MASTER THE SKILLS YOU NEED FOR AN A GRADE

# AIMING FOR AN A IN CHEMISTRY

CHEMISTRY

Sarah Longshaw

A-level

HODDER EDUCATION
LEARN MORE

# Contents

# 3 Writing skills

## Learning objectives

- To identify the different forms of writing and when to use each.
- To develop an effective form of note taking.
- To plan answers to unstructured questions.

## Study skills

Writing is the means by which the knowledge and understanding you have developed throughout the course will ultimately be assessed. For this reason alone, it is one of the most important skills to develop.

If you progress beyond A-level chemistry, you may well be involved in the writing of papers and posters, but at this stage your experience of writing will be:

- note taking
- recording practical work
- answering questions
- report writing

At A-level chemistry you are not likely to encounter extensive writing activities, however, you do need to be able to provide a logical, well-structured piece of writing, which includes the use of correct terminology. In the exam you will have a variety of different question styles, some of which will be judged for QWC (quality of written communication). In this case the answers will be expected to be:

- legible, with spelling, punctuation and grammar being accurate enough to make the meaning clear
- appropriate for the purpose and subject matter
- coherent and clearly organised, using correct subject-specific terminology

Students must make the meaning clear to be awarded the marks, so not only must words and phrases be correct, but also the sentences in which they are used must make sense.

## Note taking

Note taking is largely for your own benefit and you may not be taught how to do this. Whichever method you adopt, it needs to work for you.

One method is the Cornell note-taking system (Figure 3.1), a system devised by Cornell University, where the page is laid out to provide space for adding annotations (usually in a margin) and a summary (usually at the foot of the page).

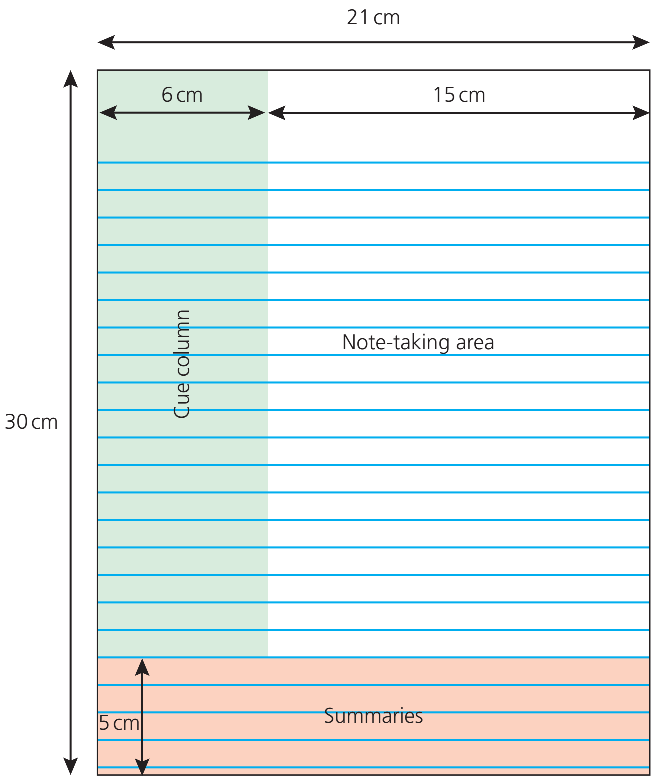



**Figure 3.1**

The idea behind this format is that, during the lesson, notes are made in the central part of the page, and that, after the lesson, these are summarised at the foot of the page and key points or questions (that are answered by the notes) are written in the margin. When you come to revise, you can then cover the central part of the page and use the questions as prompts to see what you remember. It is not just how the notes are set out that is important, but also how they are used. The Cornell method advocates reflecting on the content of the lesson soon after, and then reviewing all previous notes on a regular basis.

Your notes need to be well organised; they should have a title so that you know what they are about and that title should also set the context. You may wish to include the specification reference as well.

Key definitions need to be identified, as does other important information, such as practical procedures or equations. Underlining or highlighting this information can help it to stand out.

Calculations should be laid out so that each stage is shown clearly (see next page), including any equations in which values are substituted, and with the appropriate units. (More information on how to do this is included in chapter 1: Quantitative skills.)

**Table 3.1**

| Bond | Bond energy/kJ mol$^{-1}$ | Bond | Bond energy/kJ mol$^{-1}$ |
|---|---|---|---|
| C–H | 412 | C–C | 348 |
| C=O | 743 | O–H | 463 |
| O=O | 496 | | |

The table below shows how (and how not) to lay out your calculation if asked to calculate the energy change during the combustion of propane, using the data given in Table 3.1 above.

