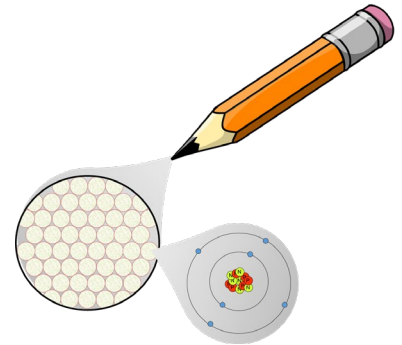




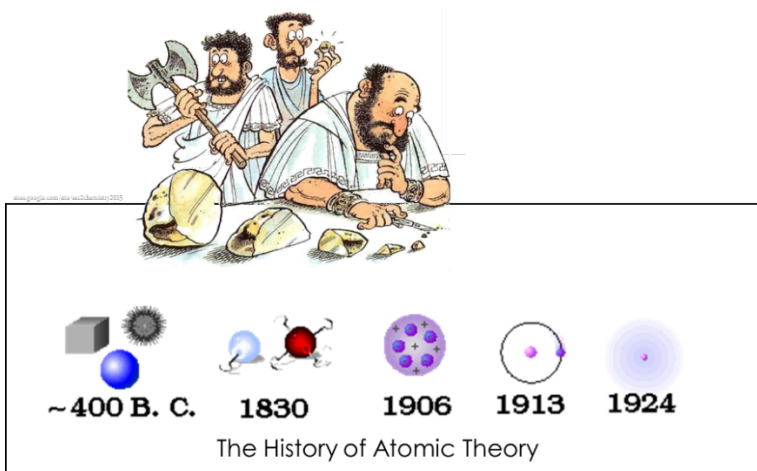
Matter is made up of atoms

An atom is the smallest neutral particle that makes up matter.

The type of atom and the way these atoms are arranged and connected to each other determines the type of matter – and therefore the physical and chemical properties of the matter.



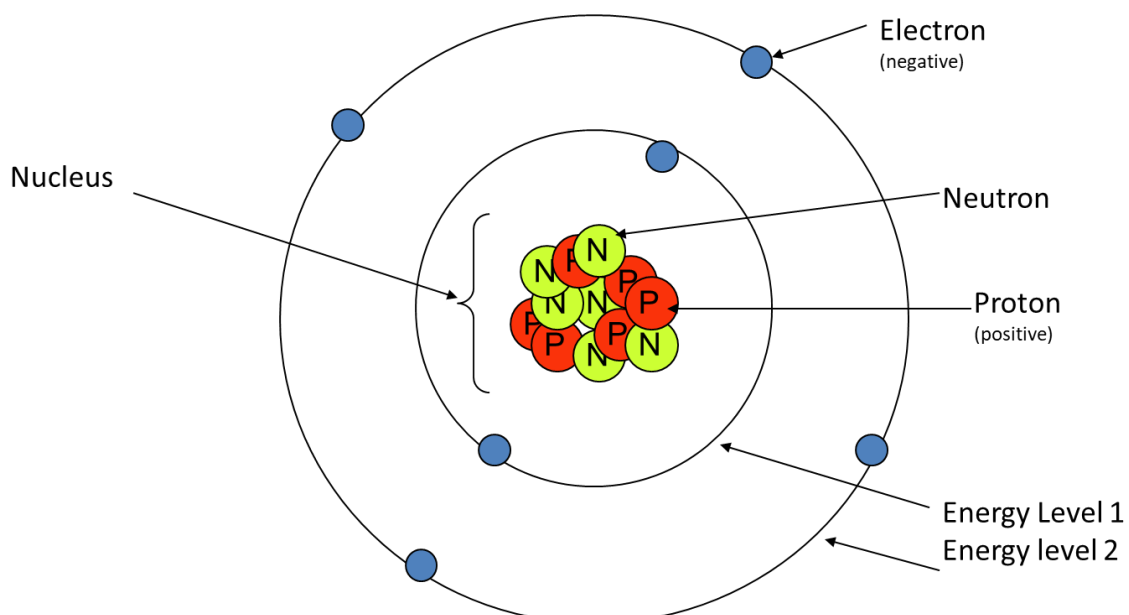
Scientists use models to show the relationship of protons, electrons and neutrons within atoms and ions



Scientists and philosophers have used **models** to represent their ideas of what an atom looks like. As more discoveries have been made, the model of the atom has changed.



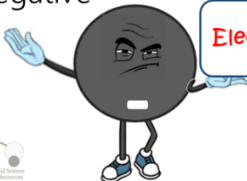
Atom structure

Atoms contain smaller particles, the number of these determine the type of atom. Atoms have a central nucleus, which contains protons (p) and neutrons (n). Electrons (e) orbit outside the nucleus, arranged in energy levels.



