

Development of the periodic table

4.1.2.2 · Atomic structure and the periodic table · revision notes

How the periodic table developed: early tables ordered by atomic weight, the changes Mendeleev made (gaps and swapped elements), and how later discoveries showed he was right. It is usually a 2 to 6 mark 'describe' or 'explain' question about how scientific ideas change with new evidence.

Key facts

- Early tables: ordered by atomic weight; incomplete; some elements in the wrong groups
- Mendeleev changed the order of some elements to fit similar properties
- Isotopes explain why atomic weight order is not always right
- Mendeleev left gaps for elements not yet discovered
- Elements discovered later (e.g. gallium, germanium) matched his predictions
- Modern table: ordered by atomic (proton) number

Notes

Early periodic tables

- Before protons, neutrons and electrons were discovered, scientists tried to classify the elements by arranging them in order of their **atomic weights** (what we now call relative atomic masses).
- The early tables were **incomplete**, because many elements had not yet been discovered.
- If the strict order of atomic weights was followed, some elements were placed in **inappropriate groups**, with elements whose properties were different from theirs.

What Mendeleev did

- **Dmitri Mendeleev** overcame some of these problems in two ways.
- He **left gaps** for elements that he thought had not been discovered yet, and used the patterns in his table to predict their properties.
- In some places he **changed the order** based on atomic weights, so that elements were in groups with similar properties. For example, he put tellurium (atomic weight about 128) before iodine (about 127), so that iodine was in the same group as chlorine and bromine.

Group 3	Group 4	
B 11	C 12	
Al 27	Si 28	
? gap	? gap	gaps later filled by gallium and germanium
In 115	Sn 119	
Te 128	I 127	Te placed before I, so I is in a group with Cl and Br

Numbers are atomic weights.

Mendeleev left gaps and swapped the order of some elements.

Evidence that he was right

- Elements with properties that matched Mendeleev's predictions were later discovered and filled the gaps, e.g. gallium and germanium.
- His predictions had been tested and found to be correct, so other scientists accepted his table.
- After protons were discovered, scientists realised that the table is really in order of **atomic (proton) number**.

Mendeleev's table compared with the modern table

- Mendeleev: ordered mainly by atomic weight, with some swaps; had gaps; had no group of noble gases (they had not been discovered).
- Modern: ordered by atomic number; no gaps; includes Group 0 (the noble gases).

How to answer each type of question

Describe how Mendeleev's table differed from earlier tables

2 marks

Grade 5

1. Gaps for undiscovered elements.
2. Some elements swapped out of atomic weight order so that they fitted groups with similar properties.

Example. Describe **two** ways in which Mendeleev's periodic table was different from earlier periodic tables.

Model answer. He left gaps for elements that had not been discovered yet (1). He changed the order of some elements (from atomic weight order) so that they were in groups with similar properties (1).

Don't lose marks

- ✗ Saying Mendeleev ordered the elements by atomic number. Protons had not been discovered.
- ✗ Saying he guessed the gaps. He predicted properties from patterns, and the predictions were tested.
- ✗ Saying he swapped elements because of isotopes. Isotopes were discovered later; they explained why his swaps were right.
- ✗ Writing 'mass number' instead of atomic weight or relative atomic mass.

More tips

Memory tricks

- Weights then, numbers now: early tables used atomic weight; the modern table uses atomic number.
- Mendeleev's two changes: Gaps and Group swaps. The proof: gallium and germanium.
- Pairs that break atomic weight order: tellurium before iodine, argon before potassium.

Exam technique

- For 'why was it accepted', the key idea is that his predictions were tested and found to be correct.
- In the 6-mark question, write in time order and use linking words such as 'because', 'so' and 'later'.
- If the question gives data, quote the numbers in your answer.

What each grade needs

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

Grade 3

State how early tables were ordered

By atomic weight, because protons, neutrons and electrons had not been discovered.

Grade 4

Describe problems with early tables

They were incomplete, and strict atomic weight order put some elements in groups with the wrong properties.

Grade 5

Describe what Mendeleev did

He left gaps for undiscovered elements and changed the order of some elements to fit their properties.

