**Grading Rubric**

***Lab 2 – RC Circuit***

***( /54)***

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.

**Pre-lab (/2)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimalist (1) | Satisfactory (2) | Exceeding (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 | - |

**Session a**

**Conceptual questions and Critical thinking (/10)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimalist (1) | Satisfactory (2) | Exceeding (3) |
| Explained the difference in standard deviation between the charging and discharging measurement | Did not explain it. | Incorrectly explained it. | Correctly explained it. | - |
| Answered step 11 | Did not explain it. | Incorrectly answered it. | Correctly answered it. | - |
| Answered step 12 | Did not explain it. | Incorrectly answered it. | Correctly answered it. | - |
| Answered step 13 | Did not explain it. | Incorrectly answered it. | Correctly answered it. | - |
| Answered step 14 | Did not explain it. | Incorrectly answered it. | Correctly answered it. | - |

**Data presentation (/14)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimalist (1) | Satisfactory (2) |
| Appropriate algebra (includes appropriate error propagation calculations) | Overwhelming number of mistakes | Roughly half the calculations are wrong | 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 |
| Fit equation for graphs | Missing | Incorrectly used | Correctly used |
| value for graphs | Missing | Incorrectly used | Correctly used |

(Note the absence of error bars, since the standard deviation should be so small that its presence is insignificant for the graphs.)

**Bonus points:**

* Took notes on the settings of the PASCO interface to obtain good data fits for the discharging part **(+2)**.
* Engage in a discussion about measuring larger time constants **(+2)**.

**Session b**

**Conceptual questions and Critical thinking (/14)**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimalist (2) | Satisfactory (4) | Exceeding (6) |
| Measured the time constant from the effective resistance and capacitance of the circuit. | Did not obtain the correct time constant and was not able to justify the cause of this discrepancy. | See Satisfactory conditions but made some computational mistakes and/or didn’t measure correctly the time constant. | Correctly constructed their circuit by calculating the effective resistance and capacitance and measured the time constants using the PASCO. | Offered and executed another way to provide evidence that they correctly constructed the right RC circuit with the demanded time constant. |
| Incrementally increased the resistance and capacitance to obtain the slope and re-verify the time constant. | Did not perform this test. | Incorrectly connected the additional component such that the fit is not linear. | Correctly connected resistors in series and capacitors in parallel to obtain graphs with linear fits. | See Satisfactory conditions and explained the discrepancy between these two methods of measurement |
|  | Unsatisfactory (0) | Minimalist (3) | Satisfactory (6) | Exceeding (9) |
| Presented their conclusion in an argumentative form by referencing correctly their data. | Provided unconvincing arguments. | Obtained a decent time constant measurement, compared using less useful measures than percentage error, showed graphs of linear fit | Obtained a good time constant measurement, compared using percentage error, showed graphs of linear fits. | Offered experimental alternatives to improve the accuracy of the time constant measurement. |

**Data presentation (/14)**

|  |  |  |  |
| --- | --- | --- | --- |
|  | Unsatisfactory (0) | Minimalist (1) | Satisfactory (2) |
| Appropriate algebra (includes appropriate error propagation calculations) | Overwhelming number of mistakes | Roughly half the calculations are wrong | 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 |
| Fit equation for graphs | Missing | Incorrectly used | Correctly used |
| value for graphs | Missing | Incorrectly used | Correctly used |

(Note the absence of error bars, since the standard deviation should be so small that its presence is insignificant for the graphs.)

**Bonus points:**

* Engage in a discussion of a mixed circuit, one where the resistors are coupled to the capacitors instead of having two separate sub-circuits **(+2)**.