - Same chemical properties
- Eg. He, Ne, Ar, Kr, Xe, Rn
  - Grp 18 elements (noble gases)
  - Outer orbital is full of electrons
  - Stable, do not easily react with other elements
  - Elements are gases at room temperature
- 7 horizontal rows: periods
  - The atomic number increases from left to right
  - Energy levels of atoms increase as you go down the period



Classification of elements

- Three groups: metals, semi-metals, non-metals
- Metals
  - All metals are solid at room temperature ($25^{o}C$) except mercury(Hg), liquid at room temperature
  - Found on the left hand side of the periodic table
- Non metals
  - Are all gases at room temperature except bromide (Br), liquid at room temperature
  - Found on the right hand side of the periodic table
- Semi-metals
  - Have properties of both metals and non-metals
  - Eg. silicon (Si), is solid and shiny like a metal but a poor conductor to heat like a non-metal
  - Found in between metals and non-metals

Classification of elements cont.

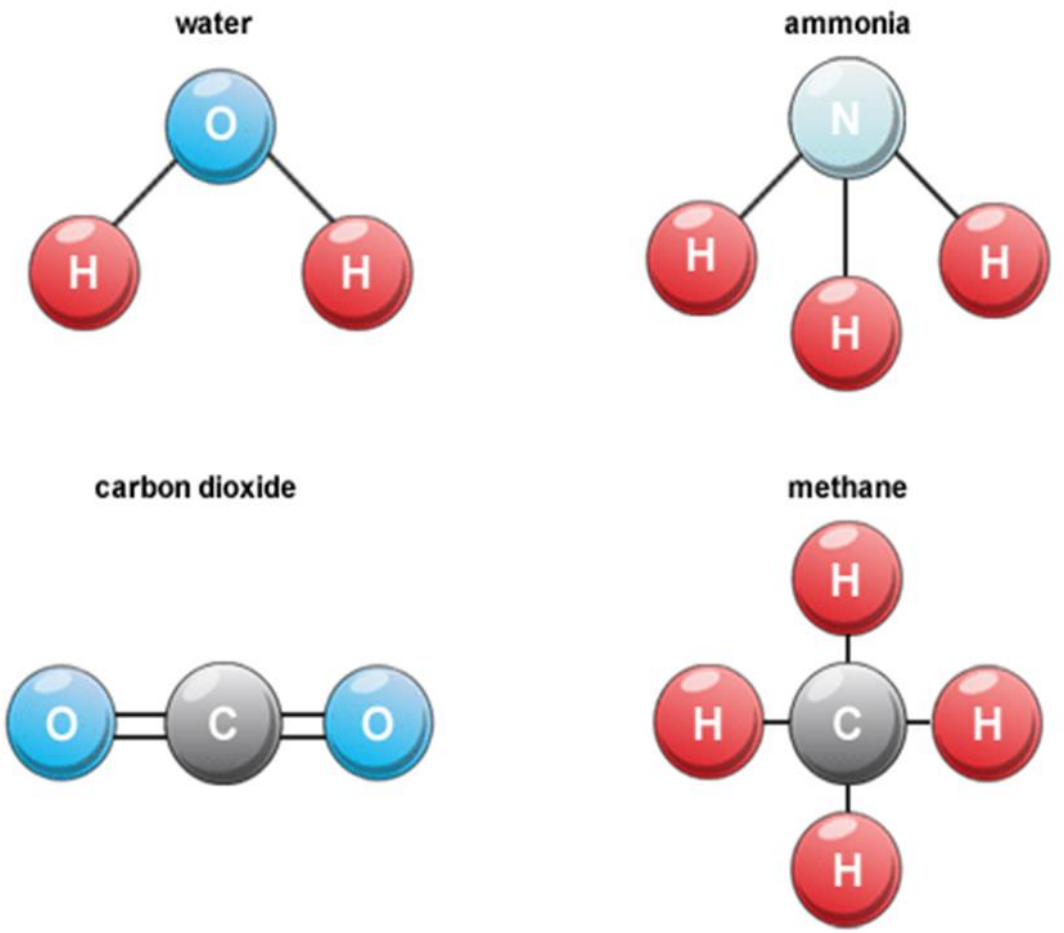


KEY QUESTIONS:

- What is a compound?
- How is a compound different from an element?
- How is a mixture of elements different from a compound?
- What does the position of an element on the Periodic Table tell us about its properties?
- Where do we find metals, non-metals and semi-metals on the Periodic Table?
- What are the vertical columns of the Periodic Table called?
- What are the horizontal rows of the Periodic Table called?
- What do elements belonging to the same 'group' of the Periodic Table have in common?
- What additional information about an element can we find on the Periodic Table?
- What does the formula of a compound tell us about it?

