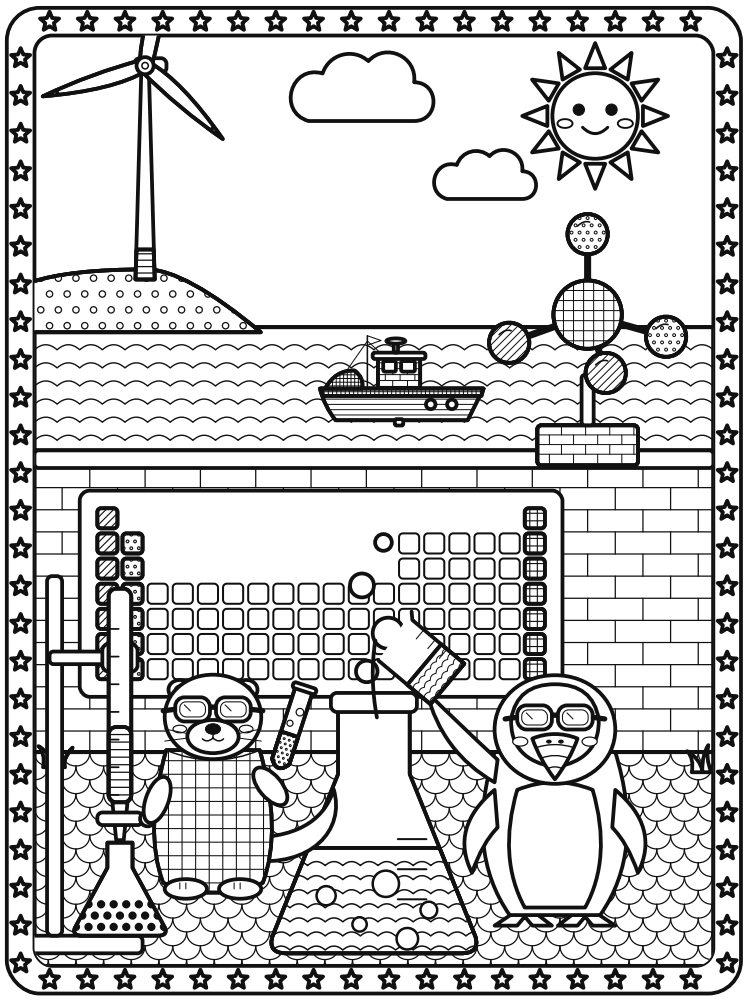
REAL-LIFE CHEMISTRY

# National 5 Chemistry

## Revision Guide

Notes, worked examples, exam-style questions and two practice exams, with full answers



C. Blewis

Blewis LEARNING

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# How to use this guide

This guide covers the whole National 5 Chemistry course in three areas. Each key area follows the same pattern, so you always know what comes next.

**EACH KEY AREA HAS**

| | |
|---|---|
| **Notes** | the ideas you need, in short sections with diagrams |
| **Calculations** | each type set out step by step with a worked example, using the same layout every time |
| **Exam tips** | common mistakes and how to pick up every mark |
| **Quick check** | short questions to test yourself straight away |
| **Exam-style questions** | longer questions with marks, like the real exam |

**A GOOD WAY TO REVISE**

1. Read the notes and cover the worked example. Can you do it yourself?
2. Try the quick check without looking back. Mark it using the answers at the back.
3. Do the exam-style questions in your jotter, with full working. Then mark them carefully against the marking guidance.
4. Tick the key area off on the tracker at the start of each area: **1** need more work, **2** getting there, **3** confident.
5. When you have revised everything, sit the practice exams under exam conditions.

**ANSWERS**

All answers are at the back. For exam-style questions the marking guidance shows where each mark comes from, so you can see exactly what examiners look for.

**CHECK THE COURSE**

Exam arrangements and course content can change. Your teacher and the latest course documents always come first.

