CAIE IGCSE Chemistry

2.2 Atomic structure and the Periodic Table

Notes

Describe the structure of the atom as a central nucleus containing neutrons and protons surrounded by electrons in shells

- An atom is the smallest part of an element that can exist.
- All substances are made up of atoms.
- Atoms contain a positively charged nucleus surrounded by negatively charged electrons.
- The nucleus contains protons (which are positively charged) and neutrons (no charge)
- The negatively charged electrons surround the nucleus arranged in shells.

State the relative charges and relative masses of a proton, a neutron and an electron

Subatomic particle	Relative charge	Relative mass
Proton	+1	1
Neutron	0	1
Electron	-1	~1/2000

- Filling in the blanks of the above table is a common exam question
- Remember that the neutron is 'neutral' so the relative charge is 0 (not 1!)

Define the atomic/proton number and the mass/nucleon number

- The atomic/proton number of an element is the number of protons in the nucleus of an atom
    - E.g. the atomic number of carbon is 6 (6 protons in the nucleus)
- The mass/nucleon number of an element is the total number of protons and neutrons in the nucleus of an atom
    - E.g. the mass number of carbon is 12 (6 protons and 6 neutrons in the nucleus

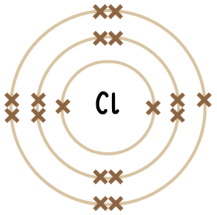
Determine the electronic configuration of elements and their ions with proton number 1 to 20, e.g. 2,8,3

- The electronic configuration shows the arrangement of the electrons in each electron shell in an atom
- The innermost shell is filled with electrons first, maximum 2 electrons, before the next shell is filled, maximum 8 electrons, and so on.

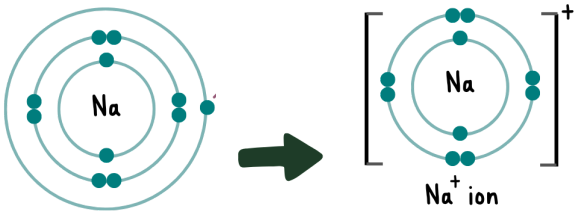
For elements with proton number 1-20

Electron shell	Maximum number of electrons that can be held
1	2
2	8
3	8

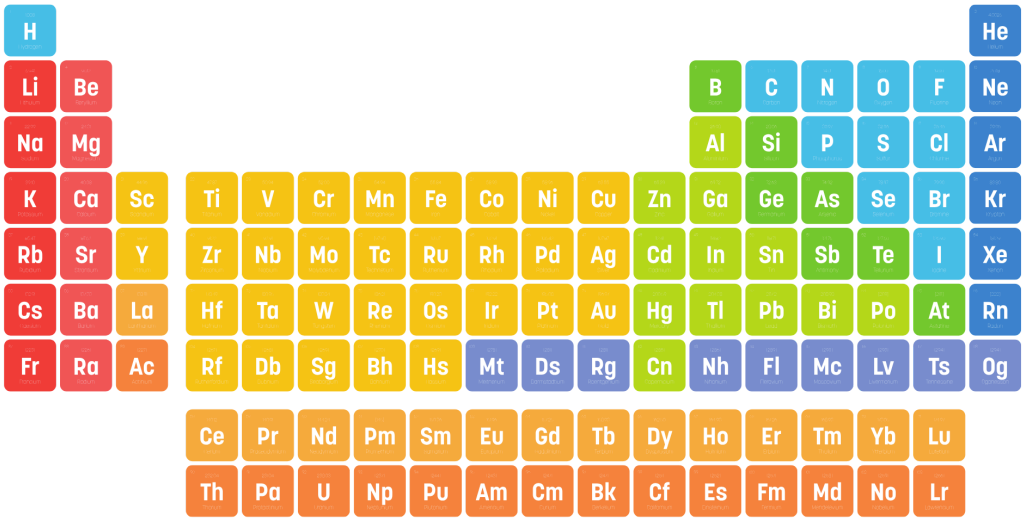
- The electron configuration of an atom of an element can be determined by looking at the proton number:
  - The proton number of chlorine is 17, so chlorine has 17 protons and 17 electrons.
  - The electron configuration of chlorine is written as: 2, 8, 7
  - The innermost/first shell of chlorine holds 2 electrons, the second shell has 8 electrons and the third shell has 7 electrons
  - Note how the written electron configuration separates the shells by putting a comma or full stop between the numbers in each shell
  - The diagram of the electron configuration is shown below: Each shell is is drawn as a circle, with electrons drawn as a cross or a dot



- The electron configuration of an ion of an element can be determined by working out how many electrons are in the ion
  - E.g. Sodium proton number is 11, so has 11 protons and 11 electrons
  - The electron configuration of a sodium atom is: 2, 8, 1
  - A sodium ion, **Na^+**, will have lost an electron so has 10 electrons
  - The electron configuration of a sodium ion, **Na^+**, is: 2, 8



State that: (a) Group VIII noble gases have a full outer shell (b) the number of outer shell electrons is equal to the group number in Groups I to VII (c) the number of occupied electron shells is equal to the period number



- Going across a row of elements is known as a **period**
  - E.g. Elements with atomic number 3-10 are in period number 2
- Going down a column of elements is known as a **group**
  - E.g. Li, Na, K, Rb, Cs and Fr are in group 1 (also known as the alkali metals)
- Group 8 (VIII) elements are known as the noble gases
  - E.g. He, Ne, Ar, Kr, Xe and Rn
  - All noble gases have a full outer shell of electrons
  - The electron configuration of the noble gases all end in 2 (for helium only) or 8
  - E.g The electron configuration of Ar is: 2, 8, 8
- For elements in groups 1-7 (I to VII), the number of electrons in the outermost shell is the same as their group number:
  - E.g. Magnesium is in group 2 and its electron configuration is: 2, 8, 2
- The number of occupied electron shells is the same as the period number the element is in:
  - E.g. Oxygen is in period number 2 and its electron configuration is: 2. 6 (so 2 occupied electron shells)