# CAIE IGCSE Chemistry

## 2.3 Isotopes

Notes

## *Define isotopes as different atoms of the same element that have the same number of protons but different numbers of neutrons*

- Isotopes are atoms of the same element that have the same number of protons and electrons but different number of neutrons
    - E.g. Carbon-12 has 12 protons and 12 neutrons but carbon-13 has 12 protons and 13 neutrons in the nucleus of each atom.

## *Interpret and use symbols for atoms, e.g. $^{12}_{6}C$, and ions, e.g. $^{35}_{17}Cl^-$*

- In a periodic table, the elements are written with their mass number on the top and their atomic number on the bottom
- The atomic number can be used to work out the mass number and vice versa
    - E.g. $^{12}_{6}C$ has the atomic number 6 so has 6 protons, so the mass number is 12 (6 protons and 6 neutrons)
- For ions, the atomic number and the mass number stays the same as the original atom, but a minus or plus symbol is added after the letters to indicate whether the ion is positive or negative
    - E.g. $^{23}_{11}Na^+$ has the mass number 23 and atomic number 11, but the plus symbol shows that an electron has been lost, so the overall charge of the ion is +1.
- The atomic number can be used to work out the mass number and vice versa, and the charge can be used to work out the number of electrons:
    - E.g. $^{35}_{17}Cl^-$
    - The atomic number shows that the chloride ion has 17 protons
    - So if the mass number is 35, there must be 18 neutrons (17 protons + 18 neutrons = 35)
    - The minus symbol shows that an electron has been gained and the overall charge of the ion is -1, so there must be 18 electrons (17 electrons + 1 gained electron)

*(Extended only) State that isotopes of the same element have the same chemical properties because they have the same number of electrons and therefore the same electronic configuration*

- Isotopes of the same element will have the same chemical properties because the number of electrons stays the same, so the electron configuration stays unchanged

*(Extended only) Calculate the relative atomic mass of an element from the relative masses and abundances of its isotopes*

- The relative atomic mass is an average value that takes account of the abundance of the isotopes of the element
    - Example question: Carbon has 2 isotopes= Carbon-14 with abundance 20% and carbon-12 with abundance 80%. Calculate the relative atomic mass of carbon.
    - Equation to work out relative atomic mass:

$$\frac{(isotope\ 1\ mass \times abundance) + (isotope\ 2\ mass \times abundance)}{100}$$

    - For this question: ((14 x 20) + (12 x 80)) ÷ 100 = 1240 ÷ 100 = 12.4