

# STRUCTURE OF THE ATOM

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**Domain:** 5.7 relates properties of elements, compounds & mixtures to scientific models, theories and laws

#### Elements

An element is a *simple substance* which cannot be made any simpler by normal *chemical* means. All the known elements are listed in the *Periodic Table*. An element is made up of many small units called *atoms*. The atoms in an element are all the *same*.

#### The Structure of Atoms

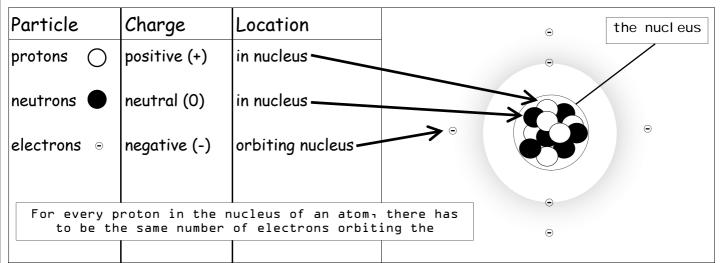
Atoms are made up of three main sub-atomic particles. These particles are:

1. the proton; 2. the neutron; 3. the electron

The proton and neutron are located in the central *nucleus*. The electron(s) occupy certain regions of space (known as energy levels) around the nucleus. They are said to 'orbit' the nucleus.

Some of the particles are electrically *charged*. The proton has a positive (+) charge. The electron has negative (-) charge. This is *opposite* to the proton. The neutron has no (0) charge- it is electrically neutral.

The table below summarises this information:



#### The Atomic Number, Mass Number and Atomic Mass of an Element

Atomic Number (Z)	The atomic number is given on the Periodic Table. Elements are listed in order of their atomic number in the Periodic Table. All atoms of the same element have the same atomic number. The atomic number equals the number of protons in the nucleus and also the number of electrons orbiting nucleus. Atomic number=no. of protons=no. of electrons	Information given on common Periodic Tables:
Mass Number (A)	The mass number is the number of protons plus neutrons in an atom. Mass number=no. of protons + no. of neutrons The number of neutrons in an atom can be found by using the equation: No. of neutrons in atom= A-Z	Na 22.99 sodium
Atomic Mass	It is difficult to define atomic mass in simple terms. It is the relative mass of the atoms of an element compared to the mass of a special type of carbon atom. Atomic mass is given on the Periodic Table for each element. Atomic mass has special units- the atomic mass unit or amu. The amu is a very small unit- 1 amu= 0.000 000 000 000 000 000 000 001 661 grams.	name of el ement

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#### Electron Energy Levels

The atomic number is important in analysing how the electrons are arranged in an atom. This is known as the *electron configuration*.

Electrons are arranged around the nucleus in *energy levels*. Each energy level can only hold a certain number of electrons. The energy levels are numbered. The first energy level from the nucleus is known as n=1, the next level is n=2 etc.

The number of electrons each level can hold is given in the table below (for the first four levels):

Energy Level	n=1		n=2		n=3	n=4	
Maximum number of electrons	2		8		18	32	
Element			carbon		sodium	chl ori ne	
Atomic Number			6		11	17	
Number of Electrons			6		11	17	
No. of electrons into n=1 (maximum is 2)			2 (full)		(full)	2 (full)	
No. of electrons into n=2 (maximum is 8)			4 (left over)		(full)	8 (full)	
No. of electrons into n=3 (maximum is 18)			7		1 (left over)	7 (left over)	
No. of electrons into n=4 (maximum is 32)			7	7		7	
El ectron confi gurati on			2,4	2, 8, 1		2, 8, 7	

Name: .....

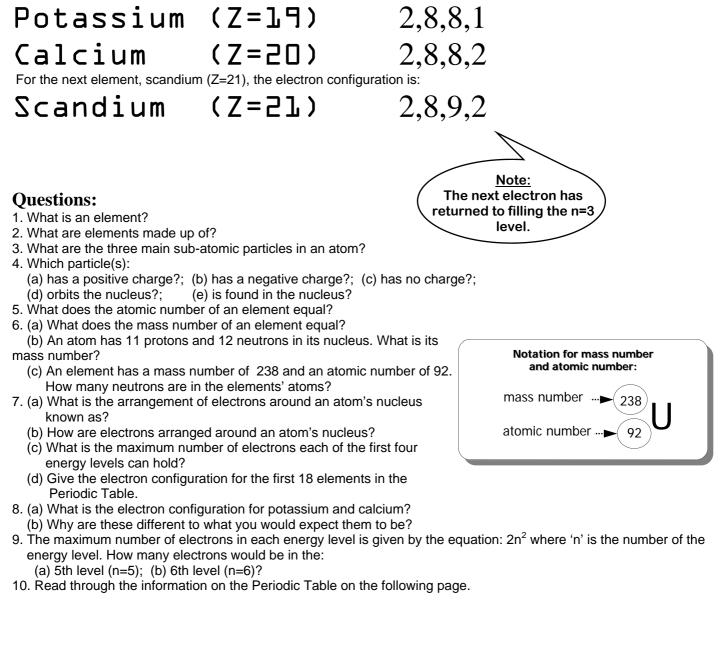
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You have to be able to indicate the electron configuration for the first twenty elements in the Periodic Table (the atomic number will be given).

Potassium (Z=19) and calcium (Z=20) have electron configurations slightly different to what you would expect. This is because electrons start filling the n=4 energy level before they have finished filling the n=3 level. The electron configurations for potassium and calcium are given below:



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#### The Periodic Table

On the Periodic Table-

- P Vertical columns are called GROUPS.
- P Each row across is a **PERIOD**.
- P Each group tends to have a common valency (indicated at bottom of group).
- P Metals are located on the left-hand side of the stepped line.
- P Non metals are located on the right-hand side of the stepped line (shaded).
- P Transition metals have variable valencies.

- P Some of the groups are named:
- 🗮 Group ❶= Alkali Metals
- **\blacksquare** Group **2** = Alkaline Earth Metals
- ₩ Group 🛛 = Halogens
- **Group**  $\$  = Noble Gases
- P The boundary between the metals and non metals is not clearly defined. Along the boundary is a set of elements which cannot be easily classified as metals or non-metals. They are called *metalloids* They are marked with an asterisk \*.

metals		non-metals				н		Group 8	
Group	Group		Group	Group	Group	Group	Group	2	
1	2		3	4	5	6	7	He	
3	ц		5	L	7	<b>₿</b>	9	10	
Li	Ве		B*	C	N	◊	F	Ne	
ll	12		13	l4	15	2	17	18	
Na	Mg		A 1	Si*	P	1	C1	Ar	
ם ג	20	als	31	32	EE	34	35	36	
ג	Ca		Ga	Ge*	*aA	Se	Br	Kr	
З7	8E	Transition Metals	49	50	51	52	53	54	
Rb	Sr		In	Sn	Sb	Te*	I	Xe	
55	56	Transi	81	82	83	84	85	86	
Cs	Ba		T1	Pb	Bi	Po	At	Rn	
+ l ions	+2 ions	Variable valencies	+l or +3 ions		-3 ions	-2 ions	-l ions	Do not form ions	
Atomic r	Atomic number & atomic mass increase across $ ightarrow$ table and down $\Psi$ table.								