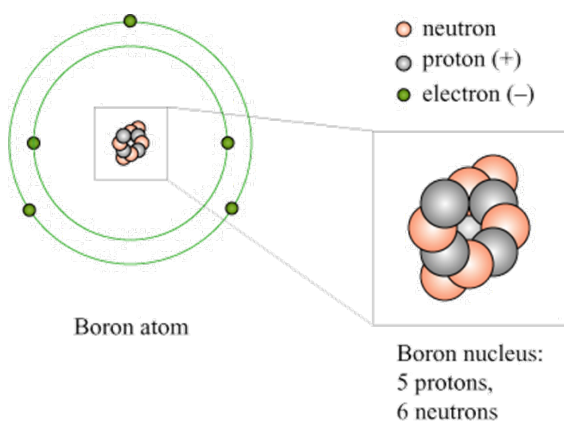
Atoms have equal number of protons and electrons

- ☐ Protons are positively charged; electrons are negatively charged; neutrons have zero electrical charge.
- ☐ Atoms have no overall charge because the number of protons = number of electrons.
- ☐ All matter is made up of atoms. Atoms consist of protons, neutrons and electrons.
- ☐ The charges of protons and electrons are equal and opposite.

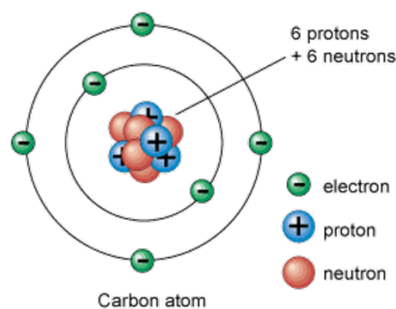
Subatomic particle	symbol	Mass compared to a proton	charge	location
 positive	p	1	+1	In the nucleus
 neutral	n	1	0	In the nucleus
 negative	e	1/1840	-1	Moving outside the nucleus

Each different type of element has a different number of protons in its atoms

Positive protons bond to each other (with a special type of force) in the centre region of an atom called the nucleus. Each type of atom has its specific number of protons. Neutral neutrons, in approximately the same number as protons, also join with the protons to form the nucleus. The positive charge of the nucleus holds the same number of negative electrons in position around it.



All Boron atoms have 5 protons in their nucleus.



All Carbon atoms have 6 protons in their nucleus.

Atomic and Mass number

The atomic number is unique for each element. An atom has the same number of electrons as protons.

The atomic number of an atom is equal to the number of **protons**

The atomic mass (mass number) of an atom is equal to the number of **protons and neutrons**.

Both numbers are normally found in the periodic table.

Calculating protons, neutrons and electrons

Number of protons:

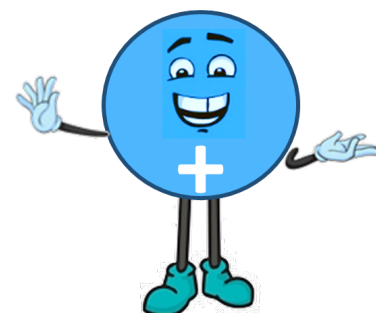
For an atom = atomic number

Number of electrons:

For an atom = atomic number

Number of neutrons:

For an atom = atomic mass - atomic number



atom or ion	number of protons	Atomic number	number of electrons	number of neutrons	Mass number
carbon (C)	6	6	6	6	12
magnesium (Mg)	12	12	12	12	24
fluorine (F)	9	9	9	10	19

Electron configuration

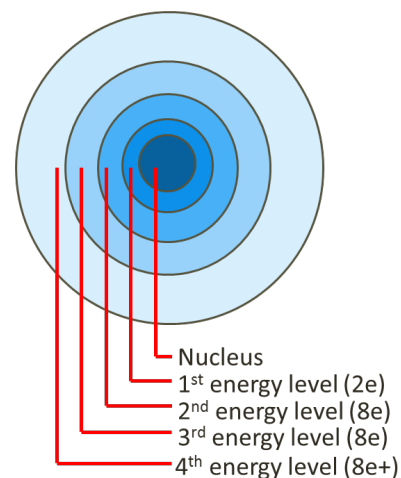
The electrons in an atom are arranged in a series of energy levels.

Electrons move or 'orbit' around the nucleus in **energy levels** or shells. The energy levels further away from the nucleus can fit more electrons.

The first energy level is filled first, followed by the second and so on until all the electrons (the same number of protons in an atom) have been used.

Maximum numbers of electrons in each energy level are:

- ☐ 2 in the first EL (nearest the nucleus)
- ☐ 8 in the second EL
- ☐ 8 in the third EL (before the fourth shell starts to fill)
- ☐ 8+ in the fourth EL



An atom's electron arrangement is known as its Electron configuration

12

Mg

24

The total of the electronic configuration must equal the atomic number in an atom

2, 8, 2

First EL, second EL, third EL

A shorthand way of describing the way electrons are arranged in an atom is called the *electron configuration*. The information for the number of electrons is found by an element's **Atomic Number** (number of electrons = number of protons in a neutral atom). Each EL is filled to its maximum capacity, starting with the lowest EL first (EL number 1). The EL are separated by a comma. The EL are filled until all the electrons are placed.

The Periodic Table

Elements are arranged on the periodic table according to their atomic number. Each element has an atomic number, which tells us how many protons are contained inside each atom's nucleus. This number of protons is matched by an equal number of electrons, which move around the nucleus. The periodic table starts with Hydrogen (H) Atomic number 1 and ends with elements that have over 100 protons such as Copernicium (Cn) Atomic number 112. Elements can be classified as metals or non-metals. A few elements are called semi-metals or metalloids (e.g. boron and silicon), because they show some, but not all, of the properties of metals.

