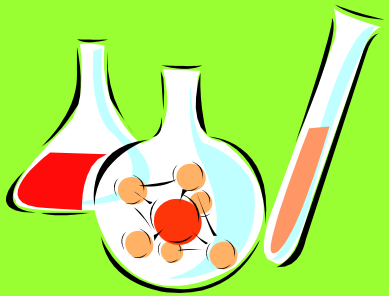
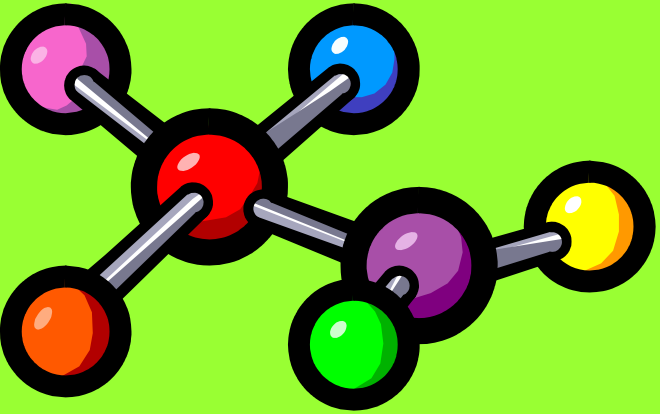
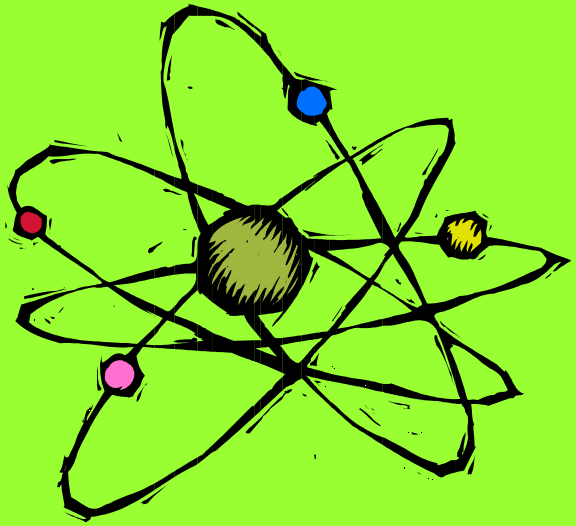


Year 10 Chemistry





Learning outcomes:

1. Know the names and symbols of the first 20 elements.
2. Know that the periodic table is a way of classifying elements according to their **atomic number.**
3. Distinguish between **elements** and **compounds** and represent them diagrammatically.
4. Describe the **structure of the atom** including protons and electrons.
5. Draw **orbital diagrams** and write **electron configurations** for atoms 1 – 20 (given their atomic number)
6. Know what an **ion** is and how it forms.
7. **Name** and write **symbols** for **positive metal ions** and **negative non-metal** ions.
8. Know how to **make** and **test** for hydrogen, oxygen and carbon dioxide gases.
9. Know the **names** and **formulae** of common **acids** and **bases**.
10. Describe the **properties** and **uses** of acids and bases.
11. Describe how **litmus and universal indicator** change colour in acids and bases.
12. Explain that **pH** is a number that shows how acidic or basic a substance is.
13. Identify the process of **neutralisation**.
14. Know **everyday examples** of acid-base reactions.
15. Describe the physical and chemical properties of **plastics**.

Matter

Everything around us is made of matter which consists of atoms.

Mixtures

Many different substances mixed together.

eg. sea water (salt, water, minerals, etc)

Pure Substances

Elements

Contain only one type of atom.

May be atoms

eg. Aluminium (Al)

or molecules

eg. Oxygen (O_2)

Compounds

More than one type of atom chemically joined together.

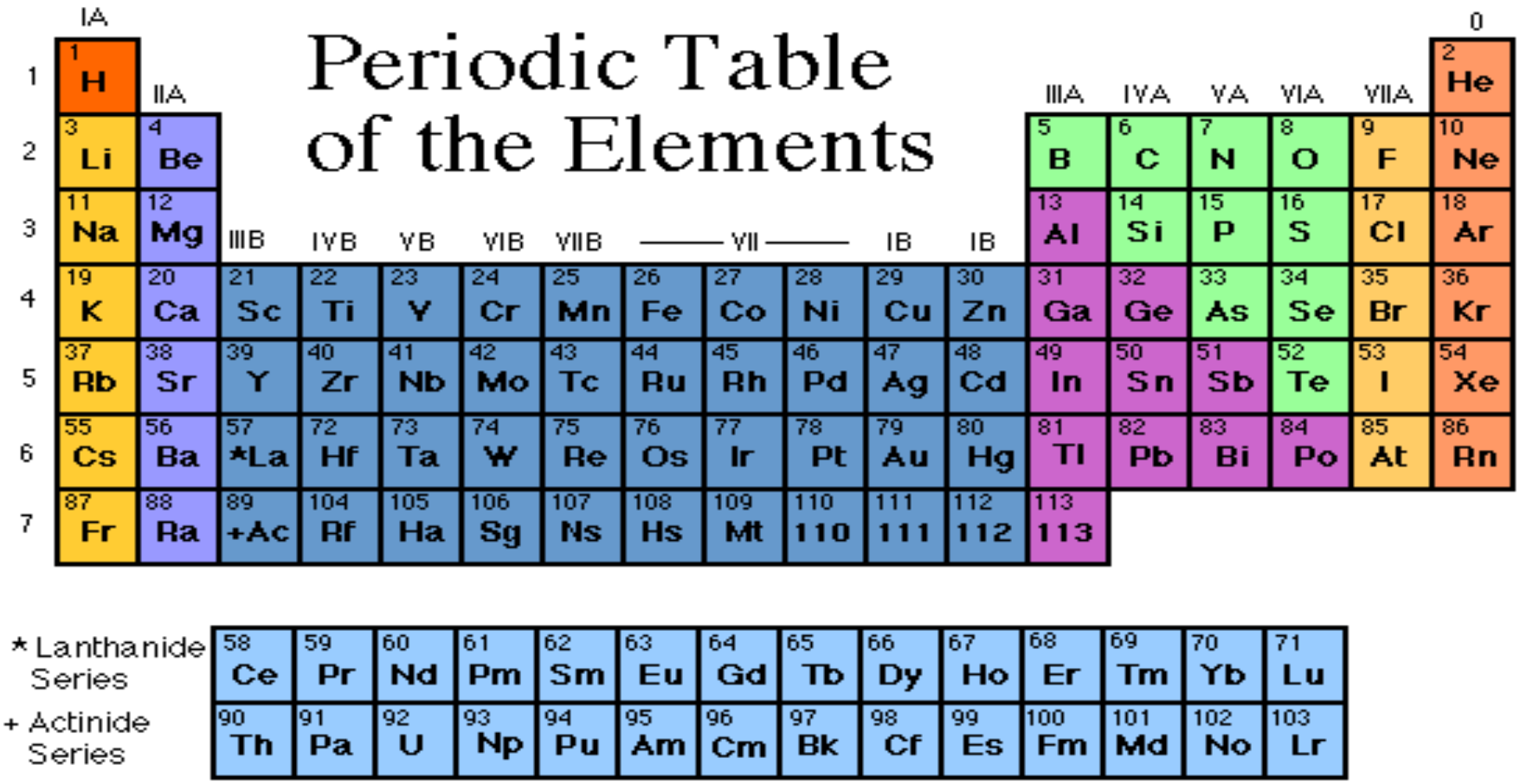
eg

1. H_2O (water)
2. NaCl (salt)
3. $C_6H_{12}O_6$ (glucose)

Classify the following as element, compound or mixture

1. Bread **mixture**
2. Gold (Au) **element**
3. Copper sulfate ($CuSO_4$) **compound**
4. Calcium (Ca) **element**
5. Sucrose ($C_{12}H_{22}O_{11}$) **compound**
6. Coca Cola **mixture**
7. Iron (Fe) **element**
8. Brass **mixture**
9. Alcohol (C_2H_5OH) **compound**
10. Wood **mixture**