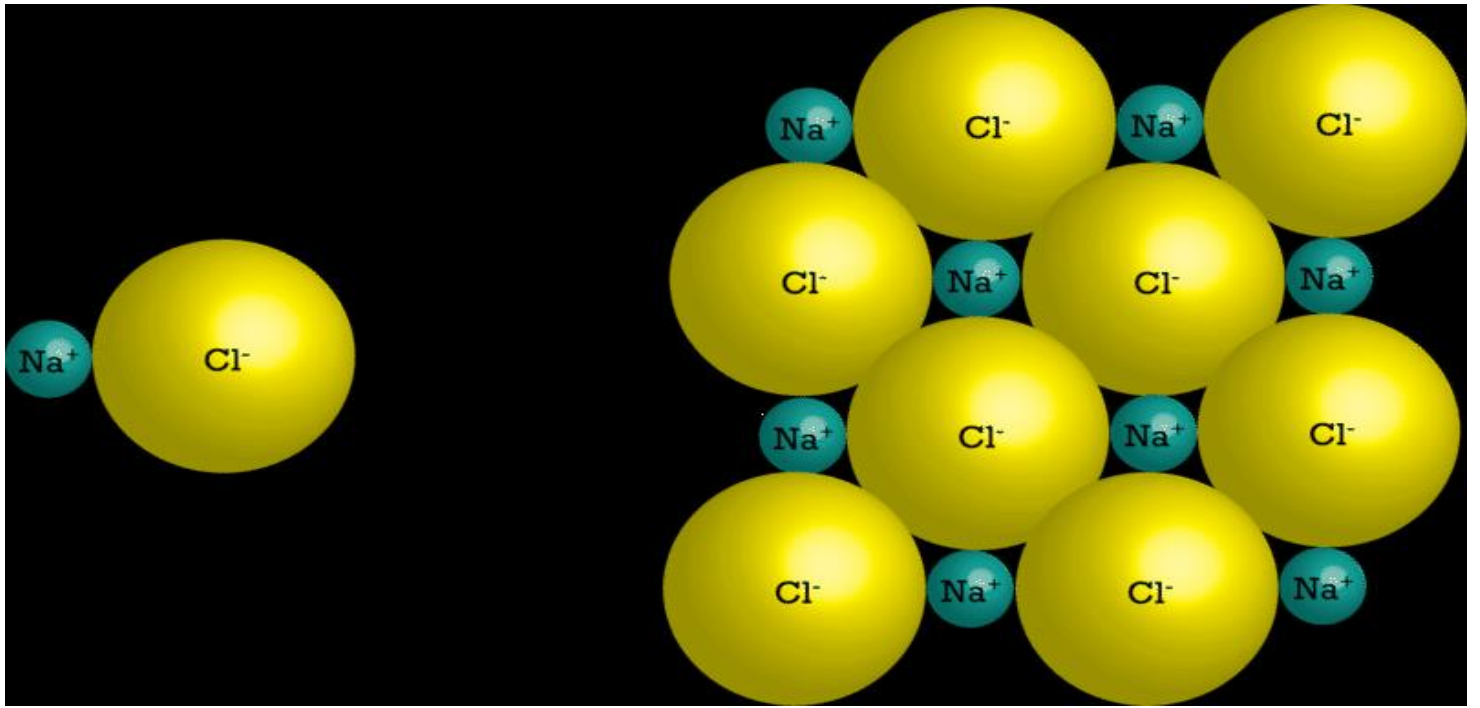
Compounds

- Pure chemical substances consisting of two or more different elements
- Formed by chemical reactions
- Have properties that are different from those of individual elements
- Can be decomposed into simpler substances by chemical reactions
- Have a fixed ratio of atoms



Compounds have different properties to those of individual elements

sodium metal + chlorine gas → table salt



Names of compounds

- Name worked out using the elements that make up the compound

  Eg. Sodium chloride (NaCl), Hydrogen sulfide (H_2S), Magnesium oxide (MgO)

- Second part of the name show which group of atoms is attached to the main atom

  Eg. Chloride for chlorine, sulfide for sulfur, oxide for oxygen

- Some compounds have common names

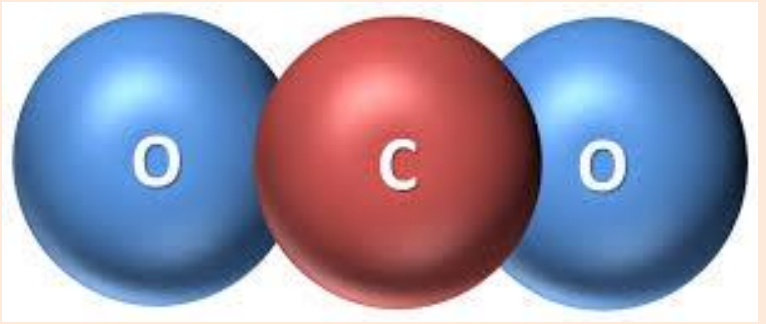
  Eg. Water (H_2O), ammonia (NH_3), Lime water (calcium hydroxide $Ca(OH)_2$)

- Prefixes (mono, di/bi, tri) can also be used

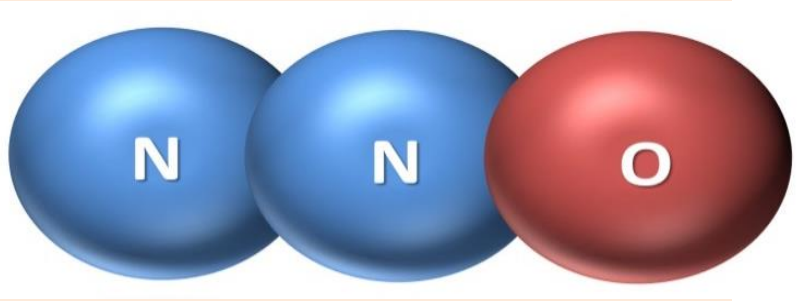
  Eg. Carbon monoxide, carbon dioxide, sulfur trioxide

Formulae for compounds

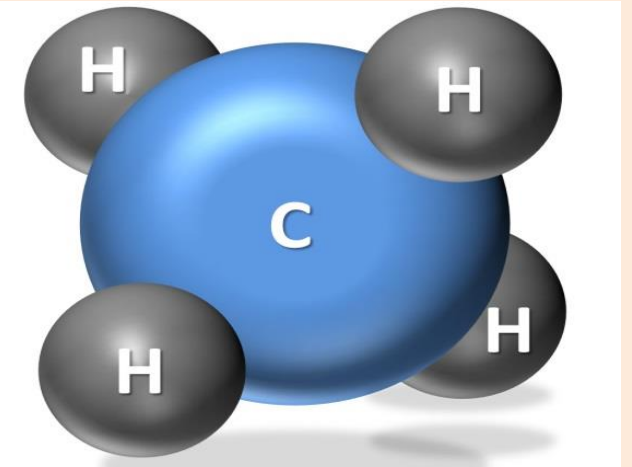
- Tells us the ratio of the number of each element in the compound



CO_2



N_2O



CH_4

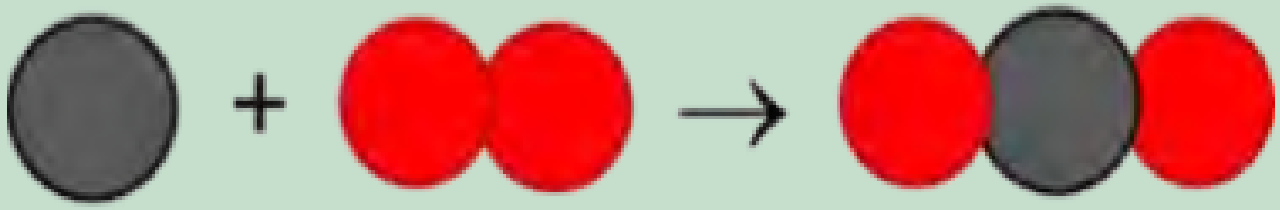
Revision

Name of substance	What it is made of?	Chemical formula
water	2 H atoms and 1 O atom	H_2O
carbon dioxide	1 C atom and 2 O atoms	
ammonia	1 N atom and 3 H atoms	
methane	1 C atom and 4 H atoms	

QUESTIONS:

1. What holds the atoms together in a compound?

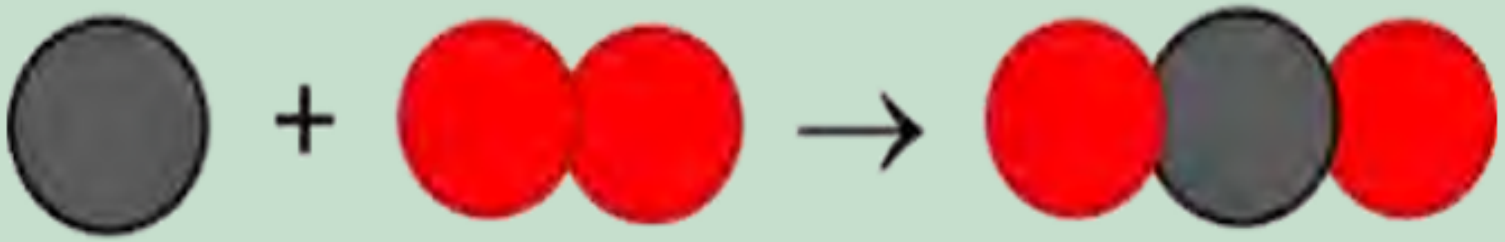
2. The following diagram shows how carbon and oxygen react to form carbon dioxide.