Elements in the same group all have the same number of electrons in their outer (or valence) energy levels.

Elements in the same period all have the same number of energy levels of electrons in their atoms

Groups are numbered vertical columns and periods are horizontal rows

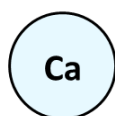
The columns (downwards) of a periodic table are called groups.

The rows (across) of a periodic table are called periods.

There is a relationship between the period number and the number of electron energy levels an atom has.

In the periodic table, elements have something in common if they are in the same row. All the elements in a period have the same number of **electron energy levels**. Every element in the top row (the first period) has one energy level for its electrons) All of the elements in the second row (the second period) have two energy levels for their electrons. It goes down the periodic table like that.

Step 1. Ca in period (row 4) so has 4 energy levels



2, 8, 8, 2

Step 2. Ca in group 2 so has 2 electrons in the outside energy level

Step 3. backfill all energy levels with 8 electrons (2 in first) and add commas between each

Periodic Table of the Elements

Atomic Number		Name		Symbol		Atomic mass	
1	H	Hydrogen	1.0				

gas		liquid		solid		synthetic	
-----	--	--------	--	-------	--	-----------	--

1		2		3		4		5		6		7		8		9		10		11		12		13		14		15		16		17		18																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																			
1	H	2	Li	3	Na	4	Be	5	B	6	C	7	N	8	O	9	F	10	Ne	11	Mg	12	Al	13	Si	14	P	15	S	16	Cl	17	Ar	18	Kr																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																		
	Hydrogen	Lithium	Sodium	Beryllium	Potassium	Calcium		Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon									Aluminum	Silicon	Phosphorus	Sulfur	Chlorine	Argon																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																										



1. Label the diagram of the atom and complete information about sub-atomic particles.

Diagram of an atom showing the nucleus (protons and neutrons) and electron shells. Labels point to the nucleus, electron shells, and individual subatomic particles.

Labels for subatomic particles:

- Name: _____
- Charge: _____
- symbol: _____

Labels for subatomic particles:

- Name: _____
- Charge: _____
- symbol: _____

Labels for subatomic particles:

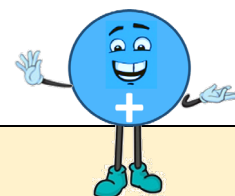
- Name: _____
- Charge: _____
- symbol: _____



2. Use the periodic table to help complete the missing information

Element	Number of protons	Atomic number	Number of electrons	Number of neutrons	Mass number
Sodium (Na)		11			23
	15				31
		18		22	
Calcium (Ca)	20				40

3. Use the periodic table to complete the electron configuration of the following elements



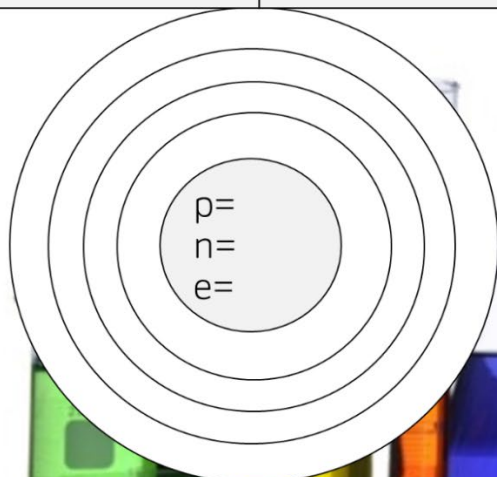
Element	Electron Configuration	Element	Electron Configuration
Cl		Mg	
Ca		P	

4. EXTENSION Use the periodic table to complete the electron configuration of the following ions

Element	Electron Configuration	Element	Electron Configuration
Cl ⁻		O ²⁻	
Na ⁺		Mg ²⁺	

5. Draw in the electrons, atomic and mass number, for the following elements

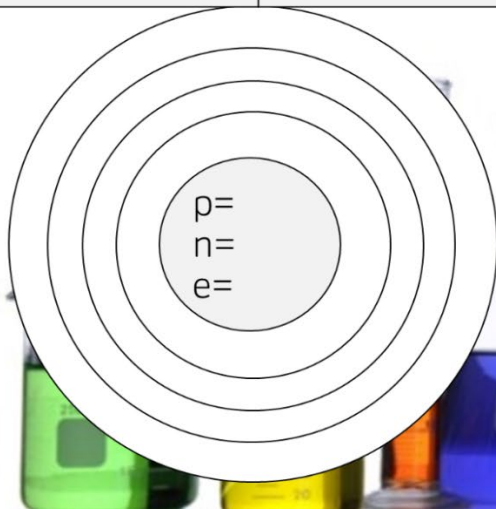
Element: Potassium	
Atomic number:	Mass number:



Element: Fluorine	
Atomic number:	Mass number:



Element: Sulfur	
Atomic number:	Mass number:



Element: Argon	
Atomic number:	Mass number:

