Group 0

4.1.2.4 · Atomic structure and the periodic table · revision notes

The noble gases in Group 0: why they are unreactive, how their electrons are arranged, and the trend in boiling point down the group. Questions ask you to explain their unreactivity and to predict properties from data.

Key facts

- Group 0 = noble gases: He, Ne, Ar, Kr, Xe, Rn
- Outer electrons: 8, except helium which has 2
- Boiling point increases down the group (as relative atomic mass increases)
- Unreactive: stable arrangement of electrons (full outer shell)
- Exist as single atoms, not molecules

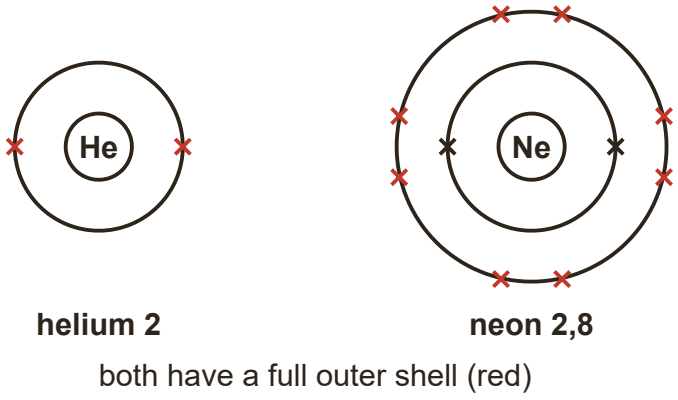
Notes

The noble gases

- The Group 0 elements are called the **noble gases**: helium (He), neon (Ne), argon (Ar), krypton (Kr), xenon (Xe) and radon (Rn).
- They are all colourless gases at room temperature.
- They are **unreactive** and do not easily form molecules, so they exist as single atoms.

Why they are unreactive

- Their atoms have **stable arrangements of electrons**: a full outer shell.
- The noble gases have **eight electrons** in their outer shell, e.g. neon is 2,8 and argon is 2,8,8.
- **Helium** is the exception: it has only **two** electrons, but that is a full outer shell because its only shell is the first shell.

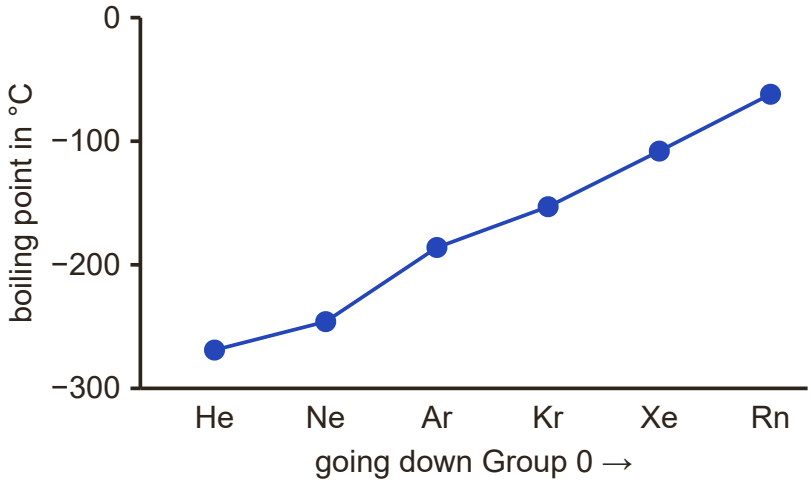


A full outer shell is a stable arrangement, so noble gases are unreactive.

- With a full outer shell, the atoms do not need to lose, gain or share electrons, so they do not easily react.

Trend in boiling point

- The boiling points of the noble gases **increase going down the group**, as the relative atomic mass increases.
- Helium has the lowest boiling point (about −269 °C) and radon the highest (about −62 °C). All are below room temperature, so all are gases.



Boiling point increases down the group.

- To predict a missing value from a table, check which way the values change and give a value that fits between its neighbours.
- The reason: bigger, heavier atoms have stronger forces of attraction between them, so more energy is needed to separate them when the liquid boils. Grade 8+ only

How to answer each type of question

Explain why the noble gases are unreactive

2 marks **Grade 5**

1. Say the atom has a full outer shell (8 electrons, or 2 for helium).
2. Say this is a stable arrangement, so the atom does not need to lose, gain or share electrons.

Example. Argon is used inside some light bulbs because it is unreactive.
Explain why argon is unreactive. Answer in terms of electrons.

Model answer. Argon has a full outer shell / 8 electrons in its outer shell (1). This is a stable arrangement, so argon atoms do not need to lose, gain or share electrons (1).

Predict a missing value from data

1 mark **Grade 5**

1. Look at the values above and below the missing one.
2. Check the direction of the trend.
3. Give a value between the neighbours, with the unit.

Example. The table gives the boiling points of some noble gases.

Noble gas	Boiling point in °C
helium	−269
neon	−246
argon	−186
krypton	.....
xenon	−108

Predict the boiling point of krypton.

Model answer. Any single value between −185 °C and −109 °C, e.g. −150 °C (1). (The actual value is about −153 °C.)

Describe the trend and explain helium 2 to 3 marks **Grade 5**

1. Describe the trend in the direction the question asks (down the group).
2. For helium, say its outer shell is the first shell, which is full with 2 electrons.

Example. (a) Describe the trend in boiling point in Group 0.
(b) Helium has only two electrons in its outer shell. Explain why helium is still unreactive.

Model answer.

(a) Boiling point increases going down the group / as relative atomic mass increases (1).

(b) Its outer shell is the first shell, which is full with 2 electrons (1), so it has a stable arrangement of electrons (1).

Don't lose marks

- Saying helium has 8 outer electrons.
- Writing 'full shells' without saying which one: the key idea is a full **outer** shell.
- Getting the boiling point trend backwards.
- Saying noble gases are unreactive because they are gases.
- Misreading negative temperatures: −186 °C is higher than −246 °C.

More tips

Memory tricks

- Group 0 is a reminder of their almost zero reactivity.
- Heavier noble gas, higher boiling point.
- Helium is the odd one out: a full outer shell with only 2 electrons.

Exam technique

- Use the phrase 'stable arrangement of electrons' or 'full outer shell' in explanations.
- When predicting from a table, give a single value (not a range) that fits the pattern, with its unit.
- Read negative numbers carefully: the value closer to zero is the higher temperature.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3 **Name Group 0 and some of its elements**
The noble gases: helium, neon, argon, krypton, xenon and radon.

Grade 4 **State that noble gases are unreactive**
They are unreactive and do not easily form molecules; they exist as single atoms.

Grade 5 **Explain their unreactivity using electrons**
Their atoms have stable arrangements of electrons: a full outer shell of 8 (2 for helium).

Grade 5 **Describe the boiling point trend**

Boiling points increase going down the group, as relative atomic mass increases.

Grade 5

Predict a property from a trend

Estimate a missing value in a table so that it fits the pattern.

Grade 6

Explain why helium is also unreactive

Its only shell is the first shell, which is full with 2 electrons.

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