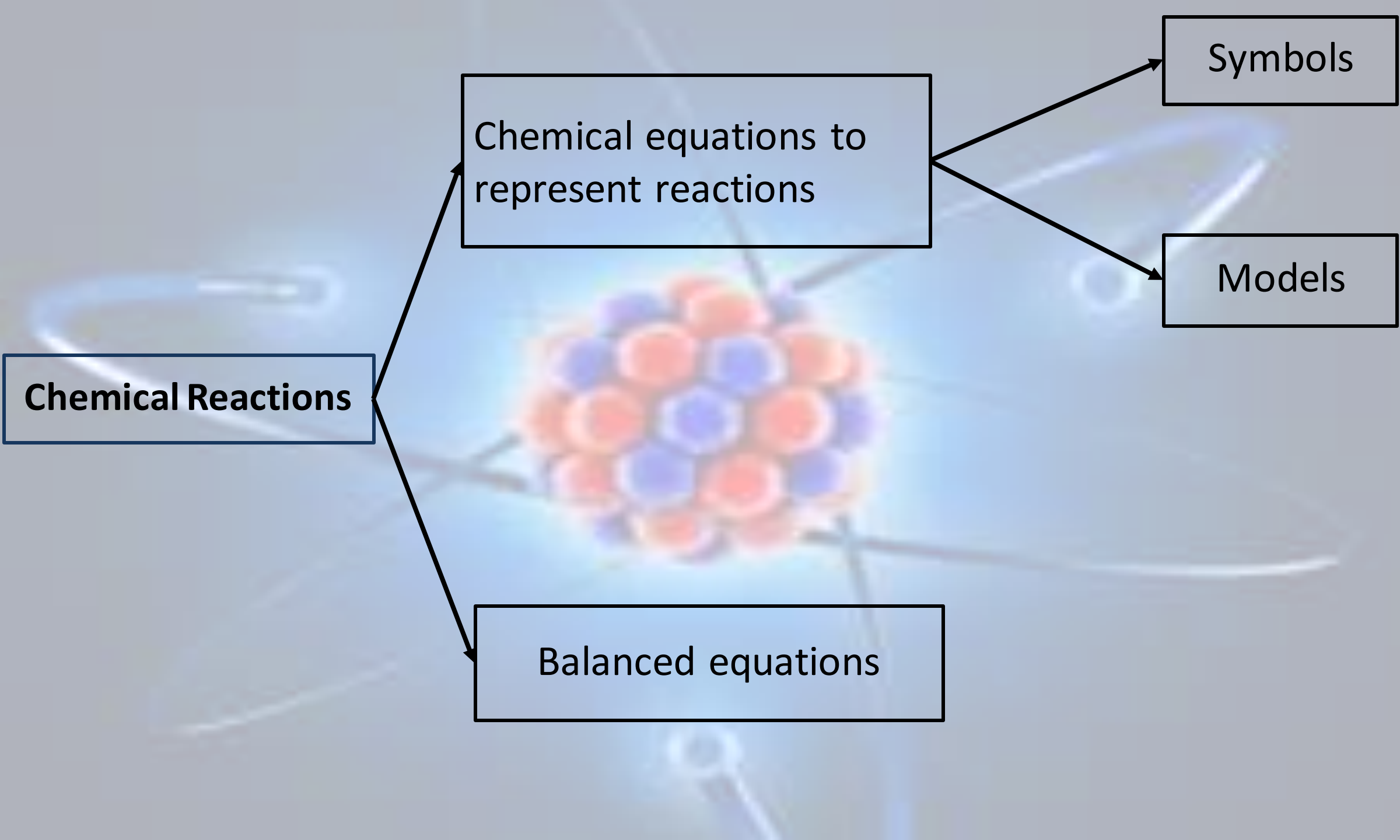
What are the reactants and what is the product in this reaction? Write these names onto the diagram.

3. Why is oxygen represented as two circles together?

1. What holds the atoms together in a compound?
   A chemical bond holds the atoms together.
2. The following diagram shows how carbon and oxygen react to form carbon dioxide.

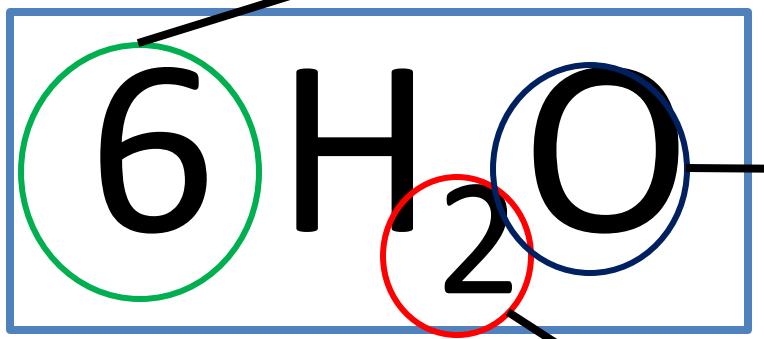


   What are the reactants and what is the product in this reaction? Write these names onto the diagram.
   the reactants are carbon (grey circle) and oxygen (red circles) and the product is carbon dioxide.
3. Why is oxygen represented as two circles together?
   The two circles each represent an oxygen atom as oxygen is a diatomic molecule meaning it exists as two oxygen atoms bonded together in diatomic molecules.
4. Magnesium oxide has the formula MgO. what does this ratio tell us about the atoms in the compound?
   It means that for every 1 magnesium atom, there is 1 oxygen atom joined to it in a chemical bond.


Chemical Reactions
Chemical equations to represent reactions
Symbols
Models
Balanced equations

Chemical reactions

- Result in a chemical change – a new substance is formed
- Atoms are neither lost nor gained during a chemical reaction
  - Atoms are simply rearranged
- Bonds between elements are broken and new ones are formed
- Represented in model or symbol form
- Reactants and products separated by an arrow



