Formatting *– font: 12pt , Times New Roman; double spaced between sections, within sections single spaced; every diagram, table, figure must be given a number and title; pages numbered; no more than 2250 words in length.*

Title of Experiment

Date:
Name:

1. AIM/RESEARCH QUESTION

(Context: 1) "States a relevant, coherent and focused research question. The topic of the investigation is identified and a relevant and fully focused research question is clearly described"

- You need to state your specific and answerable research question here.
- The research question must be clearly stated,
- be able to develop a hypothesis and be detailed.

2. THEORY/BACKGROUND INFORMATION

(Context: 2) ***"Discusses*** *a relevant environmental issue (either local or global) that* ***provides the context*** *for the research question"*

(Contex: 3) *"****Explains*** *the connections between the environmental issue (either local or global) and the research question."*

- Present an understanding of a broad environmental issue.
- You must demonstrate, using an explanation, how the research question relates to the environmental issue.
- The justification given for choosing the research question and topic under investigation must draw from personal significance, interest or curiosity.
- Try to include known values / expected results from literature/websites
- Include what you may have learned from a similar lab
- If you are going to include diagrams make sure you give them a fig # & descriptive title.
- You may include in text references from articles or books.
- Place your experiment in context. Why is it important to get to the bottom of this?

3. HYPOTHESIS

Formulate a hypothesis to predict the outcome of the experiment and explain it using logical scientific reasoning. E.g. An increase in length (cm) of the string will alter the speed (m/s) of the pendulum dropped from a consistent height.

4. VARIABLES

(Planning: 1) *"**Designs** a repeatable* method appropriate to the research question that allows for the collection of sufficient relevant data"*

Independent Variable (manipulated/changing factor)	*Units*	*How will it be manipulated*	*How will the IV be controlled*

Dependent Variable (What will be measured)	*Units*	*How will it be measured (method)*	*How will it be measured in a consistent, controlled manner*

Controlled Variable (external variables that need to be kept constant in each trial)	*Units*	*How will it be controlled*	*How would this variable affect the data if NOT controlled*

5. MATERIALS/APPARATUS AND DIAGRAM

List apparatus and materials you intend to use. Draw a labeled diagram to show how you will set up your apparatus.

- Be specific, but do not include things like, "collect materials" or "prepare to collect data" or "wash glassware after experiment". These steps are part of every experiment.
- A diagram to demonstrate what you've done will clarify the process to the teacher and moderator.

6. METHOD

(Planning: 1) *"**Designs** a repeatable* method appropriate to the research question that allows for the collection of sufficient relevant data"*

- Plan to collect between 5 and 10 replications.
- Enough data must be collected to provide a valid and reliable conclusion.
- Data must be sufficient for a proper analysis. Ex. Cannot use an correlation coefficient with less than 20 samples.
- Point form so that method is clear, specific and easy to be replicated.

(Planning: 2) *"**Justifies** the choice of sampling strategy used"*

- It takes into consideration all, or nearly all, of the significant factors that may influence the relevance, reliability and sufficiency of the collected data.

(Planning: 3) *"**Describes** the risk assessment and ethical considerations where applicable"*

- How might you, someone or an animal be hurt or injured physically or psychologically during the course of your data collection?
- How were safety measures followed throughout the lab?
- Will your experiment have an impact on the environment? How will you minimize/eliminate any negative effects?

7. DATA COLLECTION

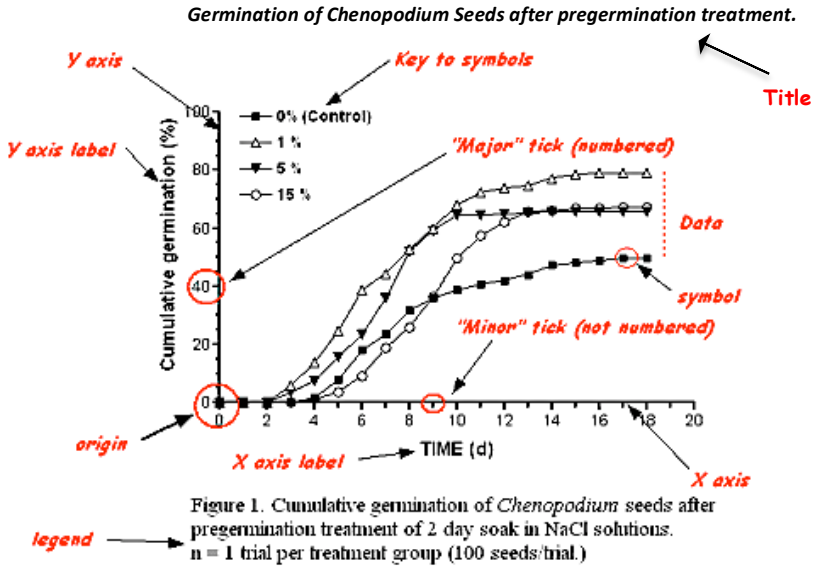
(Results: 1) *"**Constructs** diagrams, charts or graphs of all relevant quantitative and/or qualitative data appropriately"*

- The report includes sufficient relevant quantitative and qualitative raw data that could support a detailed and valid conclusion to the research question.
- a lack of primary data could be supplemented by the use of secondary data from data banks or simulations to provide sufficient material for analysis.
- Raw data Presentation
    a. Headings and units are included and are correct.
    b. Repetitive data is not included in the body of the report.
    c. Where relevant, uncertainties are included in table headings.
    d. Uncertainties are consistent (same number of significant figures) with the raw data.
    e. There is no variation in the precision of the raw data e.g. significant figures are all the same & they reflect the precision of the instrument.
    f. Appropriate graphs are created and include titles, uncertainties, units and decimal places.
    g. Insightful qualitative data can be recorded where useful as well.

