

1 Atomic structure – Part 1

Name: _____ Class: _____ Date: _____

Vocabulary 词汇

Write each word three times. 把每个单词抄写三遍。

English	中文	Write it 3 times (English)		
atoms	原子	_____	_____	_____
nucleus	原子核	_____	_____	_____
electrons	电子	_____	_____	_____
protons	质子	_____	_____	_____
neutrons	中子	_____	_____	_____
shells	壳层	_____	_____	_____
proton	质子	_____	_____	_____
neutron	中子	_____	_____	_____
electron	电子	_____	_____	_____
proton number	质子数	_____	_____	_____
nucleon number	核子数	_____	_____	_____
ion	离子	_____	_____	_____
cation	阳离子	_____	_____	_____
anion	阴离子	_____	_____	_____
Isotopes	同位素	_____	_____	_____

English	中文	Write it 3 times (English)
same chemical properties	化学性质	_____
physical properties	物理性质	_____
density	密度	_____

Recall

At IGCSE you learned that everything is made of **atoms** 原子, and that an atom has a tiny central **nucleus** 原子核 with **electrons** 电子 around it. Now we sharpen those ideas.

- The nucleus holds **protons** 质子 and **neutrons** 中子.
- Electrons sit in **shells** 壳层 around the nucleus.

Nothing here is harder than IGCSE — it just lines up the ideas the AS course starts with.

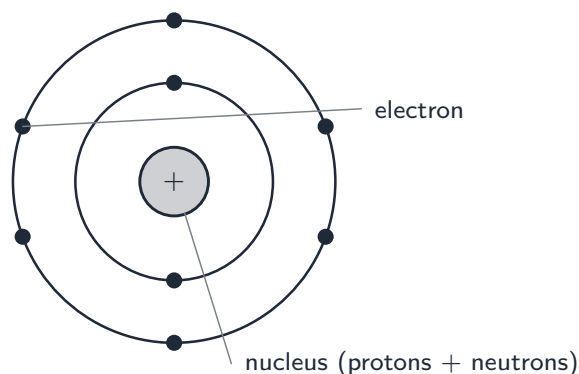
New ideas

Read these first, then do the Practice.

■ 1 The three particles

An atom is mostly empty space: a tiny heavy nucleus, with light electrons moving in shells around it.

Particle	Relative charge	Relative mass
proton 质子	+1	1
neutron 中子	0	1
electron 电子	-1	$\frac{1}{1836}$ (≈ 0)



■ 2 Proton number and nucleon number

- the **proton number** 质子数 (Z) is the number of protons (it names the element).
- the **nucleon number** 核子数 (A) is the number of protons **plus** neutrons.

So the number of neutrons is $A - Z$. In a neutral atom, the number of electrons = the number of protons = Z .

Worked example. Sodium ${}^{23}_{11}\text{Na}$ has $Z = 11$ protons and $A = 23$, so $23 - 11 = 12$ neutrons; being neutral it has 11 electrons.

■ 3 Ions

An **ion** 离子 is an atom that has lost or gained electrons:

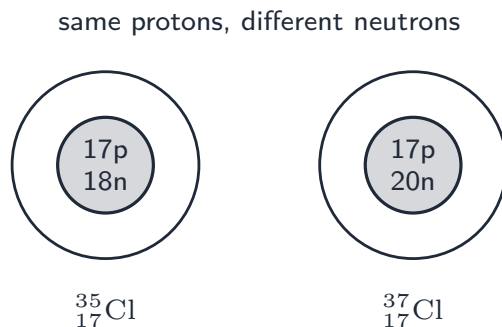
- a positive ion (**cation** 阳离子) has lost electrons (fewer electrons than protons).
- a negative ion (**anion** 阴离子) has gained electrons.

Worked example. ${}^{27}_{13}\text{Al}^{3+}$ has 13 protons, $27 - 13 = 14$ neutrons, and $13 - 3 = 10$ electrons.

■ 4 Isotopes

Isotopes 同位素 are atoms of the same element with the **same** number of protons but a **different** number of neutrons (same Z , different A).

- they have the **same chemical properties** 化学性质 (same electrons).
- they can have different **physical properties** 物理性质 such as **density** 密度 (different mass).



Watch out: almost all of an atom's mass sits in the nucleus — an electron weighs only about $\frac{1}{1836}$ as much as a proton, so the electrons add almost nothing to the mass.

Practice

Try these in order.

1.1 State the relative charge and relative mass of (a) a proton, (b) a neutron, (c) an electron. [3]

1.2 An atom has $Z = 17$ and $A = 35$. How many (a) protons, (b) neutrons, (c) electrons does it have? [3]

1.3 Define *proton number* and *nucleon number*. [2]

1.4 Work out the number of protons, neutrons and electrons in ${}^{24}_{12}\text{Mg}^{2+}$. [3]

1.5 What is meant by *isotopes*? [2]

1.6 Explain why two isotopes of an element have the same chemical properties. [2]

1.7 Challenge. Chlorine exists as ^{35}Cl and ^{37}Cl . Explain why the relative atomic mass of chlorine (35.5) is not a whole number. [2]
