

Instrumental methods

4.8.3.6 · Chemical analysis · revision notes

Instrumental methods use machines to detect and identify elements and compounds. This is in GCSE Chemistry only (not Combined Science). You need to state their advantages (accurate, sensitive and rapid) and compare them with the chemical tests in the specification.

Key facts

- | | |
|--|--|
| • Instrumental method = uses an instrument to detect and identify substances | • Advantages: accurate, sensitive, rapid |
| • Accurate = close to the true value | • Sensitive = detects very small amounts |
| • Rapid = gives results quickly | • Can analyse mixtures and measure amounts |
| • Chemical tests: cheap and simple, but less sensitive and unclear with mixtures | • Instruments: expensive, need trained staff |

Notes

What they are

- **Instrumental methods** use instruments (machines, often computer-controlled) to detect and identify elements and compounds.
- They are used, for example, in medicine, forensic science, environmental monitoring and checking the quality of products in industry.
- The one you study in detail is flame emission spectroscopy.

Advantages

- **Accurate**: the results are close to the true value.
- **Sensitive**: they can detect and measure very small amounts of a substance, so only a tiny sample is needed.
- **Rapid**: they give results quickly, and many samples can be analysed automatically.
- Many can analyse **mixtures** and measure **how much** of each substance is present.

Compared with chemical tests

- Chemical tests (gas tests, flame tests, precipitate tests) are cheap, use simple equipment and can be done almost anywhere.
- But chemical tests need more of the sample, can give unclear results with mixtures (e.g. masked flame colours), rely on judging colours by eye, and usually show only which ion is present, not how much.
- Instruments are expensive to buy and run, need trained operators, and their results must be compared with reference data for known substances.

How to answer each type of question

State advantages of instrumental methods

1 to 3 marks

Grade 4

1. Use the three spec words: accurate, sensitive, rapid.
2. If the question says 'compared with chemical tests', make each point a comparison: 'more sensitive', 'faster'.
3. If there are more marks, explain each point, e.g. 'sensitive, so it detects very small amounts'.

Example. Give **two** advantages of using instrumental methods rather than chemical tests to identify the metal ions in a sample of river water.

Model answer. Any two, 1 mark each: more sensitive / detects very small amounts (1); more accurate (1); faster / more rapid (1); can identify the ions in a mixture (1); can measure how much of each ion is present (1). Maximum 2 marks.

Don't lose marks

- ✗ Writing vague answers like 'easier' or 'better'. Use the spec words accurate, sensitive, rapid.
- ✗ Confusing sensitive with accurate: sensitive means it detects small amounts; accurate means close to the true value.
- ✗ Giving only advantages in an 'evaluate' question. Include disadvantages (cost, trained staff) and a conclusion.
- ✗ Saying chemical tests are useless. They work well for single ions in reasonable amounts, cheaply and quickly.

More tips

Memory tricks

- The three advantages, A S R: Accurate, Sensitive, Rapid ('Always Super Rapid').
- Sensitive = small: tiny samples, tiny amounts.
- For evaluate questions, score both methods on a quick grid: cost, speed, sample size, mixtures, amounts.

Exam technique

- In comparisons, use comparative words: 'more sensitive', 'faster', 'cheaper'.
- Tie each point to the context, e.g. 'sensitive, so the tiny speck of paint can be analysed'.
- Evaluate = pros and cons of each method, then a justified judgement at the end.

What each grade needs

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

Grade 3

State what instrumental methods are

Methods that use instruments (machines) to detect and identify elements and compounds.

Grade 4

State the three advantages of instrumental methods

They are accurate, sensitive and rapid.

Explain accurate, sensitive and rapid

Accurate: close to the true value. Sensitive: detects very small amounts. Rapid: gives results quickly.

Free notes, worksheets, practice papers and mock exams at chhetriacademy.com. Written for this site; not taken from past papers.
Stuck? 1-to-1 tutoring with a free 30-minute trial lesson.