

Exercise walk-through

2.5

Chemistry

GAC Science

Method — Key knowledge: particle counts distinguish elements, isotopes and ions

The **atomic number** 原子序数 is the proton count and identifies an element. The **mass number** 质量数 counts protons plus neutrons. An **isotope** 同位素 has the same proton count as another isotope of its element but a different neutron count. A neutral atom has equal proton and electron counts; changing electrons can form an ion without changing the element. Ionic bonding is electrostatic attraction between oppositely charged ions; electron transfer can explain their formation. Covalent bonding involves shared electron pairs.

Method — Source A: text or task brief

Supplied introductory models: neutral sodium-23 has atomic number 11 and mass number 23; neutral sodium-24 has atomic number 11 and mass number 24. Chlorine-35 has atomic number 17 and mass number 35. In a simplified ionic formation model, one sodium atom loses one electron to form Na^+ and one chlorine atom gains one electron to form Cl^- . The ions attract; the model is not a practical instruction to react these materials.

The periodic table orders elements by atomic number. In the introductory main-group model, outer electron arrangements help explain similarities in group behaviour. For a covalent example, two hydrogen atoms share an electron pair in H_2 . Hydrogen-1 has one proton and no neutron.

Method — Source B: response or review record

Student note: “Sodium-23 has 23 neutrons. Sodium-24 is a different element because its mass changed. Na^+ has twelve electrons and Cl^- has sixteen. Ionic bonds are simply the act of transferring an electron, with no attraction afterwards. Every atom must contain a neutron. Elements in a group are identical because all their electrons are the same.”

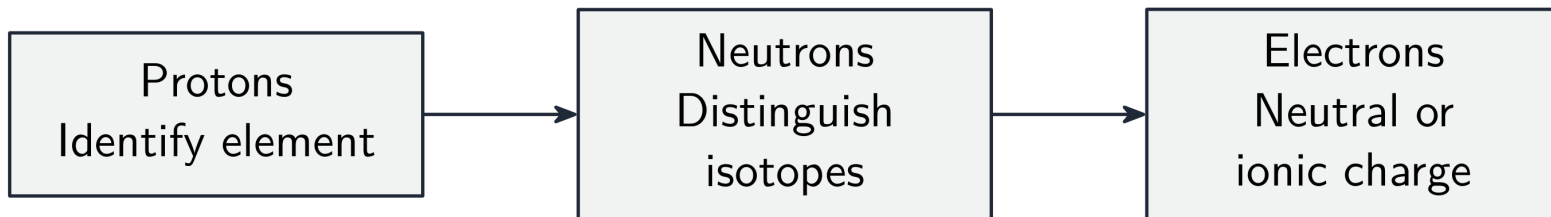
Method — Worked example: count particles before describing charge

Known: sodium-23 has proton number 11 and mass number 23. Why subtract proton number? The mass number counts protons and neutrons together.

$$N = A - Z$$

$$N = 23 - 11 = 12$$

The neutral atom has 11 electrons. Losing one gives Na^+ with 10 electrons, not 12. The positive charge arises because protons outnumber electrons by one; the proton count is unchanged.



Exercises 2.1-2.3

2.1 State the meanings of atomic number and mass number. [2]

2.2 Calculate the neutron counts of sodium-23 and sodium-24. [2]

2.3 Give the electron counts of Na^+ and Cl^- and explain one charge. [3]

Exercises 2.1-2.3

2.1 State the meanings of atomic number and mass number. [2]

2.1

: atomic number counts protons.: mass number counts protons plus neutrons.

2.2 Calculate the neutron counts of sodium-23 and sodium-24. [2]

2.2

: $N = A - Z = 23 - 11 = 12$.: $N = 24 - 11 = 13$.

2.3 Give the electron counts of Na^+ and Cl^- and explain one charge. [3]

2.3

: Na^+ has 10 electrons.: Cl^- has 18 electrons.: Na loses one electron while retaining 11 protons, or Cl gains one while retaining 17 protons, giving the stated imbalance.

Exercises 2.4·3.1

2.4 Explain why the two sodium isotopes are the same element but not identical atoms. [3]

3.1 Correct the bonding, hydrogen and group claims using six points. [6]

Exercises 2.4·3.1

2.4 Explain why the two sodium isotopes are the same element but not identical atoms.[3]

2.4

: both have 11 protons.: proton number identifies the element.: neutron counts/mass numbers differ, 12 versus 13 neutrons.

3.1 Correct the bonding, hydrogen and group claims using six points. [6]

3.1

each: ionic attraction is between opposite charges; transfer describes ion formation rather than the whole bond; covalent H_2 involves a shared pair; supplied hydrogen-1 has no neutron; main-group similarities relate to outer electron arrangements; group elements have different proton numbers/full structures and are not identical.

Exercise 3.2

3.2 Write an 80–110-word corrected particle-and-bonding note.

[8]

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[8]

3.2

Local analytic rubric, 8 ×: define proton identity; give sodium neutron counts; retain same element; correct Na^+ electron count; correct Cl^- electron count; distinguish attraction from transfer; identify covalent sharing; recognise hydrogen-1 exception; coherent truthful 80–110 word response. Example: “Atomic number counts protons, while mass number counts protons and neutrons. Sodium-23 therefore has twelve neutrons and sodium-24 thirteen. Both remain sodium because each has eleven protons. A neutral sodium atom has eleven electrons; losing one produces Na^+ with ten. Neutral chlorine has seventeen electrons; gaining one produces Cl^- with eighteen. Electron transfer explains formation of these ions, while their opposite charges produce ionic attraction. In the supplied hydrogen molecule, an electron pair is shared, giving a covalent model. Not every atom contains a neutron: hydrogen-1 has one proton and no neutron.”