## The difference between...

| A well laid out calculation | | A poorly laid out calculation |
|---|---|---|
| $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ | | $C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$ |
| Bonds broken: | Bonds made: | $8 \times 412 + 5 \times 496 + 2 \times 348 - 6 \times 743 + 8 \times 463$ |
| C–H × 8 | C=O × (2 × 3) | $= -1690\,kJ\,mol^{-1}$ |
| $412\,kJ\,mol^{-1} \times 8 = 3296\,kJ\,mol^{-1}$ | $743\,kJ\,mol^{-1} \times 6 = 4458\,kJ\,mol^{-1}$ | |
| O=O × 5 | O–H × (4 × 2) | |
| $496\,kJ\,mol^{-1} \times 5 = 2480\,kJ\,mol^{-1}$<br>C–C × 2 | $463\,kJ\,mol^{-1} \times 8 = 3704\,kJ\,mol^{-1}$ | |
| $348\,kJ\,mol^{-1} \times 2 = 696\,kJ\,mol^{-1}$ | | |
| Sum of bonds broken: | Sum of bonds formed: | |
| $6472\,kJ\,mol^{-1}$ | $8162\,kJ\,mol^{-1}$ | |
| Overall energy change = bonds broken – bonds formed | | |
| $6472\,kJ\,mol^{-1} - 8162\,kJ\,mol^{-1} = -1690\,kJ\,mol^{-1}$ | | |

Summaries should be shortened versions of the key points of a topic, not a copy of what is in the textbook. A good way of getting used to doing this is to compare what is in a textbook with what is in a revision guide. The revision guide tends to just have the key facts and not the background or the examples. For example, for the topic 'Shapes of molecules', an OCR revision guide (ISBN 9781471842108) provides information as a summary table (Figure 3.2).

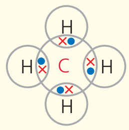
| Number of bonded pairs of electrons | Number of lone pairs of electrons | Shape | Approximate bond angle | Symmetry |
|---|---|---|---|---|
| 2 | 0 | Linear | 180° | Yes |
| 3 | 0 | Trigonal planar | 120° | Yes |
| 4 | 0 | Tetrahedral | 109.5° | Yes |
| 5 | 0 | Trigonal bipyramidal | 90° and 120° | Yes |
| 6 | 0 | Octahedral | 90° | Yes |
| 3 | 1 | Pyramidal | 107° | No |
| 2 | 2 | Angular | 104° | No |

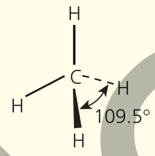
**Figure 3.2** Shapes of molecules as covered in a revision guide

The OCR textbook (ISBN 9781471827068) describes each line of the table in detail, giving an example, a dot-and-cross diagram and an image of the shape (Figure 3.3).

### Four bonded pairs and no lone pairs

Carbon forms many compounds containing four covalent bonds. The simplest is methane. The central carbon atom in methane has four bonded pairs and no lone pairs. The bonded pairs repel each other so that they are as far apart as possible. The resultant shape is **tetrahedral**; the bond angle is 109.5°:




— bond in the plane of the page
▬ bond in front of the plane of the page
--- bond behind the plane of the page

**Tip**

The bond angle in a tetrahedron is actually 109° 28′.
28′ represents 28 minutes – there are 60 minutes in 1°.

**Figure 3.3** Shapes of molecules as covered in a textbook

## Recording practical work and its application to the exam

Throughout your course you will undertake practical work and will need to record the procedure followed and your results. You may be provided with a separate lab book to keep this work in. If you study chemistry beyond A-level, you will most certainly use a lab book and you will probably be expected to write up lab reports. The report should document the procedure in sufficient detail to enable someone else to carry out the same method and to achieve similar results.

The general format is to include a diagram (or list of equipment), a step-wise method (written in the third person, usually as a series of bullet points), a results table, some form of analysis and a conclusion. The exact content and format will depend upon the experiment being carried out. It may be that, for the majority of your work, you are provided with a method to follow. In this case, this should be secured into your notes and any amendments should be recorded alongside.

### Writing a method

It is important that you can accurately describe how a practical is carried out because this is one of the skills that is now included in the written examination. Students often waste time listing apparatus, but this is not necessary because a labelled diagram or description of the method will cover this.

**Activity**

Choose a topic (it could be one you have already studied) and produce a one-page summary of your notes using the Cornell method described above. Make sure you include the cue questions and the summary of the main points.