# The exam

This is the current format. **Arrangements can change, so check the latest arrangements with your teacher.**

| | What it is | Marks |
|---|---|---|
| Question paper | One paper, 2 hours, with a data booklet | 80 |
| Section 1 | 20 multiple-choice questions (A, B, C or D) | 20 |
| Section 2 | structured and open-ended questions | 60 |
| Assignment | a report on an experiment and research | 20 |

## Command words

| Command word | What you need to do |
|---|---|
| State, name, give, identify | a short answer, no explanation needed |
| Describe | say what happens, or give the steps or features |
| Explain | say **why** or **how**, linking cause to effect |
| Calculate | show every step; give the answer with its unit |
| Predict, suggest | use a pattern or chemistry to give a sensible answer |
| Draw, write | a structure, diagram or balanced equation |
| Using your knowledge of chemistry... | open-ended: show your understanding (3 marks) |

## The assignment

You research a topic, carry out an experiment, and compare your results with data from another source. The report is written under supervision and marked out of 20.

| Section | What to include | Marks |
|---|---|---|
| Title, aim | a clear title, and what you are trying to find out | 1 + 1 |
| Underlying chemistry | the chemistry behind your topic, in your own words | 3 |
| Data collection and handling | brief method, raw data with repeats, a table with headings and units, means, data from another source and its reference | 6 |
| Graphical presentation | the right type of graph, scales, labels with units, accurate points, line of best fit | 4 |
| Analysis, conclusion | use your data to compare or find a trend; a conclusion that answers your aim | 1 + 1 |
| Evaluation | two evaluative points, e.g. about your method or the other source | 2 |
| Structure | a clear, well-organised report | 1 |

# Exam skills

## Open-ended questions

Questions that start "Using your knowledge of chemistry, comment on..." have no single correct answer. They are worth **3 marks**, given for the quality of the chemistry you show, not the length of your answer.

| Marks | What the answer shows |
|---|---|
| 3 | a **good understanding**: the chemistry is correct and explained well, with a full answer to the question |
| 2 | a **reasonable understanding**: some correct chemistry that is relevant to the situation |
| 1 | a **limited understanding**: one or more relevant points of correct chemistry |
| 0 | no relevant chemistry, or chemistry that is wrong |

**EXAMPLE PLAN**

*A friend says that ice cubes made from salty water will melt at the same temperature as normal ice. Using your knowledge of chemistry, comment on this statement.*

- Choose one or two ideas you know well, e.g. ionic compounds dissolve to give ions that are free to move; dissolved substances change the melting point.
- Explain each idea properly, using correct terms (ions, lattice, molecules, solution).
- Link back to the statement: is it true, partly true or false, and why?

**EXAM TIP**

Use correct chemical words, and a formula, equation or labelled diagram if it helps. Avoid writing wrong chemistry: it can cancel out good points.

## Multiple-choice technique

| | |
|---|---|
| **Cover the options** | read the question and work out your answer before you look at A to D |
| **Rule out** | cross out options you know are wrong, then choose from what is left |
| **Calculations** | work them out in full on rough paper; wrong options are often the result of a common mistake |
| **Check the wording** | look for NOT, LEAST and MOST in the question |

**ON THE DAY**

- You have **1.5 minutes per mark** (80 marks in 120 minutes). Aim for about 25 minutes on Section 1.
- Use the data booklet for relative atomic masses, group ion formulae and the electrochemical series: you do not need to learn these.
- Never leave a multiple-choice answer blank: there is no penalty for a wrong answer.

# 1.1 Rates of reaction

## Changing the rate

| Each change makes the reaction faster | Why |
|---|---|
| Higher temperature | particles move faster, collide more often and with more energy |
| Higher concentration | more particles in the same volume, so more collisions |
| Smaller particle size | larger surface area, so more collisions |
| Add a catalyst | provides an easier route for the reaction |

A **catalyst** speeds up a reaction and is **not used up**: it is chemically unchanged at the end, so it can be used again. Catalysts are used in industry to save energy and money, and in car exhausts (catalytic converters).

## Calculating an average rate

**RELATIONSHIP**

$$\text{average rate} = \frac{\text{change in quantity}}{\text{change in time}}$$

Quantity: mass in g or volume in cm³. Time: in s or min. Unit: quantity unit per time unit, for example g $s^{-1}$, $cm^3$ $s^{-1}$ or g $min^{-1}$.

| Time (s) | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|
| Volume of gas ($cm^3$) | 0 | 28 | 46 | 58 | 65 | 68 | 68 |

**WORKED EXAMPLE**

Use the table to find the average rate between 10 s and 30 s.

**Change in volume** 58 − 28 = 30 $cm^3$

**Change in time** 30 − 10 = 20 s

**Average rate** 30 ÷ 20 = **1.5 $cm^3$ $s^{-1}$**

**WORKED EXAMPLE**

A flask loses 0.84 g of carbon dioxide in the first 2 minutes. Find the average rate.

**Rate** 0.84 ÷ 2 = **0.42 g $min^{-1}$**

## Quick check

**1** State **four** ways to increase the rate of a reaction.

**2** What is meant by the end-point of a reaction?

**3** Give two things that a catalyst does.

**4** Gas volume rises from 12 $cm^3$ to 40 $cm^3$ between 5 s and 25 s. Find the average rate.

**5** Why does the rate of a reaction decrease as time goes on?

**6** Why does powdered chalk react faster than a single lump of the same mass?

# 1.1 Rates of reaction

## Exam-style questions (15 marks)

**1** Which change would **not** increase the rate of reaction between zinc and dilute sulfuric acid?

**A** using zinc powder instead of lumps
**B** using more concentrated acid
**C** using a larger volume of the same acid
**D** warming the acid

**2** A reaction gives off 54 $cm^3$ of gas in 30 s. The average rate is

**A** 0.56 $cm^3\ s^{-1}$
**B** 1.8 $cm^3\ s^{-1}$
**C** 24 $cm^3\ s^{-1}$
**D** 1620 $cm^3\ s^{-1}$

**3** Ruby added marble chips to dilute hydrochloric acid in a flask on a balance. Her results are shown.

| Time (min) | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| Mass (g) | 150.00 | 149.42 | 149.06 | 148.86 | 148.78 | 148.78 |

**(a)** Calculate the average rate of reaction over the first 2 minutes, in g $min^{-1}$. **(2)**

**(b)** State the total mass of carbon dioxide given off. **(1)**

**(c)** Explain why the mass stops changing after 4 minutes. **(1)**

**(d)** Ruby put cotton wool in the neck of the flask. Suggest why. **(1)**

**4** Ruby repeats the experiment with the same mass of marble, but as powder instead of chips.

**(a)** Describe how the graph of mass lost against time would differ from the graph for chips. **(2)**

**(b)** Explain why the powder reacts faster. **(1)**

**5** Kai decomposes hydrogen peroxide solution using a catalyst. Oxygen is collected in a gas syringe.

| Time (s) | 0 | 10 | 20 | 30 | 40 | 50 | 60 |
|---|---|---|---|---|---|---|---|
| Volume of oxygen ($cm^3$) | 0 | 36 | 58 | 70 | 76 | 78 | 78 |

**(a)** State what is meant by a catalyst. **(1)**

**(b)** At what time did the reaction stop? **(1)**

**(c)** Calculate the average rate of reaction in the first 20 s. **(2)**

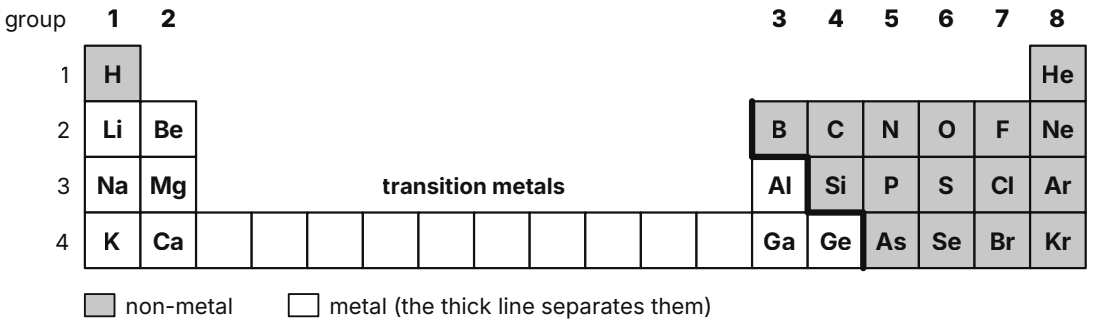
**(d)** Kai repeats the experiment at a higher temperature. State **two** things he must keep the same. **(1)**

# 1.2 Atomic structure

Elements are arranged in the **periodic table** in order of increasing **atomic number**. Columns are **groups**: elements in the same group have the same number of outer electrons, so they have similar chemical properties. Rows are **periods**.

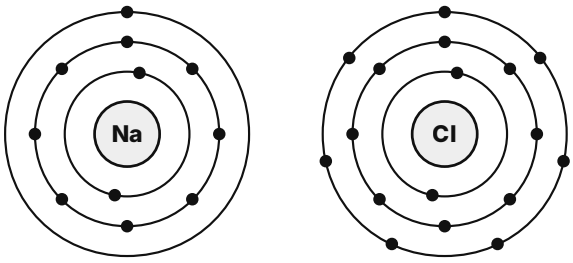
**KEY POINTS**

- Group 1: the alkali metals. Group 7: the halogens. Group 8 (also called group 0): the noble gases, which are very unreactive.
- The transition metals sit in the middle block. Metals are to the left of the thick line, non-metals to the right.
- Electrons are arranged in shells (energy levels): up to 2 in the first, then 8, then 8 for the first 20 elements.
- The **valency** of an element is the number of bonds it usually forms. It links to the group: 1, 2, 3, 4, 3, 2, 1, 0 for groups 1 to 8.




## Electron arrangement

| Element | Atomic number | Arrangement |
|---|---|---|
| Li | 3 | 2,1 |
| O | 8 | 2,6 |
| Na | 11 | 2,8,1 |
| Cl | 17 | 2,8,7 |
| Ca | 20 | 2,8,8,2 |




sodium 2,8,1 and chlorine 2,8,7

**EXAM TIP**

Fill shells in order: 2, then 8, then 8. Calcium (atomic number 20) is 2,8,8,2. The number of outer electrons equals the group number for groups 1 to 7, and noble gases have full outer shells.

# 1.2 Atomic structure

## Inside the atom

| Particle | Charge | Relative mass | Where |
|---|---|---|---|
| proton | +1 | 1 | nucleus |
| neutron | 0 | 1 | nucleus |
| electron | −1 | almost 0 | shells around the nucleus |

An atom is **neutral**: it has the same number of protons and electrons, so the charges cancel.
**Atomic number** = number of protons.
**Mass number** = protons + neutrons.

## Nuclide notation

$^{23}_{11}\mathrm{Na}$

$^{35}_{17}\mathrm{Cl}^{-}$

**WORKED EXAMPLE**

Work out the particles in $^{35}_{17}\mathrm{Cl}^{-}$.

| | |
|---|---|
| **Protons** | atomic number = 17 |
| **Neutrons** | 35 − 17 = 18 |
| **Electrons** | 17 + 1 = 18 (the ion has gained 1 electron) |

The mass number goes at the top left and the atomic number at the bottom left. An **ion** forms when an atom loses or gains electrons: metals lose electrons to form positive ions, non-metals gain electrons to form negative ions. The protons never change.

## Isotopes and relative atomic mass

**Isotopes** are atoms of the same element with the same atomic number but different mass numbers (different numbers of neutrons). Most elements are a mixture of isotopes. The **relative atomic mass** is the average mass of the atoms, taking into account how common each isotope is. It is usually not a whole number, and it is closest to the mass number of the most common isotope.

**WORKED EXAMPLE**

Chlorine is 75% chlorine-35 and 25% chlorine-37. Calculate its relative atomic mass.

| | |
|---|---|
| **Multiply** | 35 × 75 = 2625 and 37 × 25 = 925 |
| **Add** | 2625 + 925 = 3550 |
| **Divide by 100** | 3550 ÷ 100 = **35.5** |

**WORKED EXAMPLE**

Boron is 20% boron-10 and 80% boron-11. Calculate its relative atomic mass.

| | |
|---|---|
| **Average** | (10 × 20 + 11 × 80) ÷ 100 |
| **Answer** | 1080 ÷ 100 = **10.8** |

FREE SAMPLE

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