Coefficient: The number of molecules

= 6 water molecules

= $H_2O + H_2O + H_2O + H_2O + H_2O + H_2O$

Symbol: Element in the molecule

H = Hydrogen

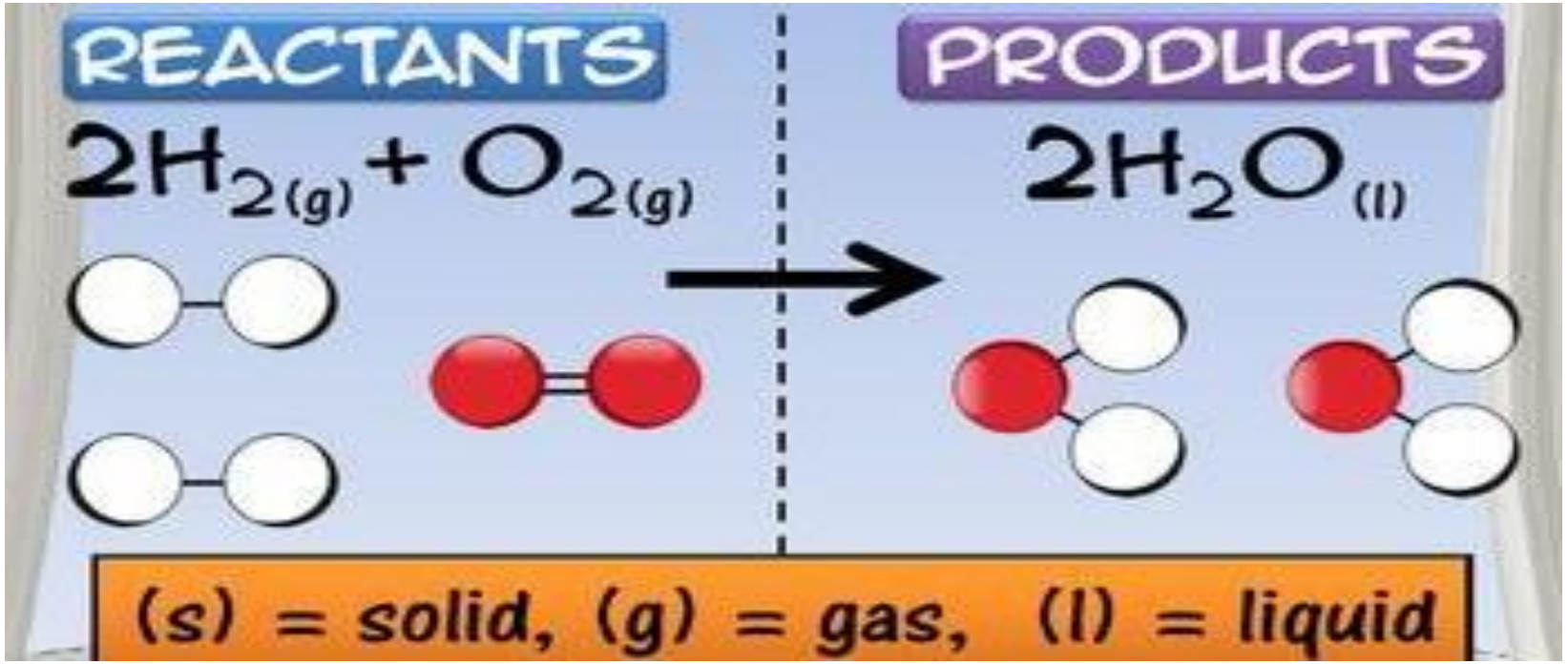
O = Oxygen

Subscript: The number of atoms of a specific element

= 2 H atoms

= 1 O atom

Representing a chemical reaction



$$2\,H_2 + O_2 \longrightarrow 2\,H_2O$$

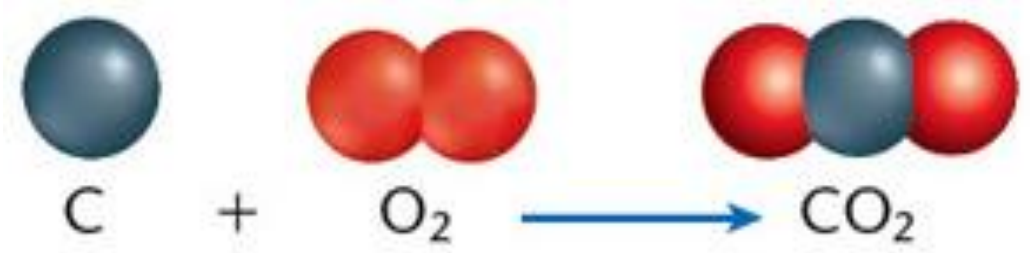
reactants *products*

Types of chemical reactions

Type of Reaction	Definition	★ Equation
Synthesis	Two or more elements or compounds combine to make a more complex substance	A + B → AB 
Decomposition	Compounds break down into simpler substances	AB → A + B 
Single Replacement	Occurs when one element replaces another one in a compound	AB + C → AC + B 
Double Replacement	Occurs when different atoms in two different compounds trade places	AB + CD → AC + BD 

Colors: A = Red, B = Blue, C = Green, D = Yellow

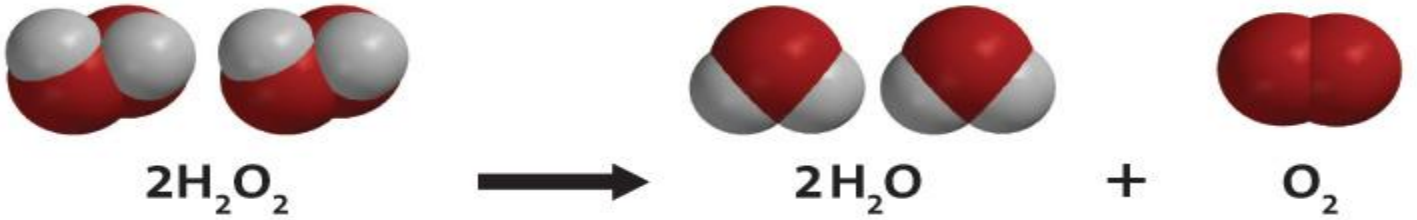
Chemical reactions cont.



1 carbon atom

1 oxygen molecule

1 molecule of carbon dioxide



$2H_2O_2$ hydrogen peroxide

$2H_2O$ water + O_2 oxygen

CH_4 methane

$2O_2$ oxygen

CO_2 carbon dioxide

$2H_2O$ water

5 Signs of a Chemical Reaction

A chemical reaction has definitely occurred if any of the following are observed :

1. A permanent colour change occurs, eg. Metal rusting.

2. A gas is given off, eg. Berocca tablet dissolving.

3. There is a change in temperature, indicating that energy has been produced or absorbed.
   eg. Gas burns in a bunsen burner.