Elements are arranged in the **periodic table** in order of atomic number.



http://www.youtube.com/watch?v=rSAaiYKF0cs

Elements I need to know

- The names and symbols of the first 20 elements.
- Also Fe, Cu, Zn, Ag, Sn, Au, Hg, Pb, Br and I

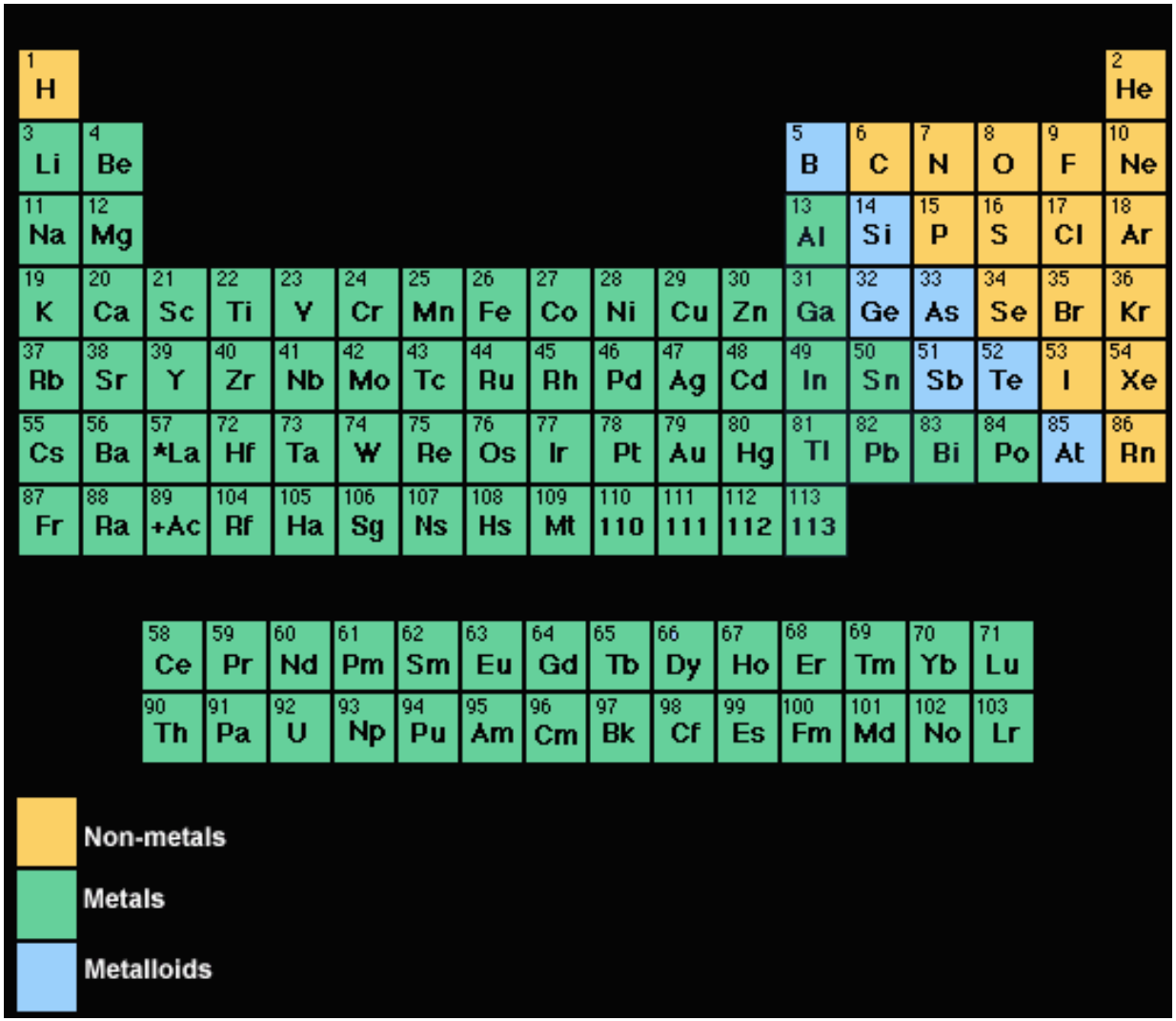
- Put these elements in their correct place in the periodic table (use the back page in your workbook to help you).
- Highlight the metals and non-metals using 2 different colours.

http://www.youtube.com/watch?v=uJGrwWOWt3Q

Elements I need to know:

H	Na	Fe
He	Mg	Cu
Li	Al	Zn
Be	Si	Ag
B	P	Sn
C	S	Au
N	Cl	Hg
O	Ar	Pb
F	K	Br
Ne	Ca	I

Metals and Non-metals

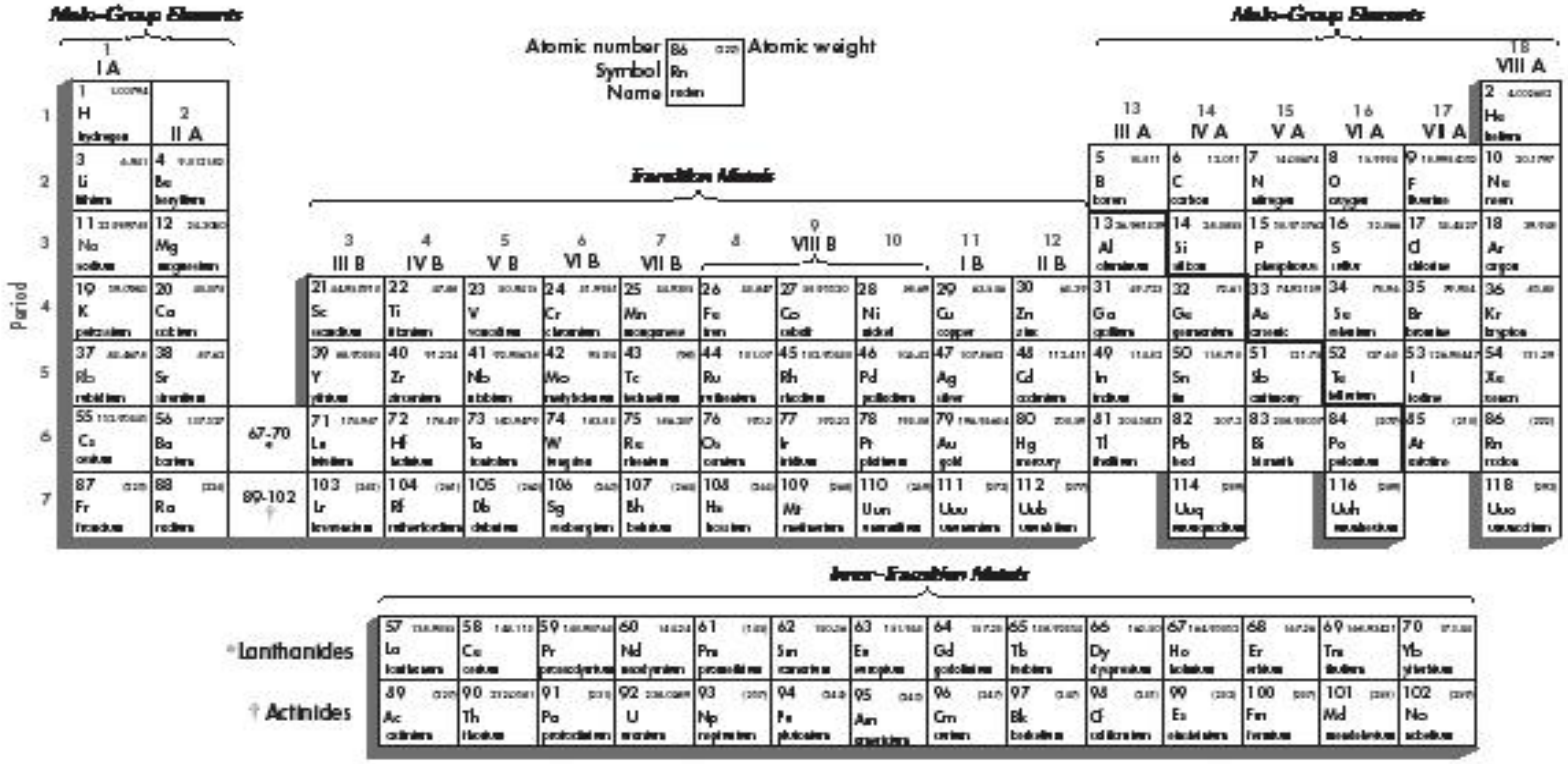


To view The Periodic Table click

http://www.periodictable.com/

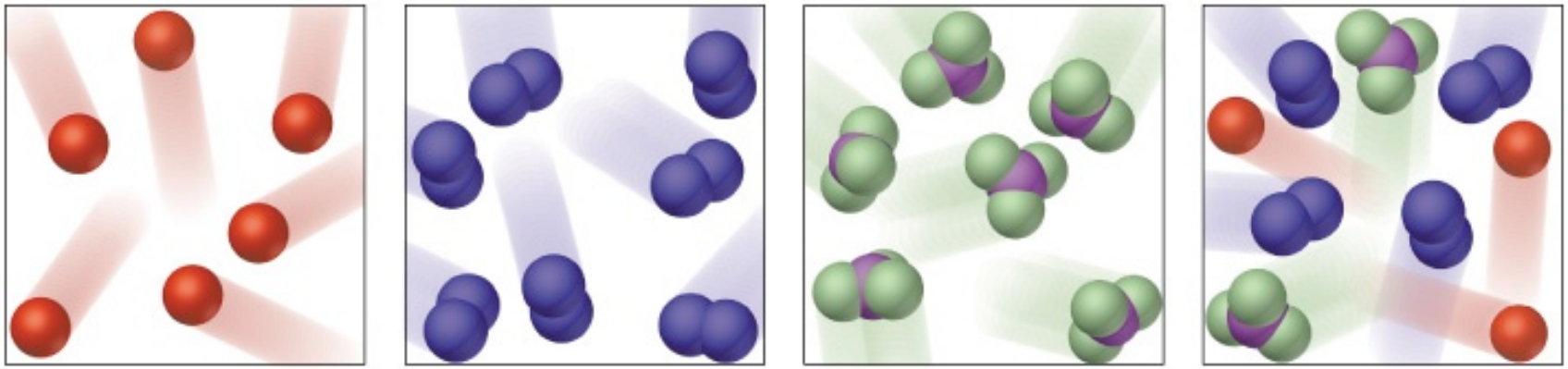
here

Click on an element



What are atoms?

- An atom is the smallest particle of an element.
- There are over 100 known elements which means that there are over 100 different kinds of atoms.



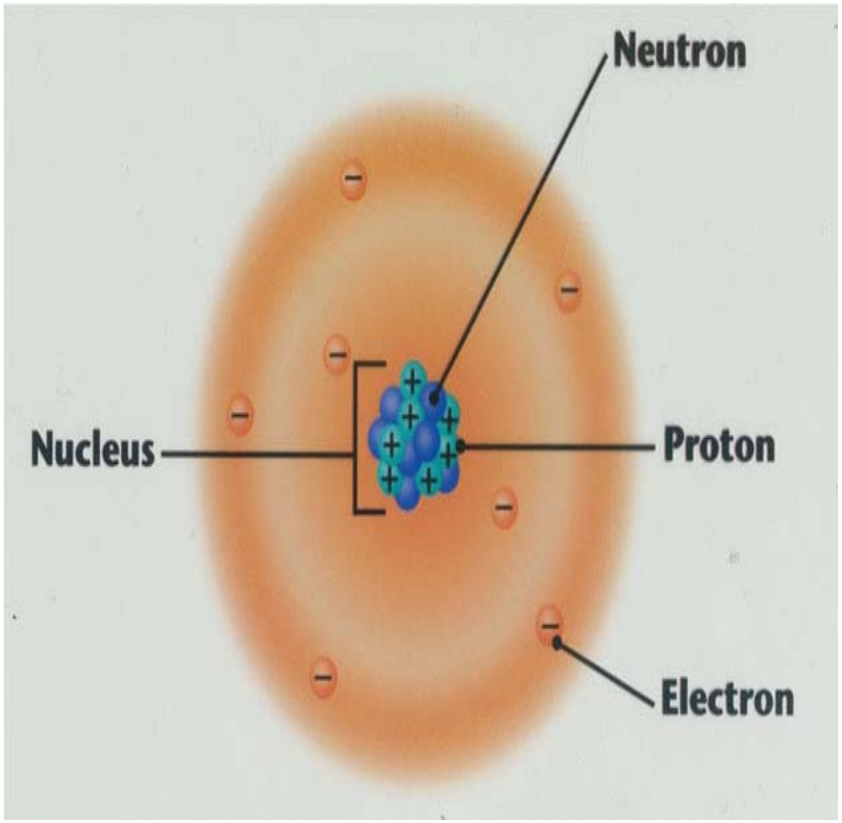
(a) Atoms of an element

(b) Molecules of an element

(c) Molecules of a compound

(d) Mixture of elements and a compound

All atoms contain:



A nucleus

- This is the central part of an atom

  It contains:

➢ **Protons** - positively charged (+)

➢ **Neutrons** - no charge (o)

Electrons

- These orbit around the nucleus in different energy levels or shells.

