Astronomy Sample 1 - Determining the Circumstellar Habitable Zones of five Stars.

Personal Engagement x/2	Exploration x/6	Analysis x/6	Evaluation x/6	Communication x/4	Total x/24
2	5	5	5	3	20

Personal Engagement

This criterion assesses the extent to which the student engages with the exploration and makes it his or her own. Personal engagement may be recognized in different attributes and skills. These could include addressing personal interests or showing evidence of independent thinking, creativity or initiative in the designing, implementation or presentation of the investigation.

Mark	Descriptor
2	**The evidence of personal engagement with the exploration is clear with significant independent thinking, initiative or creativity.** • 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 Award 2	**Moderator's Comment** There is ample evidence of personal engagement and curiosity, and good use of research to select appropriate methodology and an online database. Personal input is evident in the design, implementation and presentation (even where flawed in part) of the investigation.

Exploration

This criterion assesses the extent to which the student establishes the scientific context for the work, states a clear and focused research question and uses concepts and techniques appropriate to Diploma Programme level. Where appropriate, this criterion also assesses awareness of safety, environmental, and ethical considerations.

Mark	Descriptor
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 Award 5	**Moderator's Comment** The research question clearly describes the aim of this investigation. The background information is entirely relevant, detailed, and helps explain the methodology, which is initially well laid out. The selection of stars is limited (there are no O, B, A, F stars), and given the 'hypothesis' in Section 1, a wider range would have been appropriate. Some explanation of the values for inner and outer range would also have been helpful. More common details, like the AU, are explained.

Analysis

This criterion assesses the extent to which the student's report provides evidence that the student has selected, recorded, processed and **interpreted** the data in ways that are relevant to the research question and can support a conclusion.

Mark	Descriptor
3-4	• The report includes relevant but incomplete quantitative and qualitative raw data that could support a simple or partially valid conclusion to the research question. • The processed data is interpreted so that a broadly valid but incomplete or limited conclusion to the research question can be deduced.
5-6	• 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.
Moderator's Award 5	**Moderator's Comment** The data is properly selected (from a wide variety of options) despite using only three star types. The processing is done correctly and follows the Morris method for calculating CHZ. The bar graph, for some unknown reasons, is incorrect (although the values are correct); the graph does not show the CHZ region. The habitable zone for our Sun is given as 0.95 to 1.37, and this should have been on the graph. There is a genuine attempt to consider and propagate uncertainties although the data source is somewhat limited. Error analysis is consistent but is not a main issue in this type of investigation. There is no citation for the log 10 error but it is handled correctly. Finally, the interpretation is correct despite the major error on the graph.

Evaluation

This criterion assesses the extent to which the student's report provides evidence of evaluation of the investigation and the results with regard to the research question and the accepted scientific context.

Mark	Descriptor
3-4	• A conclusion is described which makes some relevant comparison to the accepted scientific context.
5-6	• A detailed conclusion is **described and justified** which is entirely relevant to the research question and fully supported by the data presented. • Strengths and weaknesses of the investigation, such as limitations of the data and sources of error, are **discussed** and provide evidence of a clear understanding of the **methodological issues** involved in establishing the conclusion. • The student has **discussed** realistic and relevant suggestions for the improvement and extension of the investigation.
Moderator's Award 5	**Moderator's Comment** The conclusion is appropriate and justified by the data analysis. Although there may be no accepted values for the selected starts, there are similar CHZ boundaries and that Tau Ceti is Sun-like in its extensive CHZ range. The student outline strengths and weakness, and highlights areas of concern for data sources. The student notes that there are several methods to construct CHZ boundaries, and these calculations do not show that liquid water may be present. There is a valid and appropriate extension suggested. The use of a spreadsheet

	would have enables much more data to be processed and included in this investigation, but the student acknowledges this.

Communication

This criterion assesses whether the investigation is presented and reported in a way that supports effective communication of the focus, process and outcomes.

Mark	Descriptor
3-4	**The presentation of the investigation is clear. Any errors do not hamper understanding of the focus, process and outcomes**. • 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. • The use of subject specific terminology and conventions is appropriate and correct. Any errors do not hamper understanding.
Moderator's Award 3	**Moderator's Comment** Communication is generally good and the text is clear but errors such as the graph (which expresses the purpose of the investigation) is a major fault. Some of the calculations are dense but the presentation and organization of the report is nicely structured. Communication, then, is not as concise or focused as required for a 4 level of assessment. Terminology is correct.

*For example, incorrect/missing labelling of graphs, tables, images; use of units, decimal places. For issues of referencing and citations refer to the "Academic honesty" section.