4. A precipitate (solid) forms when two clear solutions are mixed.

5. One metal deposits on another.

Balancing equations

Balance equations "by inspection" with these steps:

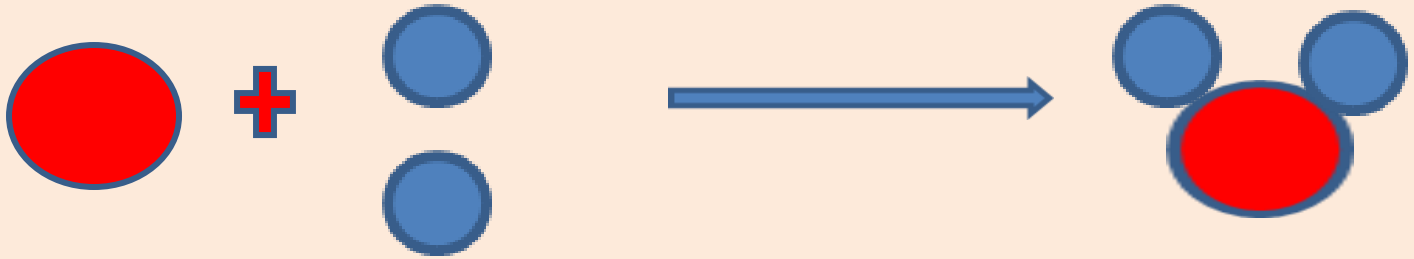
1. Check for diatomic molecules.
2. Balance the metals (not Hydrogen).
3. Balance the nonmetals (not Oxygen).
4. Balance oxygen.
5. Balance hydrogen.
6. The equation should now be balanced, but recount all atoms to be sure.
7. Reduce coefficients (if needed).

The burning of coke

- coke (carbon) burns in air (oxygen) producing carbon dioxide gas

- Word equation: carbon + oxygen ⟶ carbon dioxide
- Chemical equation: $C + O_2 \longrightarrow CO_2$

- Model:



The burning of hydrogen

- **Hydrogen burns in air (oxygen) producing water**

- **Word equation: hydrogen + oxygen → water**
- **Chemical equation: $2H_2 + O_2 \rightarrow 2H_2O$**

Balance the following equations

1. Copper + oxygen ⟶ copper oxide
2. Iron + oxygen ⟶ iron oxide
3. Silver nitrate + calcium bromide ⟶ silver bromide + calcium nitrate

$AgNO_3 + CaBr_2 \longrightarrow AgBr + Ca(NO_3)_2$

Revision Pg 95

- $2Cu + O_2 \longrightarrow 2CuO$
- $4Fe + 30_2 \longrightarrow 2Fe_2O_2$
- $2AgNO_3 + CaBr_2 \longrightarrow 2AgBr + Ca(NO_3)_2$

Reactions of metals with oxygen

- Metals react with oxygen during:
  - storage
  - combustion
- Metal oxides are formed

Combustion of a metal

$$\text{Metal} + \text{oxygen} \longrightarrow \text{metal oxide}$$

- Not all metals react with oxygen in the air to form metal oxides, some metals are too unreactive
  - Gold, silver, platinum

Combustion of different metals

- Sodium – bright yellow flame
- Potassium - bright light
- Calcium – combustion less vigorous
- Zinc - white flame
- Copper – not very reactive…glows and forms a black powder

Reactions of metals with oxygen

- Grp 1 elements - very reactive, stored away from oxygen to prevent them from being oxidized
- Metals at the bottom are very reactive compared to the ones at the top

Reactions of grp 1 metals with oxygen

- **Magnesium + oxygen ⟶ Magnesium oxide**
  - $Mg + O_2 \longrightarrow MgO$
  - $2Mg + O_2 \longrightarrow 2MgO$
- **Lithium + oxygen ⟶ lithium oxide**
  - $Li + O_2 \longrightarrow Li_2O$
  - $4\,Li + O_2 \longrightarrow 2Li_2O$
- **Potassium – potassium peroxide or potassium superoxide**
  - $2K + O_2 \longrightarrow K_2O_2$ (peroxide)
  - $K + O_2 \longrightarrow KO_2$ (superoxide)

Reaction of iron with oxygen

- During combustion
- Iron oxide is formed
- Iron + oxygen ⟶ iron oxide

– Rust

➢ $Fe + O_2 \longrightarrow Fe_2O_3$ (unbalanced)

➢ $4Fe + 3O_2 \longrightarrow 2Fe_2O_3$

– Magnetite

$Fe + O_2 \longrightarrow Fe_3O_4$ (unbalanced)

$3Fe + 2O_2 \longrightarrow Fe_3O_4$

Reaction of magnesium with oxygen

- During combustion
- Magnesium oxide is formed
- Magnesium + oxygen ⟶ magnesium oxide

➢ $Mg + O_2 \longrightarrow MgO$ (unbalanced)

➢ $2Mg + O_2 \longrightarrow 2MgO$

Investigating the reaction of iron with oxygen

- **Materials**
  - Steel wool, tongs, matches, safety goggles, heat source
- **Procedure**
  - Use the tongs to hold the steel wool
  - Hold the steel wool over the flame until it ignites
  - Observe what happens

Questions

1. **Record your observations under the headings:**

– **Aim, Method, Results, Conclusion**

2. **Answer the following questions**

a) **What colour did the flame burn**

b) **What is the colour of the product formed**

c) **Write a word equation for the reaction**

d) **Write a balanced chemical equation for the reaction**

3. **Describe the safety precautions that need to be taken in this investigation**

Investigating the reaction of magnesium with oxygen

- **Materials**
  - Magnesium ribbon, tongs, matches, safety goggles, heat source
- **Procedure**
  - Use the tongs to hold the magnesium ribbon
  - Hold the Mg ribbon over the flame until it ignites
  - Observe what happens

Questions

1. **Answer the following questions**

a) **What colour did the flame burn**

b) **What is the colour of the product formed**

c) **Write a word equation for the reaction**

d) **Write a balanced chemical equation for the reaction**

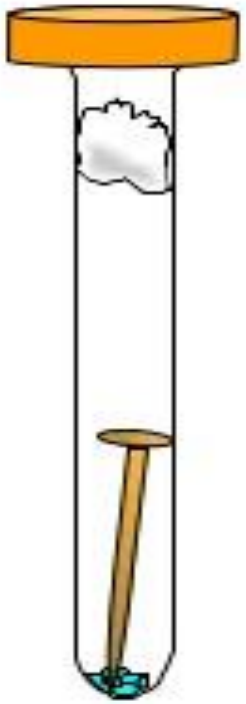
Formation of rust

- Slow chemical reaction involving
  iron metal, oxygen and moisture (water)
- Is a form of corrosion –wearing away
- Only occurs at the surface which is exposed to air
- Weakens steel equipment and structures

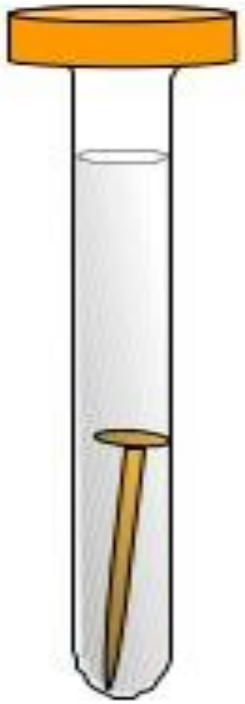
06/11/12

Rusting

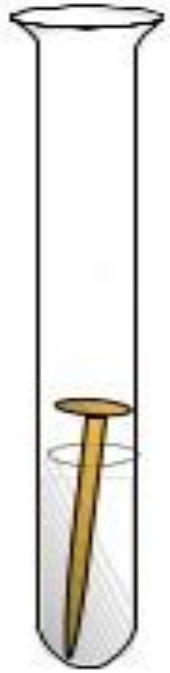
Task: To investigate what causes rusting