➢ **Electrons** - negatively charged (-)

Protons, neutrons and electrons are called **sub-atomic particles**.

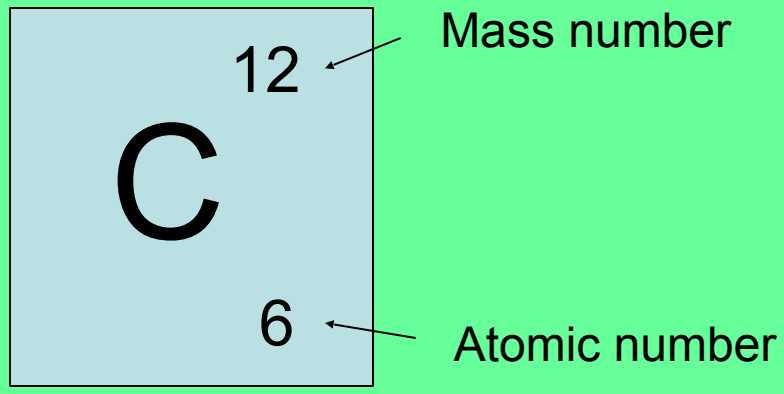
An atom is a **neutral** particle because its number of protons (+) and electrons (-) is the same.

Atomic Number

- Elements are arranged in the periodic table in order of **atomic number**.
- **Atomic number is the number of protons (+) an atom has.**
- In an atom, the number of protons = the number of electrons.
- Each type of atom has a different atomic number.
- eg
  - Hydrogen (H) has 1 proton and 1 electron
  - Carbon (C) has 6 protons and 6 electrons.
  - Lead (Pb) has 82 protons and 82 electrons

Mass number

- The **mass number** of an element is the number of **protons and neutrons** combined.
- The mass number is usually bigger than the atomic number.



To work out the number of neutrons:

- mass number – atomic number = number of neutrons
- eg 12 - 6 = 6 neutrons

Summary

- Atomic N^{o} = N^{o} of protons
- N^{o} of protons = N^{o} of electrons
- Mass N^{o} = N^{o} of protons + N^{o} of neutrons
- Mass N^{o} – Atomic N^{o} = N^{o} neutrons

Use the periodic table to help you complete the table below:

Name	Symbol	Atomic No	Mass No	No of protons	No neutrons	No of electrons
hydrogen						
helium						
nitrogen						
sodium						
boron						
beryllium						
magnesium						
chlorine						
argon						
iron						

Use the periodic table to help you complete the table below:

Name	Symbol	Atomic No	Mass No	No of protons	No neutrons	No of electrons
hydrogen	H	1	1	1	0	1
helium	He	2	4	2	2	2
nitrogen	N	7	14	7	7	7
sodium	Na	11	23	11	12	11
boron	B	5	11	5	6	5
beryllium	Be	4	9	4	5	4
magnesium	Mg	12	24	12	12	12
chlorine	Cl	17	35	17	18	17
argon	Ar	18	40	18	22	18
iron	Fe	26	56	26	30	26

Complete the table below

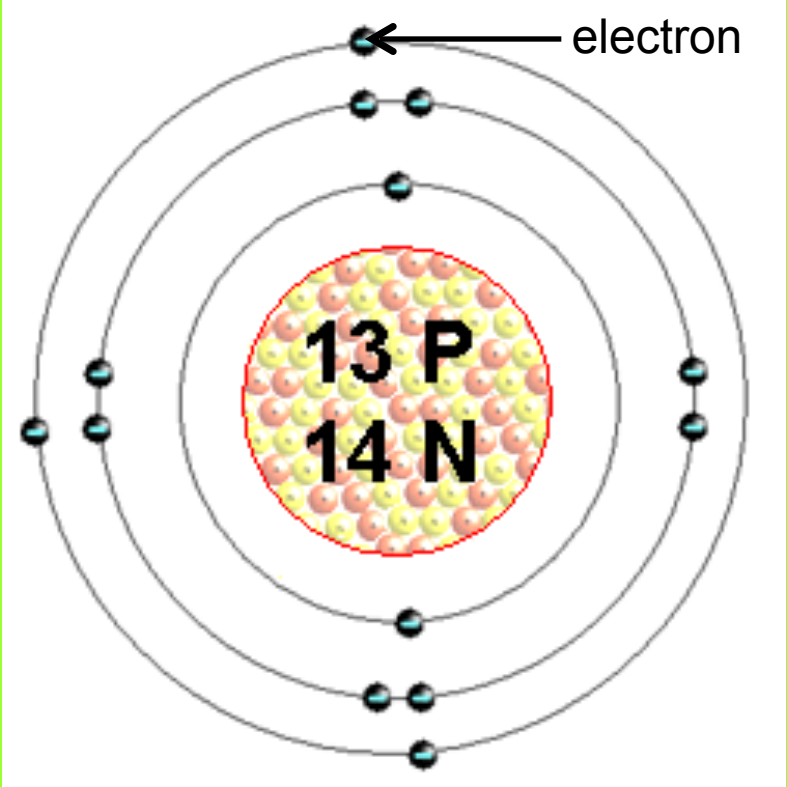
Name	Symbol	Atomic No	Mass No	No of protons	No neutrons	No of electrons
Oxygen			16			
				16	16	
	Li		7			
		13			14	
Carbon			12			
		9	19			
			21			10
				14	14	

Complete the table below

Name	Symbol	Atomic No	Mass No	No of protons	No neutrons	No of electrons
Oxygen	**O**	**8**	**16**	**8**	**8**	**8**
Sulfur	**S**	**16**	**32**	**16**	**16**	**16**
Lithium	**Li**	**3**	**7**	**3**	**4**	**3**
Aluminium	**Al**	**13**	**27**	**13**	**14**	**13**
Carbon	**C**	**6**	**12**	**6**	**6**	**6**
Fluorine	**F**	**9**	**19**	**9**	**10**	**9**
Neon	**Ne**	**10**	**21**	**10**	**11**	**10**
Silicon	**Si**	**14**	**28**	**14**	**14**	**14**

Orbital Diagrams

- Electrons orbit around an atom much like planets orbit around the sun.
- The protons in the nucleus of an atom attract the same number of electrons.
- eg Al has 13 protons so it will attract 13 electrons.