8. DATA PROCESSING

(Results: 1) *"**Constructs** diagrams, charts or graphs of all relevant quantitative and/or qualitative data appropriately"*

- See the presentation on graphs and charts.
- Processed data
    a. Processes raw data, if necessary, into a form suitable for graphical representation
    b. Headings and units are included and are correct.
    c. Where relevant, uncertainties are included in table headings.
    d. Uncertainties are consistent (same number of significant figures).
    e. There is no variation in the precision of the raw data e.g. significant figures are all the same & they reflect the precision of the instrument.
    f. Appropriate graphs are created and include titles, uncertainties, units and decimal places.
    g. Error bars are included unless insignificant and their source (such as Standard deviation or Max/Min values) is stated.



9. ANALYSIS

(Results: 2) *"**Analyses** the data correctly and completely so that all relevant patterns are displayed"*

(Results: 3) *"**Interprets** trends, patterns or relationships in the data, so that a valid conclusion to the research question is deduced."*

- Appropriate and sufficient data processing is carried out with the accuracy required to enable a conclusion to the research question.
- Patterns and trends in data are described and reference directly to tables and graphs used.
- Variation within the data is discussed.
- *The report shows evidence of full and appropriate consideration of the impact of measurement uncertainty on the analysis.*
- Addresses the research question.

10. CONCLUSION

(Results: 3) *"**Interprets** trends, patterns or relationships in the data, so that a valid conclusion to the research question is deduced."*

States a conclusion, with justification, based on a reasonable interpretation of the data.

a. The relationship between the variables is correctly stated.
b. You must justify their conclusion and note any systematic or **unforeseen** random uncertainties (anomalies).
c. Connects to the research question, and hypothesis.
d. Use the table below to help you organize your ideas but don't include this in the paper.

Trend identified in data	Conclusion the trend leads to	Data (numbers from graph) to support conclusion

11. Discussion

(Discussion: 1) ***"Evaluates** the conclusion in the context of the environmental issue"*

- Discuss how the conclusion links back to the research question and the environmental issue.
- Discuss how the conclusion is similar or different to the expected trends or patterns.

12. Strengths, weaknesses and limitations

(Discussion: 2) *"**Discusses** strengths, weaknesses and limitations within the method used"*

- Evaluate the methodology of your research, discussing the strengths, weaknesses and limitations of the process.
- *Significant weaknesses and limitations in the process, equipment used and management of time are identified.*
- 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.
- Reflect on how they have impacted on the conclusion of the study
- Use the table below to organize your thoughts. You may include the table in the paper if you find it useful. Remember that this table will be included in your word count.

Strengths	How did it assist your lab to get good results?

Weakness/Limitation	How did it affect your lab to get poor results?

13. IMPROVEMENTS

(Discussion: 3) ***"Suggests*** *modifications addressing one or more significant weaknesses with large effect and further areas of research.*

- Weaknesses and limitations identified earlier are addressed.
- Realistic and relevant suggestions for the improvement and extension of the investigation.Suggestions state exactly what should be done to reduce random uncertainties or to improve the quality of the data.
- Suggestions on how to remove systematic uncertainties, if present, are made.
- Must also reflect on the outcomes of their investigation in relation to the broader environmental issue, which was raised at the beginning of the internal assessment process.

14. APPLICATION

(Application: 1) "Justifies one potential application and/or solution to the environmental issue that has been discussed in the context, based on the findings of the study"

- A high achieving paper will suggest how your findings could be applied to address the environmental issue, or to propose a potential solution to one aspect of the issue.
- This criterion attempts to synthesis of new ideas based on research findings.
- The suggestion might be based in the local context of the study itself, or might have relevance in a wider field, depending on the nature of the initial research question and the quality of the data obtained.

(APP: Aspect 2) "Evaluates relevant strengths, weaknesses and limitations of this solution.

- In order to score highly, the student must justify and evaluate their suggestion rather than just stating a proposal.
- Discusses the strength, weaknesses and limitations of the solution and uses these to provide a final appraisal.

15. COMMUNICATION

(COM: Aspect 1) *"The report is well-structured and well-organized."*
(COM: Aspect 2) *"The report makes consistent use of appropriate terminology and is concise."*
(COM: Aspect 3) **"***The report is logical and coherent."*

- The information and explanations should be targeted at the question in hand rather than a general exposition of the subject area; in other words, it should be focused.
- The vocabulary should be subject specific and of a quality appropriate to the Diploma Programme.
- The subject-specific conventions that can be expected are the correct formats for graphs, tables and cell headings, and the correct use of units.
- A report that exceeds the given word limit is likely to be penalized in this section for not being concise.