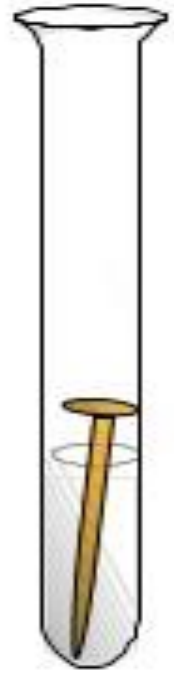
Tube 1 – drying agent



Tube 2 – boiled water

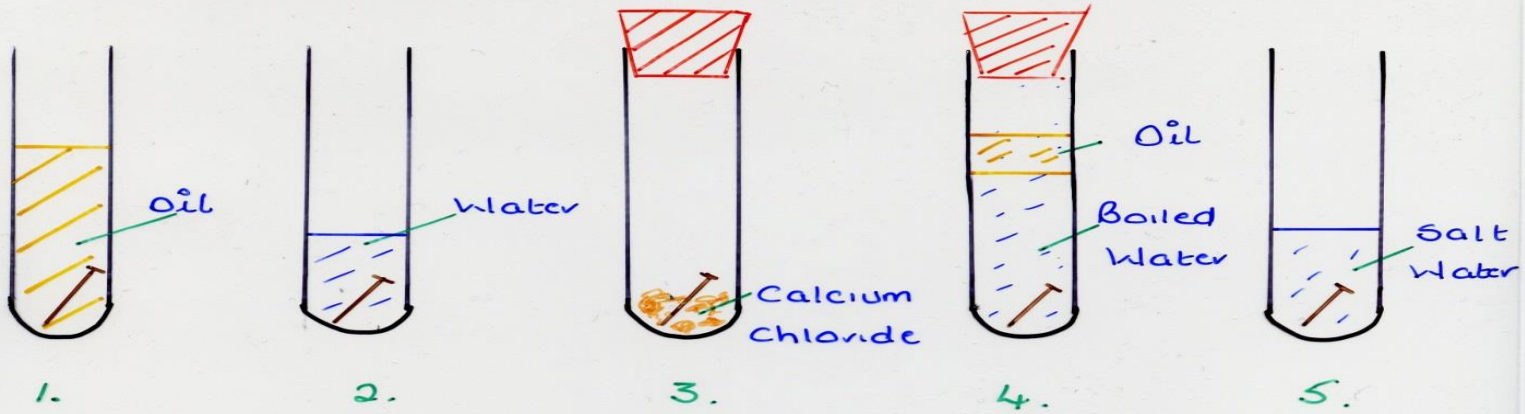


Tube 3 – water + air



Tube 4 – water + air + salt

To Investigate the Rusting of Nails.



Test Tube	Contents	Results
1	Nail. No moisture No air	No Rust.
2	Nail, Moisture + Air.	Rust
3	Nail No moisture + Air.	Rust
4	Nail. No Air. Moisture.	Rust.
5	Nail, Air, Moisture, Salt.	Rust.

From the experiment we can see that _____ and _____ are needed to make iron RUST.

Ways to prevent rusting

- **Exclusion of air**

1. **Painting- cheap but not effective.**
2. **Oil or grease – water repellent**
3. **Galvanizing/ galvanization – Iron or steel is coated with a thin layer of zinc**
4. **Electroplating – thin layer of metal (chromium or zinc), is bonded to a surface of metal by electrolysis**

– **Taps and door handles**

Reactions of non-metals with oxygen

- Non-metal oxide formed

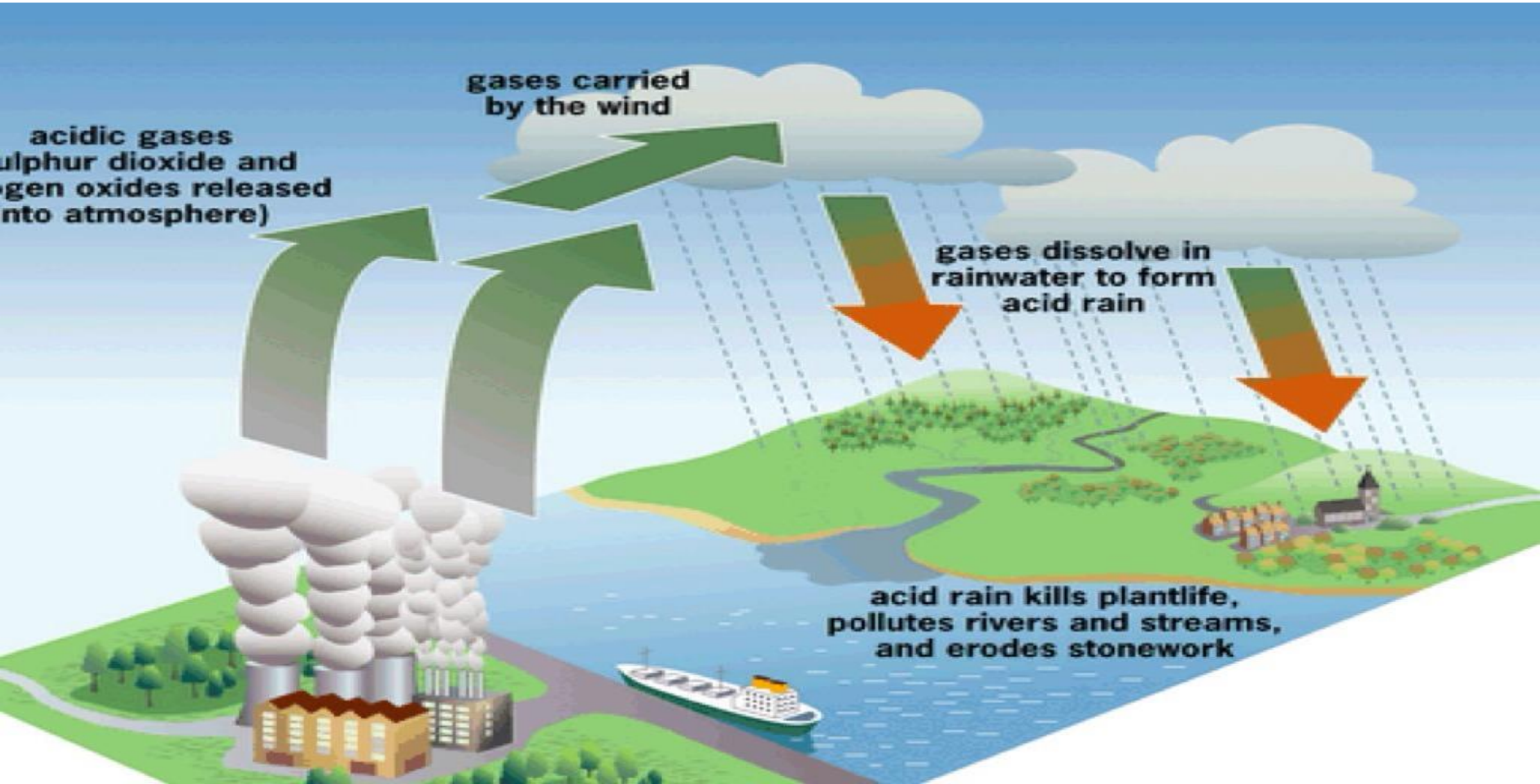
- Carbon + oxygen ⟶ carbon dioxide
  - Carbon forms: diamonds, graphite, charcoal
  - Combustion of carbon – yellow flame

