

## Chemistry: Interpreting the EE assessment criteria

### **Criterion A: Focus and method**

(Strands: Topic, Research question, Methodology)

The EE in chemistry must have a clear chemical emphasis and should focus on the chemistry aspect of the investigation.

It should incorporate chemical principles and relate to the study of matter and its chemical changes.

The topic can come from:

- the core
- the AHL topics or
- one of the IB Chemistry options of the syllabus.

However, the emphasis should be on chemistry.

The research question must be formulated as an actual question, such as “Can the spectator ions influence the rate of oxidation-reduction reaction?”

To address the research question the student must research the existing literature on the topic and choose an appropriate methodology to pursue the investigation by:

- undertaking work in the laboratory or
- basing their research on existing data.

If practical work is undertaken, the rationale for choosing the procedure should be clearly explained.

If the investigation is undertaken in an external laboratory, students have to show clearly their understanding of the methods and materials, and their role in collecting the data.

### **Criterion B: Knowledge and understanding**

(Strands: Context, Subject-specific terminology and concepts)

Students are expected to show understanding of the relevant chemical principles and ideas and to apply them correctly.

Students must demonstrate clearly the underlying chemistry behind the research question and the techniques and apparatus chosen.

The source materials accessed should be:

- clearly relevant and appropriate to the research question
- effectively referenced and incorporated into the main body of the essay in a way that demonstrates the students' understanding.

Literature cited should predominantly come from acknowledged scientific sources.

Students must demonstrate the ability to apply their selected sources and methods effectively in support of their argument.

The student must try to maintain a consistent linguistic style throughout the essay.

Chemical nomenclature and terminology should be used consistently and effectively throughout the essay. Students should also use appropriately and consistently:

- relevant chemical and structural formulas
- balanced equations with state symbols
- mechanisms of reactions
- significant digits
- SI units.

### **Criterion C: Critical thinking**

(Strands: Research, Analysis and Discussion and evaluation)

In a chemistry EE, the “research” refers to both literature sources and data collected by the students themselves. This research must be consistently relevant to the research question.

The student is expected to appropriately present and analyse the data. This analysis will often include:

- mathematical transformations
- statistical analysis
- tables of processed data and graphs.

If the data are analysed statistically, the student must clearly show understanding of why that particular test was chosen and what the results mean.

If graphs are used, they must be correctly selected and drawn to illustrate key elements of the analysis. They should only be included if they improve communication.

Students must analyse and present their data in such a way that they support and clarify the argument leading to the conclusion.

Students must make a particular effort to maintain a reasoned, logical argument that focuses on the research question. Essays that attempt to deal with a large number of variables are unlikely to be focused and coherent. A clear and logical argument can be achieved by making repeated reference to the research question.

An assessment of the extent to which the question is answered, either by the data or by information accessed, should form part of the argument.

The stated conclusion(s) must be based on and be consistent with the research presented in the essay.

The original research question need not be fully answered by the investigation. In these cases, the student should point out unresolved issues and make suggestions as to how these might be further investigated.

Inadequate experimental design or any systematic errors should be exposed. The uncertainties of the measurements should be evaluated and discussed.

The student must comment on the quality, balance and quantity of their sources. Students are expected to show an awareness of any limitations or uncertainties inherent in their approach. In particular, they should critically comment on the validity and reliability of their data relative to their management of variables within the investigation.

### **Criterion D: Presentation**

(Strands: Structure, Layout)

This criterion relates to the extent to which the essay conforms to accepted academic standards in relation to how research papers should be presented. It also relates to how well these elements support the reading, understanding and evaluation of the essay.

Students may use numbered and headed paragraphs to impose a clear structure. Subheadings should not distract from the overall structure of the essay or argument presented.

### **Use of charts, images and tables**

Any charts, images or tables from literature sources included in the essay must be carefully selected and labelled. They should only be used if they are directly relevant to the research question, contribute towards the understanding of the argument and are of a good graphic quality.

Large tables of raw data collected by the student are best included in an appendix, where they should be carefully labelled. Tables of processed data should be designed to clearly display the information in the most appropriate form. Graphs or charts drawn from the analysed data should be selected to highlight only the most pertinent aspects related to the argument. Too many graphs, charts and tables will distract from the overall quality of the communication.

Only processed data that is central to the argument of the essay should be included in the body of the essay, as close as possible to its first reference. Tables should enhance a written explanation but not themselves include significant bodies of text. If they do, then these words must be included in the word count.

If an experimental method is long and complex, students may place the raw data in an appendix and include a summary of the methods in the body of the essay. Students who choose this option must be careful to ensure that the summary contains all elements that contribute to the quality of the investigation, since appendices are not an essential section of the EE and examiners are not required to read them.

In other words, any important information that contributes to the evaluation of the method must be in the body of the essay and not the appendix. For experiments where numerical results are calculated from data obtained by changing one of the variables, it is generally good practice to show one example of the calculation in the main body of the essay. The remainder can be displayed in tabular or graphical form.

Any material that is not original must be carefully acknowledged, with specific attention paid to the acknowledgment and referencing of quotes and ideas. This acknowledgment and referencing is applicable to audiovisual material, text, graphs and data published in print and electronic sources. If the referencing does not meet the minimum standard as indicated in the guide (name of author, date of publication, title of source and page numbers as applicable), and is not consistently applied, work will be considered as a case of possible academic misconduct.

A bibliography is essential and has to be presented in a standard format. Title page, table of contents, page numbers, etc must contribute to the quality of presentation.

The essay must not exceed 4,000 words of narrative. Students should be aware that examiners will not read beyond the 4,000-word limit, nor assess any material presented thereafter. Graphs, figures, calculations, diagrams, formulas and equations are not included in the word count.

### **Criterion E: Engagement**

(Strands: Reflections on planning and progress)

This criterion assesses the student's engagement with their research focus and the research process. It will be applied by the examiner at the end of the assessment of the essay, and is based solely on the candidate's reflections as detailed on the [RPPF](#), with the supervisory comments and extended essay itself as context.

Students are expected to provide reflections on the decision-making and planning process undertaken in completing the essay. Students must demonstrate how they arrived at a topic as well as the methods and approach used. This criterion assesses the extent to which a student has evidenced the rationale for decisions made throughout the planning process and the skills and understandings developed.

For example, students may reflect on:

- the approach and strategies they chose, and their relative success
- the *Approaches to learning* skills they have developed and their effect on the student as a learner
- how their conceptual understandings have developed or changed as a result of their research
- challenges they faced in their research and how they overcame these
- questions that emerged as a result of their research
- what they would do differently if they were to undertake the research again.

Effective reflection highlights the journey the student has engaged in through the EE process. Students must show evidence of critical and reflective thinking that goes beyond simply describing the procedures that have been followed.

The reflections must provide the examiner with an insight into **student** thinking, creativity and originality within the research process. The **student** voice must be clearly present and demonstrate the learning that has taken place.