**Grading Rubric**

***Lab 1 – Capacitance***

***( /42)***

Recall that your goal is to teach them through inquiry-based teaching, and therefore you should encourage discussions, and make them understand the concepts (and achieve the best marks possible) as opposed to strictly evaluating them. You should try and assess their understanding in the last 30 mins of the lab session, or before they leave.

Points are distributed in four parts: **Pre-lab**, **Log book structure**, **Session A** and **Session B**. For the latter two, there’s always a **Conceptual questions and Critical thinking** and sometimes **bonus points**. Only during Session B will there be a **Data presentation** subsection.

**Pre-lab (/2)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) | Exceeding Expectations (3) |
| Pre-lab Activity | Did not attempt any of them | Gave an answer to all of them. Made some mistakes. | Gave an answer to all of them. Made no mistakes | - |

**Log book Structure (/4)**

We expect students to **always** have sections of introduction and conclusion to clearly show their objective in the lab and what they learned.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) | Exceeding Expectations (3) |
| Session a | Did not write any introduction or conclusion | Made no effort in evaluating their sources of error, and potential follow-up. | Made some effort in evaluating their sources of error, and potential follow-up. | Put in a lot of effort in evaluating their sources of error, and potential follow-up. |
| Session b | Did not write any introduction or conclusion | Made no effort in evaluating their sources of error, and potential follow-up. | Made some effort in evaluating their sources of error, and potential follow-up. | Put in a lot of effort in evaluating their sources of error, and potential follow-up. |

**Session A**

No grading for this session.

**Session B**

**Conceptual questions and Critical thinking (/20)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (2) | Satisfactory (4) | Exceeding Expectations (6) |
| Adjusted their initial proposal from the end of Session a **after** the group discussion. | They still do not understand that they must vary the distance and area between the plates. |  | They intend to study the effect of and on the capacitance by following the expected protocol. | Offered an unexpected method to further test the effect of , or on the capacitance. |
| Observed that the capacitance is proportional to the area of the plates. | They did not observe this. | They observed it, but their data was inconclusive, and did not provide a justification. | They both observed the effect and obtained good data.  **OR**  They obtained bad data but were able to justify their sources of error. | See “Satisfactory” conditions. Further noticed that the main source of error comes from misalignment of the plates |
| Observed that the capacitance is inversely proportional to the distance between the plates. They need to have more than 3 data points.  **Remember** that the  we found was only valid for short distances **3 layers or less**. | **Did not** notice the behaviour in any range **and did not** explain the discrepancy with theory. | **Did not** notice the behaviour in any range **but did attempt** explain the discrepancy with theory. | **Noticed** the behaviour in a short range **and did not** explain the discrepancy with theory. | **Both noticed** the behaviour in a short range **and attempted to** **explain** the discrepancy with theory. |
| Gave a physical explanation why area and the distance affected the capacitance of the setup. | Did not answer the question. | Incorrectly answered the question. | Correctly answered the question. | Exceeded expectations by making connections to other topics. |

**Data presentation (/16)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimally satisfactory (1) | Satisfactory (2) |
| Appropriate algebra (includes appropriate error propagation calculations) | Overwhelming number of mistakes | Made mistakes but it did not affect the overall understanding of the physical concepts. | Most calculations are correct. |
| Units (results and graphs) | Missing | Incorrectly used | Correctly used |
| Standard deviation  and significant figures | Missing | Incorrectly used | Correctly used |
| Title (figures and tables) | Missing | Incorrectly used | Correctly used |
| Axes labels | Missing | Incorrectly used | Correctly used |
| Error bars on graphs | Missing | Incorrectly used | Correctly used |
| Fit equation for graphs | Missing | Incorrectly used | Correctly used |
| value for graphs | Missing | Incorrectly used | Correctly used |

**Bonus points:**

* Fixed a technical issue with the setup **(+2)**.
  + Since this lab has more freedom than the others, it is unlikely that we’ve accounted for every possible scenarios and therefore, if students can help us improve these labs, they should be rewarded for doing so.
* Improved the Arduino code **(+2)**.
  + See the explanation above.
* Discusses the mathematical description of the electric field between the parallel plates (in comparison with that of an electric charge) **(+2)**.
  + The electric field is constant for an infinite plane
* Contrast the electric field of an infinite plane to that of a point charge or infinite line **(+2)**.
  + The former is and the latter is .