

Treatment of the topic

An EE in chemistry may be based on:

- literature
- theoretical models
- experimental data.

Whichever approach is chosen, the student must ensure that they have access to sufficient data to research the topic effectively.

Students who choose to write a literature- or survey-based essay should ensure that it clearly shows its chemical basis. Essays written at the level of a newspaper or news magazine article are unlikely to achieve a high mark.

Since chemistry is an experimental science, students are strongly encouraged to undertake experimental work as part of their research, although this is not compulsory.

In order to place their research into the appropriate context, students should research the area of the investigation before commencing any experimental work. Where possible, they should consult original research using:

- scientific journals
- personal communications
- online sources
- textbooks.

The internet should never be the sole source of information.

All essays involving experimental work undertaken by the student should include a clear and concise description of the experimental work. Students should indicate clearly whether they have personally designed the experiment or used an existing method. If they use an existing method, they must give its source and state how they have adapted and improved upon it.

Supervision

All essays must be supervised by a school supervisor.

Many of the best essays are written by students investigating relatively simple phenomena using apparatus and materials that can be found in most school laboratories, and this approach is to be encouraged.

If the practical work is carried out in an industrial or university laboratory, the essay should be accompanied by a letter from the external supervisor outlining the nature of the supervision and the level of guidance provided. The school supervisor must be satisfied that the work described in the essay is genuine and essentially that of the student.

The supervisor has the responsibility to ensure that students understand that the EE must not duplicate the research topic, data or the results of the internal assessment. A statement to that effect should be included in the supervisor's comment on the cover of the EE.

Generating and presenting data should not be an end in itself; students must analyse data using appropriate techniques, evaluate it and where appropriate compare it with appropriate models or literature values.

Use of secondary data

Students can also use data collected elsewhere. For example, for a research question that requires calculation of enthalpy changes in reactions, students can obtain average bond enthalpies from databases and manipulate these in order to answer the question.

However, to achieve high marks, students must devise their own method to analyse the secondary data in a way that leads to a specific answer to their research question.

In any chemistry EE, students must demonstrate that they understand the theory underlying any experimental work and state any assumptions made.

They should show an understanding of the results obtained and be able to interpret them with reference to the research question posed.

They should be critical of inadequate experimental design, the limitations of the experimental method and any systematic errors.

Students should be encouraged to consider unresolved questions in their research, and to suggest new questions and areas for further investigation. Throughout the essay, students should emphasize clearly their own personal contribution.

Examples of topics, research questions and suggested approaches

Once students have identified their topic and written their research question, they can decide how to research their answer. They may find it helpful to write a statement outlining their broad approach. These examples are for guidance only.

Topic	The effect of storage temperature on alkaline battery discharge time
Research question	What is the effect of storage temperature on the operational lifespan of an alkaline battery?
Approach	Experimental: set of 3 batteries is subjected to 5°C, 20°C, 30°C, 40°C, 50°C for a specific period of time, after which the batteries are discharged. Voltage is measured before and after storage period.

Topic	Investigation of changing reflux time on the yield of aspirin
Research question	Does increasing reflux time increase the percent yield of aspirin for the reaction between acetic anhydride and salicylic acid?
Approach	Experimental: aspirin is produced from acetic anhydride and salicylic acid at varying reflux time intervals.

Topic	Replacement of coal with natural gas for electric power generation
Research question	What would be the reduction in CO ₂ emission (measured as % change by mass) in Germany of replacing all coal-fired power plants with modern CH ₄ power stations?
Approach	Data based: calculate the CO ₂ emission per kWh using public domain data for the heat of combustion, composition and efficiency of coal and natural gas power plants.

Topic	Periodic properties of super-heavy elements 113–118
Research question	Can the physical and chemical properties of the undiscovered elements be predicted using the law of periodicity?
Approach	Literature based: examine the ionization potential, electron affinity and other periodic trends, predict if the super-heavy elements obey the periodic law.

An important note on “double-dipping”

Students must ensure that their EE does not duplicate other work they are submitting for the Diploma Programme.

The chemistry EE and internal assessment

An EE in chemistry is not an extension of the internal assessment (IA) task. Students must ensure that they understand the differences between the two.

- The IA is more likely to focus on the syllabus content, whereas the EE could explore aspects of chemistry not covered in the syllabus.
- The IA must include data collection and analysis (from hands-on experiments, databases, simulations or modelling) and cannot purely be a literature review.
- The EE must construct a theoretical framework for the underlying chemistry of the chosen topic, whereas the IA focuses on the application of the scientific method to a problem of interest and will only include some background information.
- The EE explicitly assesses the students’ ability to analyse and evaluate scientific arguments.

Supervisors play an important role in guiding students on these distinctions. Students risk their diploma if academic misconduct is detected.