## Worked example 3.1

### Writing in a logical sequence of steps

**A student produced a sample of 1-bromobutane, starting from 28.1 g of butan-1-ol and an excess of powdered sodium bromide. Describe the procedure used and state any additional reagents required. Your answer should include a calculation of the minimum mass of sodium bromide, but no other quantities are required.**

This is an example of the synthesis of an organic liquid. You need to describe the method in a logical sequence of steps. You are not asked to justify why you are carrying out particular steps, but you should refer to any safety precautions (beyond the obvious).

Start off by jotting down what the different stages of the procedure will be. It might be helpful to draw a rough sketch of the apparatus as a reminder.

(a) Mixing the reactants

(b) Reflux and then distillation of the product

(c) Purification of the product

(d) Drying the product

Having done this, you can then add a little more detail, again in note style. Name the reagents that will be used, how they will be prepared and any other equipment or resources that may be required. This may be dependent on the reagents involved in the process.

(a) Mixing the reactants: mass of solid NaBr; water to make solution; conc. sulfuric acid — dropping funnel and ice bath

(b) Reflux and then distillation of the product — organic liquid, so water bath or heating mantle; choice depends on boiling point

(c) Purification of the product: use of separating funnel and identification of organic layer; sodium hydrogen carbonate solution to remove acid (release pressure)

(d) Drying the product: add drying agent and filter (anhydrous calcium carbonate)

This then forms the plan for the answer you will write and following it enables you to produce a logical and well-structured response.

### Activity

Write an answer to the question given at the start of Worked example 3.1, using the suggested plan as a guide.

### Exam tip

When you are faced with an unstructured question, such as describing a practical procedure, produce an outline plan. When you have written your response in full, put a single line through the plan to show that it was rough work. Proofread your work and amend any errors you spot.

## Writing a conclusion

When you have generated some data — whether qualitative or quantitative — you will need to write a conclusion to summarise what your major findings were. This may also include what the errors were and how you could improve the practical.

Again, this is an aspect of the practical work that could be examined, and so writing in a logical and structured way is key to securing full credit.

## Worked example 3.2

### Evaluation of a practical

When a question asks you to *evaluate*, you are being asked to make a judgement about something — in this case the practical procedure that has been performed. You will need to use your own experience of the procedure as a reference point, comparing the information in the question with your knowledge and understanding. Read through the information given, including any results or other data, and annotate anything that stands out as being unusual.

**A student carried out an experiment to determine the concentration of ethanoic acid, by titration against 20.0 cm³ aliquots of a 0.500 mol dm⁻³ solution of sodium carbonate. The results obtained are shown in Table 3.2.**

Table 3.2

| | Trial | 1 | 2 | 3 |
|---|---|---|---|---|
| Final burette reading/cm³ | 7.30 | 14.25 | 21.15 | 28.25 |
| Initial burette reading/cm³ | 0.00 | 7.30 | 14.25 | 21.15 |
| Volume of $CH_3COOH$ used/cm³ | 7.30 | 6.95 | 6.90 | 7.10 |

Titres 1 and 2 are concordant;
however, the titres seem rather low.

**(a) When setting up the apparatus, the student failed to fill the burette correctly and left the gap between the tip and the tap full of air. State and explain the impact that this will have had on the results that the student recorded. (2)**

The burette would deliver less solution than that indicated by the result.

**(b) Suggest a way in which the student could gain more accurate results, using the same equipment and procedure. (2)**

Using a bigger volume would give a smaller percentage error.

**Step 1:** Read through and annotate the question. Some examples have been added for you.

**Step 2:** Part (a) tests your knowledge of how a burette works and the fact that it is calibrated so that the volume delivered includes the amount of liquid in the portion of the burette beyond the tap. If this is not filled, then the actual titre would be greater, because when the tap is opened, the liquid will fill the gap before being delivered to the flask, so the total volume reading would increase.

**Step 3:** The question says *state and explain*, so you need to say *what* the impact is and give a *reason*.

**Step 4:** Part (b) asks you to *suggest* a way of increasing the accuracy using the same equipment and procedure. Looking at the results, the titres seem rather low and so one way to improve the accuracy would to decrease the impact of the equipment error — by making the titre larger.

For most measuring equipment, the manufacturer will provide the maximum error that is inherent in using that piece of equipment, which is usually ± half the smallest measurement that the equipment is capable of. This can then be used to calculate the percentage error:

$$\text{percentage error} = \frac{\text{equipment error}}{\text{measurement made with that piece of equipment}} \times 100$$

If you increase the size of the denominator, then the error becomes less.