An aluminium atom

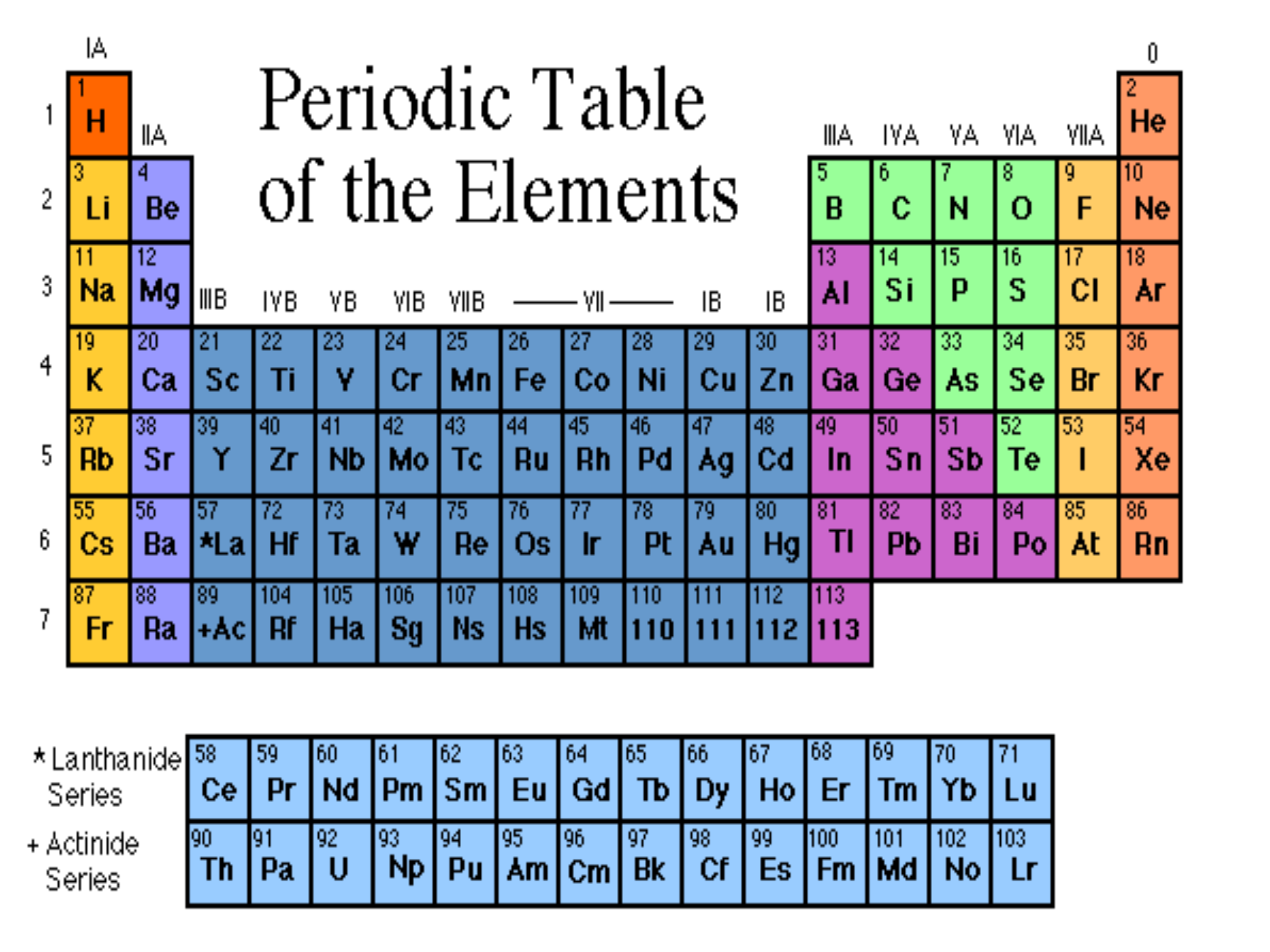
Electrons orbit the nucleus in an orderly manner!!

- The first orbit holds up to 2 electrons.
- The second orbit holds up to 8 electrons.
- The third orbit holds up to 8 electrons.
- The fourth orbit holds any remaining electrons.

To draw electron orbital diagrams:

1. Find atomic number of the element
2. Draw nucleus showing the number of protons and neutrons
3. Draw electrons around nucleus in correct orbits

(We only need to know how to draw orbital diagrams for the first 20 elements)


Periodic Table of the Elements
IA
IIA
IIIB
IVB
VB
VIB
VIIB
VII
IB
IB
IIIA
IVA
VA
VIA
VIIA
0
1 H
2 He
3 Li
4 Be
5 B
6 C
7 N
8 O
9 F
10 Ne
11 Na
12 Mg
13 Al
14 Si
15 P
16 S
17 Cl
18 Ar
19 K
20 Ca
21 Sc
22 Ti
23 V
24 Cr
25 Mn
26 Fe
27 Co
28 Ni
29 Cu
30 Zn
31 Ga
32 Ge
33 As
34 Se
35 Br
36 Kr
37 Rb
38 Sr
39 Y
40 Zr
41 Nb
42 Mo
43 Tc
44 Ru
45 Rh
46 Pd
47 Ag
48 Cd
49 In
50 Sn
51 Sb
52 Te
53 I
54 Xe
55 Cs
56 Ba
57 *La
72 Hf
73 Ta
74 W
75 Re
76 Os
77 Ir
78 Pt
79 Au
80 Hg
81 Tl
82 Pb
83 Bi
84 Po
85 At
86 Rn
87 Fr
88 Ra
89 +Ac
104 Rf
105 Ha
106 Sg
107 Ns
108 Hs
109 Mt
110 110
111 111
112 112
113 113
* Lanthanide Series
58 Ce
59 Pr
60 Nd
61 Pm
62 Sm
63 Eu
64 Gd
65 Tb
66 Dy
67 Ho
68 Er
69 Tm
70 Yb
71 Lu
+ Actinide Series
90 Th
91 Pa
92 U
93 Np
94 Pu
95 Am
96 Cm
97 Bk
98 Cf
99 Es
100 Fm
101 Md
102 No
103 Lr

Orbital diagram of Argon

Atomic number = 18

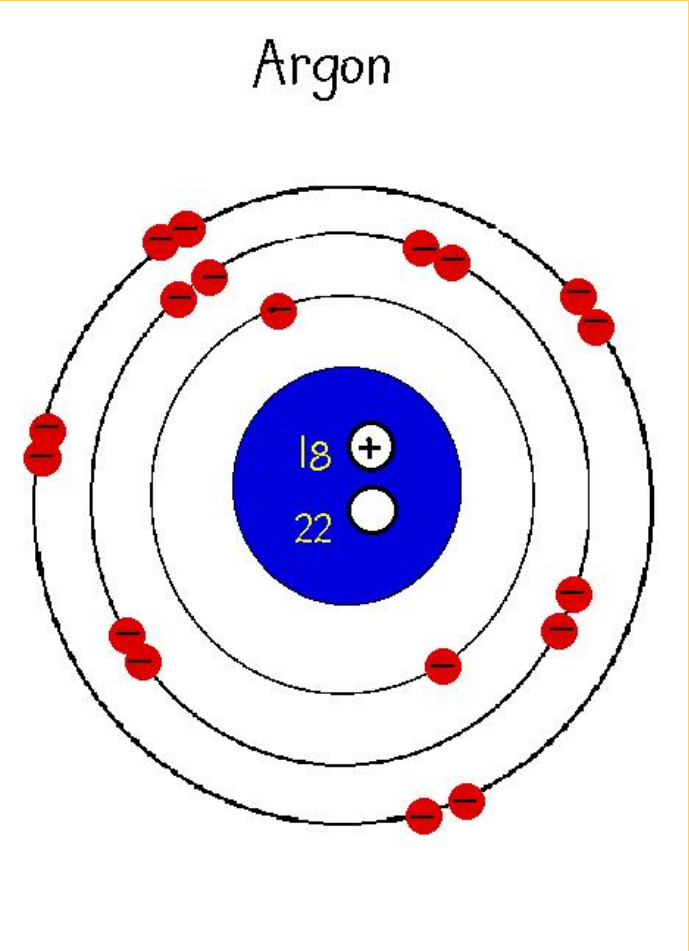
Mass number = 40

so Argon has 18 protons

18 electrons

40 -18 = 22 neutrons

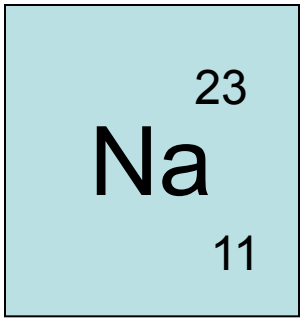
Note: the electrons in the second shell pair up. This only happens after 4 electrons have been added, then they pair.