- Sulfur + oxygen ⟶ sulfur dioxide
  - Combustion of sulfur – bright blue flame
  - sulfur dioxide- colourless gas, sharp suffocating smell

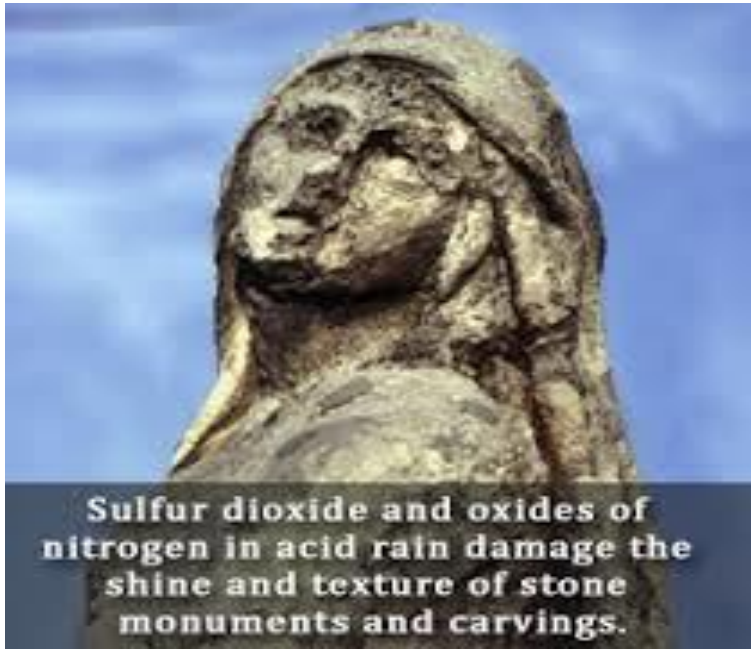
Acid rain

- Coal
  - Contains sulfur as an impurity
  - Combustion – sulfur dioxide and carbon dioxide released into the atmosphere
  - Non-metal oxides dissolve in water – acidic
  - Acid rain formed

Formation of acid rain



Effects of acid rain



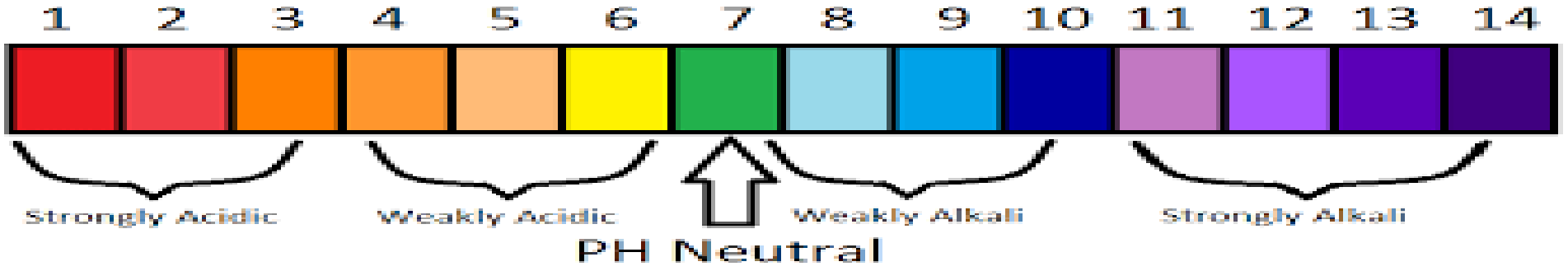
Acids, bases, and pH scale

Common household acids and bases

ACIDS	ALKALIS
Sharp, sour taste	Soapy feel
Strong acids can corrode (eat away) metals, e.g. hydrochloric acid	Strong alkalis can corrode metals, e.g. sodium hydroxide
Some can burn living tissue, e.g. battery acid, other kinds won't, e.g. lemon juice	Can be caustic (burn living tissue), e.g. caustic soda for oven cleaning
Some are hazardous, e.g. sulphuric acid, some are harmless, e.g. vinegar	Some are hazardous, e.g. sodium hydroxide, some are harmless, e.g. sodium bicarbonate (baking powder)
Neutralise (cancel out) alkalis	Neutralise (cancel out) acids
Turn litmus indicator RED	Turn litmus indicator BLUE
Have a pH of 1-6	Have a pH of 8-14
Examples hydrochloric acid sulphuric acid nitric acid citric acid (lemons, oranges etc) vinegar soap (Johnson's pH 5.5)	Examples Sodium hydroxide (caustic soda) ammonium hydroxide (ammonia) calcium hydroxide (limewater) Washing powder Oven cleaner soap

The pH scale

- pH – measure of how acidic or basic a substance is
  - Measures the concentration of hydrogen ions
- Ranges from 0-14
- Acids pH range of 0-7
  - Strong acids – very low pH values
- Bases pH range of 7-14
  - Strong bases – very high pH values
- Neutral substance – pH 7



Concentration of Hydrogen ions compared to distilled water			
	1/10,000,000	14	Liquid drain cleaner, Caustic soda
	1/1,000,000	13	bleaches, oven cleaner
	1/100,000	12	Soapy water
	1/10,000	11	Household Ammonia (11.9)
	1/1,000	10	Milk of magnesium (10.5)
	1/100	9	Toothpaste (9.9)
	1/10	8	Baking soda (8.4), Seawater, Eggs
	0	7	"Pure" water (7)
	10	6	Urine (6) Milk (6.6)
	100	5	Acid rain (5.6) Black coffee (5)
	1,000	4	Tomato juice (4.1)
	10,000	3	Grapefruit & Orange juice, Soft drink
	100,000	2	Lemon juice (2.3) Vinegar (2.9)
	1,000,000	1	Hydrochloric acid secreted from the stomach lining (1)
	10,000,000	0	Battery Acid

Indicators

- Dye or chemical that tell us whether a substance is an acid, base or neutral
- Examples
  - Litmus paper
  - Bromothymol blue
  - Phenolphthalein
  - Universal indicator

Litmus paper

	Red litmus	Blue litmus
ACIDIC SOLUTION	Stays red	Turns red
NEUTRAL SOLUTION	Stays red	Stays blue
ALKALINE SOLUTION	Turns blue	Stays blue

