



Cambridge (CIE) A Level Chemistry



Isotopes

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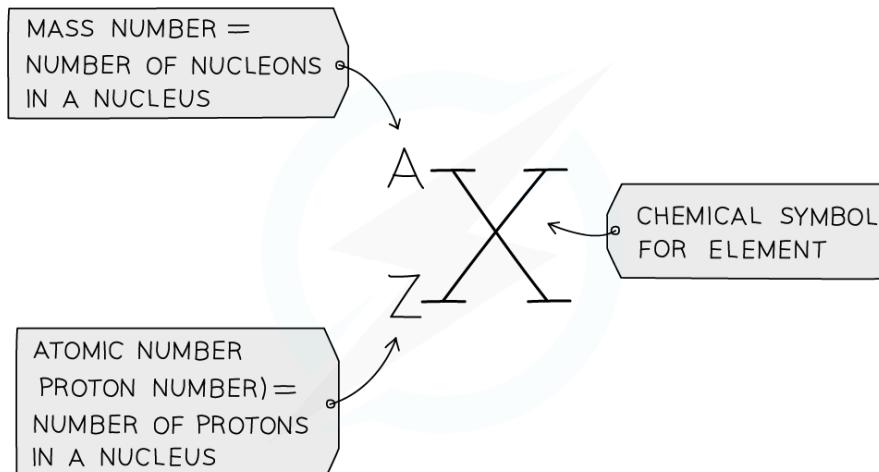
* Isotopes



Defining Isotopes

- Isotopes are atoms of the **same element** that contain the same number of **protons** and electrons but a different number of **neutrons**
- The name of an isotope is the **chemical symbol** (or **word**) followed by a **dash** and then the **mass number**
 - E.g. carbon-12 and carbon-14 are isotopes of carbon containing 6 and 8 neutrons respectively
- The chemical symbol of an isotope will still be shown in the usual form, as shown:

A general chemical symbol



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Isotopes of the same element have the same chemical symbol with a different mass number

- For chemical symbols, isotopes have:
 - The **same chemical symbol**
 - e.g. isotopes of chlorine all have the symbol Cl
 - The **same atomic number**
 - e.g. isotopes of chlorine all have an atomic number of 17
 - A different mass / nucleon number**
 - e.g. the chlorine-35 isotope has a mass number of 35, while the chlorine-37 isotope has a mass number of 37

The atomic structure and symbols of three isotopes of hydrogen

	PROTIUM	DEUTERIUM	TRITIUM
PROTONS	1	1	1
NEUTRONS	0	1	2
ISOTOPIC SYMBOL	^1_1H	^2_1H	^3_1H
● = ELECTRON ● = PROTON ● = NEUTRON			

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All three hydrogen isotopes have the chemical symbol H, the same number of protons but a different number of neutrons

Chemical & Physical Properties of Isotopes

- Isotopes have similar chemical properties but different physical properties

Chemical properties

- The chemical behaviour of an atom depends on its **electron configuration**, especially the electrons in the outer (**valence**) shell
- This is because all isotopes of the same element have the **same number of electrons and the same electron arrangement**, they:
 - Form the same types of bonds
 - React with the same elements
 - Show identical chemical reactivity

Physical properties

- Although isotopes have **identical chemical properties**, they differ in **physical properties** because they have **different numbers of neutrons**
- Neutrons add **mass** to the nucleus but carry **no charge** and don't influence chemical bonding
- As a result, isotopes have:

- Different relative atomic masses
- Slight differences in density



Your notes



Examiner Tips and Tricks

- These small differences in **physical** properties become important in processes like:
 - **Mass spectrometry** (detecting different isotopes by mass)
 - **Isotope separation** (e.g. in nuclear chemistry)
 - **Medical imaging** (radioisotopes rely on differences in physical properties)