

## Topic 1 – Atomic Structure

### 1.1 Atomic Structure (5.1, 5.2, 5.4)

**Element:** pure substance that cannot be broken down into two or more simpler substances by chemical processes

→ made up by same type of atoms

Subatomic particles

Particles	Symbol	Relative charge	Relative mass	Explanation
1. <b>Protons</b>	p	+1	1	Tightly packed together in centre, form <b>nucleus</b>
2. <b>Neutrons</b>	n	0	1	
3. <b>Electrons</b>	e	-1	1/1840	Move rapidly around nucleus

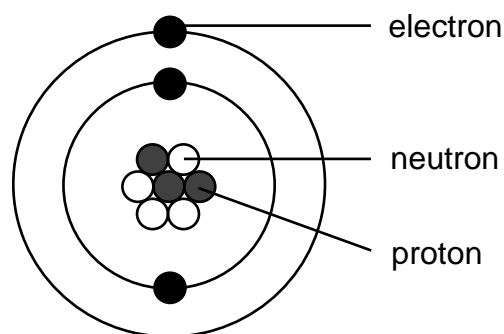
Atom: **electrically neutral**

- Number of electrons = protons
- Negative charges cancel out positive charges

#### Arrangement of electrons

**Electron shells:** regions that electron move around nucleus

- Corresponds to specific energy level
- Can only hold certain number of electrons



Proton numbers 1 – 18

Shell	Electrons	Energy level	Filled up
1	2	Lowest	First
2	8	Increasing	Filled in order (2 <sup>nd</sup> then 3 <sup>rd</sup> )
3	8		

#### Valence electrons

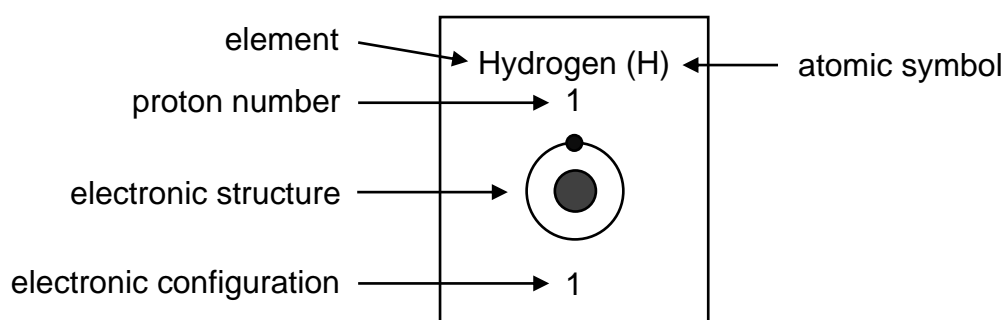
**Valence shell** / outer shell: shell that is furthest away from nucleus

**Valence electrons** / outer electrons: electrons in outer shell

**Outer electronic structure:** shows only electrons in outer shell

**Periods:** 7 horizontal rows

**Groups:** 8 vertical columns





## Metallic and non-metallic properties

### Classification of elements

Type	Properties	
	Metallic	Non-metallic
1. <b>Metal</b>	/	
2. <b>Non-metal</b>		/
3. <b>Metalloid</b>	/	/

### Change of metallic properties

Direction	Change	
	Metallic properties	Non-metallic properties
across period (left to right)	Decrease	Increase
down group (up to down)	Increase	Decrease

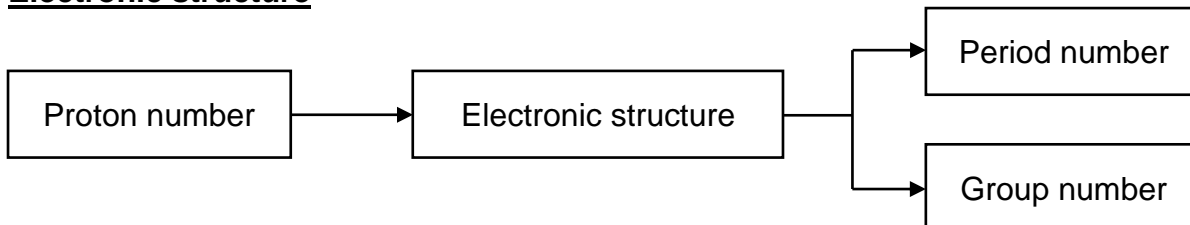
### Period 3

Group	I	II	III	IV	V	VI	VII	0
Element	Na	Mg	Al	Si	P	S	Cl	Ar
Properties	metallic			metalloid	non-metallic			
Nature of oxide	basic		amphoteric	acidic				

### Group 1

Period	Element	Explanation
1	Li	<ul style="list-style-type: none"> <li>Size of atom increases</li> <li>Valence electrons further away from attractive force of nucleus</li> <li>Lose valence electrons more easily</li> </ul>
2	Na	
3	K	

## Electronic structure



Period number = number of electron shells

Group number = number of valence electrons

### Charge of ion

Group	Type of ion	Charge	Example	Explanation
I	positive	+1	Na <sup>+</sup>	<ul style="list-style-type: none"> <li>Metals</li> <li>Lose electrons → positive ion</li> <li>Group number = charge</li> </ul>
II		+2	Mg <sup>2+</sup>	
III		+3	Al <sup>3+</sup>	
IV	covalent		CH <sub>4</sub>	<ul style="list-style-type: none"> <li>Share electrons → covalent bond</li> <li>Group number = maximum oxidation state</li> </ul>
V			PCl <sub>5</sub>	
VI	negative	-2	O <sup>2-</sup>	<ul style="list-style-type: none"> <li>Non-metals</li> <li>Gain electrons → positive</li> </ul>
VII		-1	Cl <sup>-</sup>	
0	-		Ar	<ul style="list-style-type: none"> <li>Stable electronic structure</li> <li>Do not form compounds</li> </ul>

### 1.3 Isotopes (5.3)

#### What isotopes are

Definition: atoms of same element with

1. same number : protons, electrons → proton number
2. different number : neutrons → nucleon number

Elements	Isotopes	Example
Most	Mixture of isotopes	Chlorine: 2 isotopes 1) chlorine-35 2) chlorine-37
A few	No isotopes	Beryllium

#### Properties

- ✓ same chemical properties
- ✗ slightly different physical properties

Subatomic particle	Explanation	Example
Same number: proton & electron	<ul style="list-style-type: none"> <li><b>Chemical</b> reactions involve valence electrons</li> <li>Isotopes: similar chemical properties</li> </ul>	chlorine-35 and chlorine-37 react with Na → NaCl
Different number: neutrons	<ul style="list-style-type: none"> <li><b>Physical</b> properties affected by mass</li> <li>Isotopes: different masses, different physical properties</li> </ul>	Boiling point and density hydrogen-2 > hydrogen-1

**Uses of isotopes**

Radioisotopes: isotopes emit high-energy radiation (radioactive substances)

Field of application	Isotope	Uses
Medical	Technetium-99	Detect tumours
	Iodine-131	Treat thyroid disorder
Safety and security	Californium-252	Detect explosives
	Americium-241	Used in smoke detectors
Archaeology	Carbon-14	Estimate age of things that contain carbon
Geology	Uranium-238	Estimate age of rocks