The universal indicator

- **Indicates the full range of pH values on the pH scale by colour changes:**
  - **Acids change colour of the indicator towards yellow, orange and red colours**
  - **Bases change colour of the indicator towards the blue and purple colours**
  - **Neutral change colour of the indicator to green**

Making a turmeric indicator

Aim

To make an indicator to show pH, using turmeric

Materials

- Turmeric
- Bicarbonate of soda
- Baking soda
- Surgical spirits
- Filter paper/ coffee filters
- Beakers/test tubes/glass jars
- Teaspoon

Method

1. Sprinkle some turmeric powder in a little surgical spirit
2. Filter the yellow solution
3. Test your indicator by adding a pinch of bicarbonate of soda. It should turn red

Red cabbage indicator

- Boil red cabbage leaves
- Allow resultant solution to cool

Red cabbage water is:

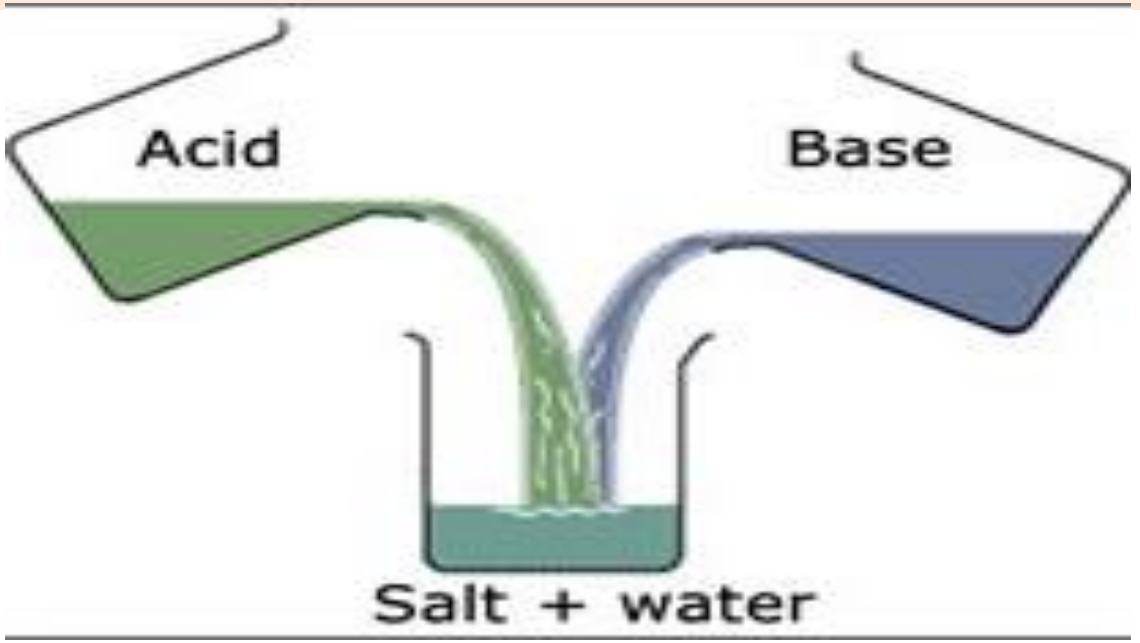
- Violet or purple in a neutral solution
- Red/pink in an acidic solution
- Green or yellow in a basic solution

Item	Red Cabbage Water	Neutral, Acid or Alkali?
Baking Powder	Green/blue	Alkali
Flour	Purple	Neutral
Vinegar	Pink/red	Acid
Sprite	Pink/red	Acid
Apple Juice	Pink/red	Acid
Conditioner	Slightly pink	Weak acid
Shampoo	Stayed Purple	Neutral
Lemon Juice	Pink/red	Acid
Icing Sugar	Stayed purple	Neutral
Hand Sanitiser	Stayed purple	Neutral

Item	Blue Litmus Paper	Red Litmus Paper	Neutral, Acid or Alkali?
Baking Powder	Stayed blue	Blue	Alkali
Flour	A bit purple	A bit purple	Neutral, a bit alkali
Vinegar	Pink/red	Stayed pink	Acid
Sprite	Pink/red	Stayed pink	Acid
Apple Juice	Pink/red	Stayed pink	Acid
Conditioner	Slightly pink	Stayed pink	Weak acid
Shampoo	Slightly pink	Stayed pink	Weak acid
Lemon Juice	Pink/red	Stayed pink	Acid
Icing Sugar	Stayed blue	Stayed pink	Neutral
Hand Sanitiser	Slightly pink	Stayed pink	Weak acid

Reaction of acids with bases

- Neutralisation reaction
- Base cancels out the properties of an acid
  - Base contains negative ions
  - Acid contains positive ions



Neutralisation reaction

Materials

- Vinegar
- Bicarbonate of soda
- Water
- Beakers
- Universal indicator
- Test tube droppers

Procedure

1. Pour some vinegar into a test tube
2. Add some universal indicator into the vinegar
3. Dissolve the bicarbonate of soda in water
4. Add the bicarbonate of soda to the vinegar drop by drop until the vinegar has been neutralised

Questions

1. **Identify the acid and base in this experiment**
2. **What colour does the UI turn when you add it to the vinegar**
3. **How will you know when the solution has become neutral**

Neutralising stings

- **Wasp sting – vinegar**
- **Bee sting – bicarbonate soda**

Neutralisation reactions

Acids	Bases
Non-metal oxides (SO_2, CO_2)	Metal oxides (MgO, Fe_2O_3)
Hydrochloric acid	Metal hydroxides (NaOH)
Sulfuric acid	Metal carbonates
Nitric acid	

Reaction of acids with metal oxides

- Metal oxides are basic; pH > 7
- acid + metal oxide ⟶ salt + water

Hydrochloric acid + magnesium oxide → magnesium chloride + water

$$HCl + MgO \longrightarrow MgCl_2 + H_2O$$

Reaction of acids with metal hydroxides

- Metal + water ⟶ hydroxide
- acid + metal hydroxide ⟶ salt + water

Hydrochloric acid + sodium hydroxide → sodium chloride + water

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

Reaction of acids with a metal carbonate

- Metal, carbon and oxygen
- $CaCO_3$ (limestone)
- Acid + metal carbonate ⟶ salt + carbon dioxide + water

Hydrochloric acid + calcium carbonate ⟶ calcium chloride + carbon dioxide + water

$$HCl + CaCO_3 \longrightarrow CaCl_2 + CO_2 + H_2O$$

- Calcium carbonate – antacid
- Neutralises stomach acid

Reaction of acids with a metals

- Acid + metal salt + hydrogen gas

Hydrochloric acid + magnesium ⟶ magnesium chloride + hydrogen gas

$$HCl + Mg \quad MgCl_2 + H_2$$

Pop test for hydrogen

- Burns easily and is explosive
- Hold a flame near the opening of a test tube containing hydrogen gas, it will burn with a squeaky pop

Summary

Acid reactions

1. acid + metal → salt + hydrogen

2. acid + metal oxide → salt + water

3. acid + metal carbonate → salt + carbon dioxide + water