Draw the orbital diagrams of:

1. Hydrogen (Atomic No = 1 Mass No = 1)
2. Beryllium (Atomic No = 4 Mass No = 9)
3. Phosphorous (Atomic No = 15 Mass No = 31)
4. Chlorine (Atomic No = 17 Mass No = 35)
5. Calcium (Atomic No = 20 Mass No = 40)

Quick Quiz on Atomic Structure



1. What is the **name** of this element?	sodium
2. What is its **Mass Number**?	23
3. What is its **Atomic Number**?	11
4. How many **protons** does it have?	11
5. How many **electrons** does it have?	11
6. How many **neutrons** does it have?	23 – 11 = 12
7. Draw an orbital diagram.	

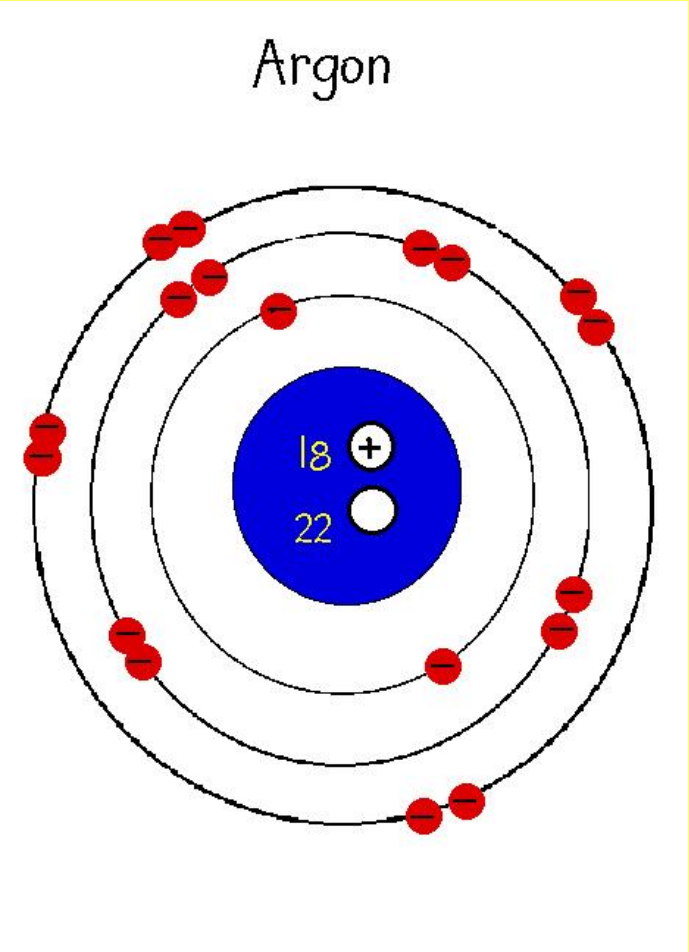
Electron Configurations

- These are a shorthand way of writing orbital diagrams.
- eg Argon's electron configuration is:

  Ar : 2,8,8.

The periodic table is set up in shells.

You can read orbital diagrams and electron configurations directly from the periodic table.



Use the periodic table to help you write the electron configurations for the following elements:

- Nitrogen
- Calcium
- Hydrogen
- Oxygen
- Magnesium
- Beryllium

Answers

- Nitrogen N: 2,5
- Calcium Ca: 2,8,8,2
- Hydrogen H: 1
- Oxygen O: 2,6
- Magnesium Mg: 2,8,2
- Beryllium Be: 2,2

Ions

- Ions are atoms that have ***lost or gained electrons***.

- This means they have a *positive or negative charge*.

  eg: H^+

  F^-

  Mg^{2+}

  Al^{3+}

How atoms become ions

An atom has the same number of protons as it has electrons and has a zero charge. (No. of protons = No. of electrons)

An atom loses, gains or shares electrons because it wants a **full outer orbital**. They are stable when the outer orbit is full.

- ***If an atom loses electrons it becomes a positive ion.***
- ***If an atom gains electrons it becomes a negative ion.***

Example: sodium

A sodium atom has 11 protons and 11 electrons.

Its electron arrangement is 2,8,1 which means it has one electron in its outer shell.

To become stable, sodium loses its outer or valence electron.

i.e. The Na atom loses one electron to form a sodium ion.

sodium atom:	sodium ion:
11 protons (+)	11 protons (+)
11 electrons (-)	10 electrons (-)
overall charge = 0	overall charge = 1+

We write the sodium ion as **Na^+** showing it has a charge of 1+
The electron arrangement of the sodium ion is now 2,8.

Example: oxygen

An oxygen atom has 8 protons and 8 electrons.

Its electron arrangement is 2,6 which means it has six electrons in its outer shell.

To become stable, oxygen could lose all 6 electrons but it is easier for it to gain two electrons instead to fill its outer shell.

i.e. The O atom gains two electrons to form an oxide ion.

oxygen atom:	oxide ion:
8 protons (+)	8 protons (+)
8 electrons (-)	10 electrons (-)
overall charge = 0	overall charge = 2-

We write the oxide ion as O^{2-} showing it has a charge of 2-
The electron arrangement of the oxide ion is now 2,8.

Ion questions

- Draw the orbital diagrams and electron configurations of the *ions* that these elements form and state their charge.

1. Li
2. O
3. Cl
4. Mg
5. Al
6. Will neon form an ion?

Positive and negative ions

- We can use the periodic table to help us work out the charges on ions.
- Atoms with 1,2 or 3 electrons in their outer shell (groups 1,2 and 3) lose electrons to become positive ions.
- Atoms with 5,6 or 7 electrons in their outer shell (groups 15,16 and 17) gain electrons to become negative ions.
- Atoms with 4 electrons in their outer shell do not gain or lose electrons but share electrons with other atoms.
- Group 18 atoms do not form ions at all because they already have full outer shells and are stable.

Ions

- Positive ions are also called CATIONS
- Negative ions are also called **AN**IONS

- Positive ions keep their same name.

- Negative ions change the end of their name.
  O^{2-} **S^{2-}** **Cl^{-}** all end in **-ide**

- Some ions contain more than one type of atom. These are called <u>polyatomic ions</u>. (polyatomic = many atoms). The atoms in polyatomic ions are all non-metals.
  CO_3^{2-} **SO_4^{2-}** **NO_3^{-}** and **HCO_3^{-}** all end in **-ate**

Table of Ions

+1	+2	+3	-3	-2	-1
H^+ hydrogen	Ca^{2+} calcium	Al^{3+} aluminium		O^{2-} oxide	Cl^- chloride
Li^+ lithium	Mg^{2+} magnesium	Fe^{3+} iron III		S^{2-} sulfide	OH^- hydroxide
Na^+ sodium	Cu^{2+} copper			CO_3^{2-} carbonate	NO_3^- nitrate
K^+ potassium	Pb^{2+} lead			SO_4^{2-} sulfate	HCO_3^- hydrogen carbonate
Ag^+ silver	Fe^{2+} iron II				
NH_4^+ ammonium	Ba^{2+} barium				
	zinc				

Table of Ions

+1	+2	+3	-3	-2	-1
H^+	Ca^{2+}	Al^{3+}		O^{2-}	Cl^-
Li^+	Mg^{2+}	Fe^{3+}		S^{2-}	OH^-
Na^+	Cu^{2+}			CO_3^{2-}	NO_3^-
K^+	Pb^{2+}			SO_4^{2-}	HCO_3^-
Ag^+	Fe^{2+}				
NH_4^+	Ba^{2+}				

Polyatomic ions.

These are ions that are made of more than one atom (poly means many).

SO_4^{2-} is a polyatomic ion. It is made up of S atoms and O atoms

Highlight all the polyatomic atoms in your table of ions.

How to write chemical formulae using ions

Step 1.

Write the name of the compound and use your ion table to write the ions for each part of the name underneath.

Example:

What is the formula of **aluminium sulfide**?

Al^{3+} S^{2-}

Step 2.

Add more of each ion so that the total charges are equal.

Al^{3+} S^{2-}

Al^{3+} S^{2-}

S^{2-}

$= 6+$ $= 6-$

This tells you how many lots of each ion are needed in the chemical formula.

2 lots of Al

3 lots of S

Show this in the chemical formula

Al_2S_3

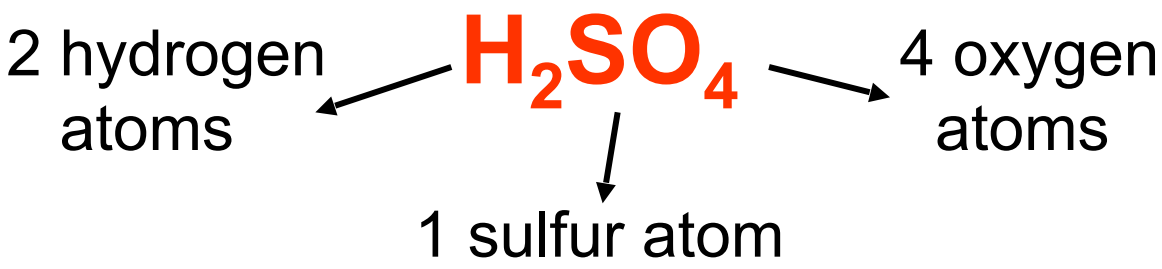
Write formula for these compounds following the rules

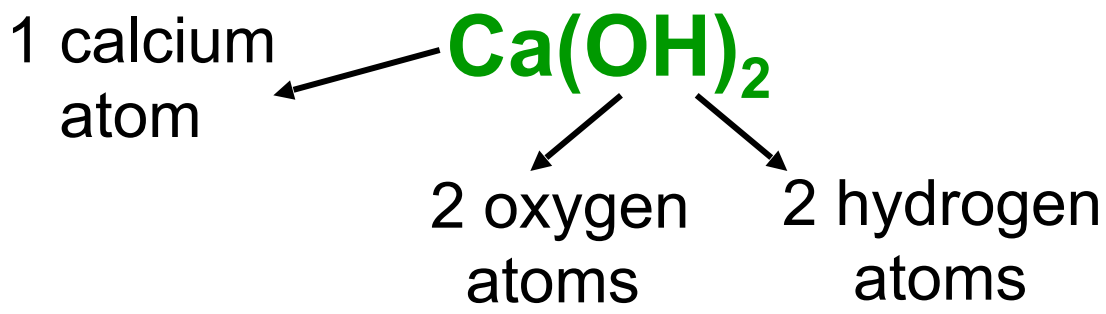
1. Barium oxide
2. Lithium chloride
3. Aluminium chloride
4. Calcium chloride
5. Iron (III) oxide
6. Sodium oxide
7. Aluminium oxide

Answers

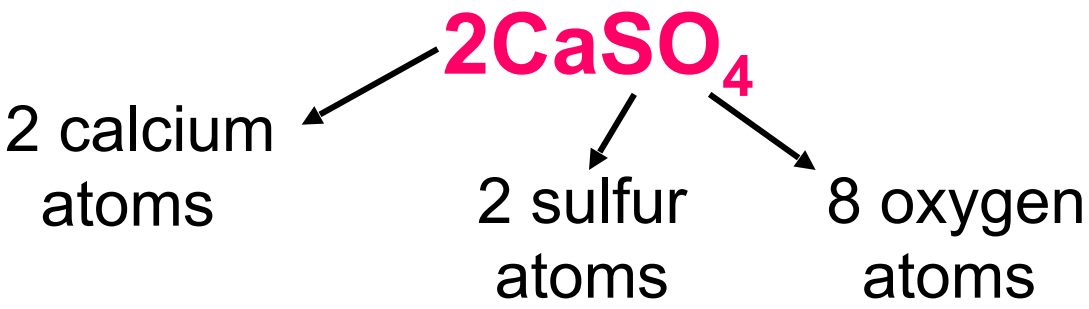
1. BaO
2. LiCl
3. $AlCl_3$
4. $CaCl_2$
5. Fe_2O_3
6. Na_2O
7. Al_2O_3

How to read a chemical formula





When there is a number beside the bracket, you must multiply everything inside the bracket by that number.



This formula tells you that there are two molecules of calcium sulfate.

Cations and Anions

A cation is another name for a positive ion

Fe^{3+} is a cation.

An anion is another name for a negative ion

S^{2-} is an anion.

Ionic compounds

- Positive and negative ions join together to form **ionic compounds**.
- The forces holding the ions together are called **ionic bonds**.
- Ionic compounds are easy to recognise because they contain both positive **metal ions and negative non-metal ions**.

- MgO = magnesium oxide
- NaCl = sodium chloride
- $CaCO_3$ = calcium carbonate
- $CuSO_4$ = copper sulfate

Circle the metal ion in each of the above examples.

