Investigation 4: Moderator comments

Personal Engagement	Exploration	Analysis	Evaluation	Communication	Total
x/2	x/6	x/6	x/6	x/4	x/24
2	4	6	4	3	**19**

Personal engagement

Mark	Descriptor
2	• The justification given for choosing the research question and/or the topic under investigation demonstrates **personal significance, interest or curiosity.** • There is evidence of **personal input and initiative** in the designing, implementation or presentation of the investigation.

	Moderator's Comment
Moderator's Award 2	The research question extends thinking from class work. Finding activation energy of denaturation is an interesting practical application of class work. The procedure used is a standard one for determining activation energy. There is some evidence of initiative in the design, for example the use of the microscopes slides is novel.

Exploration

Mark	Descriptor
1–2	• The report shows evidence of limited awareness of the significant safety, ethical or environmental issues that are **relevant to the methodology of the investigation**
3–4	• The methodology of the investigation is mainly appropriate to address the research question but has limitations since it takes into consideration only some of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.
5–6	• The topic of the investigation is identified and a relevant and fully focused research question is clearly described. • The background information provided for the investigation is entirely appropriate and relevant and enhances the understanding of the context of the investigation.

	Moderator's Comment
Moderator's Award 4	An interesting topic is identified and a relevant focused research question is clearly described.

The student sets the research in context by looking at relevant concepts and presenting information from different sources.

The methodology applies concepts appropriate to Diploma level Chemistry. In terms of the controlled variables, the amount of egg white, how the diameter of the circle of egg white is measured, how the temperature is controlled is not clear. It is not evident what range of temperatures are used and why these are chosen (although the values do appear in the data collection). The student identifies the difficulty in determining when the egg sample had denatured but does not describe how this is resolved.

Hot glassware is used but the student does not mention the use of gloves, tongs for safety purposes.

Analysis

Mark	Descriptor
5–6	• The report includes sufficient relevant quantitative and qualitative raw data that could support a detailed and valid conclusion to the research question. • Appropriate and sufficient data processing is carried out with **the accuracy** required to enable a conclusion to the research question to be drawn that is fully **consistent** with the experimental data. • The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis • The processed data is correctly interpreted so that a completely valid and detailed conclusion to the research question can be deduced.

Moderator's Award 6

Moderator's Comment

The investigation shows sufficient quantitative data which is reported with corresponding uncertainties in most cases. Mass values show a difference in the number of decimal places and their corresponding uncertainty. It is unclear whether it is an honest slip or if the data are processed values. Qualitative data are not clearly presented. Nonetheless, when discussing methodology the student does mention that the thin slice becoming opaque indicates the final time of denaturing. Tables are constructed in terms of this and hence it has been considered that qualitative data are implicit.

The student efficiently uses chemical theory and graphical analysis to process raw data to produce final results. There are two points that are found particularly noteworthy: one is the identification of anomalies and how the student deals with them in the processing; the other is the excellent grasp of graphical analysis shown in the production of the third graph.

The student understands the impact of measurement uncertainties, shown by the way they manipulate the raw data in order to produce a best fit line with a stronger linear relationship (R^2). The student does not consider the relevance of the different

diameter recordings and uncertainties for time and 1/T are missing from the table of processed data on page 6.

The student correctly interprets the results to state an activation energy.

Evaluation

Mark	Descriptor
1–2	• The student has **outlined** very few realistic and relevant suggestions for the improvement and extension of the investigation.
3–4	• Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **described** and provide evidence of some awareness of the **methodological issues*** involved in establishing the conclusion.
5–6	• A conclusion is **described and justified** which is relevant to the research question and supported by the data presented. • A conclusion is correctly **described and justified** through relevant comparison to the accepted scientific context.

Moderator's Comment

The conclusion that is described answers the research question and uses the processed data as support.

The student goes to some length to attempt to compare the experimental activation energy with a literature value.

Moderator's Award 4

The student does not offer a suggestion for how to determine when the egg sample denatured or discuss the difficulty with controlling other variables. They do reflect on the reliability of the Arrhenius equation as a method of analysis (even though this is not a gas phase reaction) which indicated some understanding of methodological issues.

The student does not offer any improvements and the suggestion for an extension was not sufficiently clarified. This was the weakest aspect of the report.

Communication

Mark	Descriptor
1–2	• There are many errors in the use of subject specific terminology and conventions*.
3–4	• The report is well structured and clear: the necessary information on focus, process and outcomes is present and presented in a coherent way.

- The report is relevant and concise thereby facilitating a ready understanding of the focus, process and outcomes of the investigation.

Moderator's Comment

Moderator's Award

3

The report is well structured. The methodology could have been more detailed; as it stands it is not particularly reproducible. It is also unclear how the final uncertainty on the activation energy was calculated. The methodology is poorly phrased and organized (step 1 contains two separate and unrelated operations) and is not described in sufficient enough detail to be easily repeated.

The report retains focus throughout and it is easy to follow the research's development through to the conclusion. It stays within the twelve page limit.

The precision of the raw data collected for time is not given, and in graph 1 the 1/T scale does not reflect precision of the data. Where given, the precision is not consistent, and the number of significant figures for the activation energy is not consistent with the input data.