Naming ionic compounds

Name the cation then the anion-don't worry about how many of each ion there is

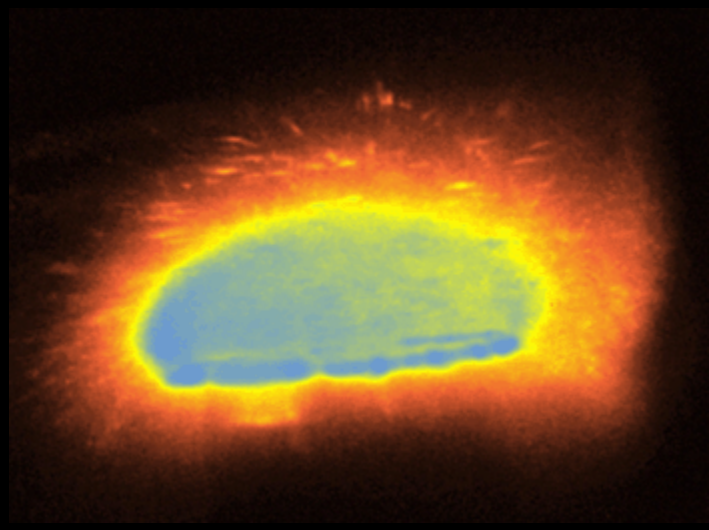
$CaCO_3$ is calcium carbonate

- Na_2SO_4 is sodium sulfate
- $Pb(HCO_3)_2$ is lead hydrogen carbonate

Covalent substances

- Non-metals join together to form **covalent substances**.
- Instead of losing or gaining electrons to form ions, the non-metals in covalent substances **share electrons** and form **molecules**.
- The bonds joining the non-metal atoms together are called **covalent bonds**.
- Common covalent substances include:
- H_2O , CO_2, O_2 and H_2

Chemical reactions



- These occur around us every day.
  eg Food cooking
  Wood burning
  Metal rusting

- When a chemical reaction occurs ***Reactants*** turn into ***Products***

Reactants → Products

Eg Iron + oxygen → Iron oxide (rust)
(reactants) (product)

How can we tell if a chemical reaction has occurred?

In a chemical reaction, new substances are formed.

You may observe:

- a change in colour
- a solid (precipitate) forming.
- a gas (bubbles/fizzing) being produced.
- a change in smell.
- a test tube getting hotter or colder.

Chemical changes are usually difficult to reverse.

Note: changing the state (solid/liquid/gas) of a substance or dissolving it in water is a physical change rather than a chemical one. Physical changes can be easily reversed.

Complete 14.04 on p9-10 of your Science 10 workbook.

Complete the sentences (use SciPad p8)

Signs of a chemical reaction:

- Bubbles can show that a _____ is given off.
- There is a _____ change
- There is a different _____
- The test tube feels _____ meaning heat is given out
- The change is not easily reversed (can't go back again)

Observing a chemical reaction

- Collect a heatproof mat, bunsen, matches, tongs and safety glasses.
- Set up and light the bunsen then open the air hole to give a blue flame.
- Hold a 2cm piece of magnesium ribbon in the flame until it starts to burn then hold it over the heat proof mat until the reaction is complete.
- *What do you observe? How do you know that a chemical change has occurred?*
- *What are the reactants and products? Write a word equation for the reaction.*
- HW: Complete 14.04 and 14.05 on p9-11 of your Science 10 workbook.

Making and testing for Hydrogen gas (H_2)

Aim

- To make Hydrogen gas

Method

1. In a clean test tube put a 1cm piece of Magnesium ribbon
2. Add 2cm depth of hydrochloric acid.
3. Invert a clean test tube over this test tube and collect the gas.

To test to confirm that this is Hydrogen gas (H_2) insert a lit taper into the inverted test tube and you should hear a squeaky **pop**.

Why does hydrogen give a ‘pop’?

- Hydrogen is a very light gas – this is why we collected it in an inverted test tube. It is lighter than air so it rises up.
- Hydrogen is also a very reactive gas – it explodes if ignited. This is why it ‘pops’.
- Early airships such as the Hindenberg used hydrogen for buoyancy. This had disastrous consequences, as the following You Tube clips show…
- http://www.youtube.com/watch?v=7viNdrq8qt0
- http://www.youtube.com/watch?v=JSuR2IgnimA
-

Making and testing for Oxygen Gas (O_2)

Aim

- To make Oxygen gas

Method

1. Place 2cm of hydrogen peroxide (H_2O_2) into a test tube.
2. Place a rice grain amount of manganese dioxide into the test tube.

To test to confirm that gas is Oxygen place a glowing splint into the test tube and it should re-ignite.

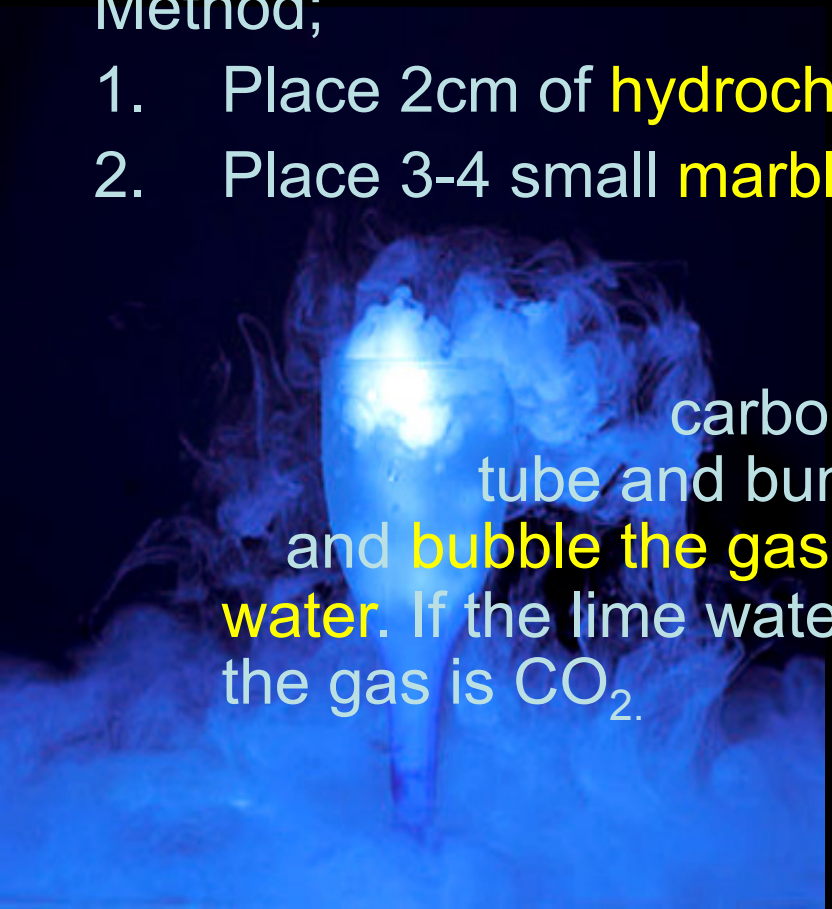
Making and testing for Carbon dioxide (CO_2)

Aim

- To make Carbon dioxide gas

Method;

1. Place 2cm of hydrochloric acid (HCl) into a test tube.
2. Place 3-4 small marble chips into the acid



To test to confirm that this gas is carbon dioxide, place a delivery tube and bung on the test tube and bubble the gas through lime water. If the lime water goes milky the gas is CO_2.