Rubric for Performance Indicators of Student Outcome (b):
An ability to design and conduct experiments, as well as to analyze and interpret data

<table>
<thead>
<tr>
<th>Performance Indicator</th>
<th>1: Beginning</th>
<th>2: Developing</th>
<th>3: Proficient</th>
<th>4: Exemplary</th>
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</thead>
</table>
| Design an Experiment Plan | • Missing Experiment Plan  
• Missing Driving Question  
• Missing identification of key variables  
• Missing data collection procedure | • Flawed Experiment Plan  
• Weak Driving Question  
• Majority of key variables are not identified  
• Data collection procedure is formulated poorly | • Adequate Experiment Plan  
• Driving Question is presented, though it might have minor flaws  
• Almost all variables have been identified  
• Data collection procedure is formulated adequately, but does not account for all externalities | • Well thought out Experiment Plan  
• Driving Question is appropriately narrow and focused  
• All relevant variables and externalities have been identified  
• Data collection procedure is detailed without being unnecessarily complicated |
| Acquire data on appropriate variables | • Data acquisition appears to have significant errors or unrealistic accuracy (fake data?)  
• Data collected for variables that are not part of Experiment Plan or some variables are not sampled  
• Missing large portions of data range | • Data acquisition does not include any detail on instrument precision or accuracy performance (sensitivity & calibration)  
• Acquired data is not accompanied by a data acquisition illustration or diagram (test setup not adequately described)  
• Input data range is significantly limited or obviously meaningless for some variables | • Data acquisition includes most instrument capabilities (sensitivity & calibration)  
• Data acquisition setup is illustrated / explained, but a few minor details are missing  
• Input data covers most of the “range of interest” for the key variables | • Data acquisition includes all relevant sensitivity and calibration information  
• Data acquisition setup is carefully and thoroughly explained  
• Input data covers entire range of interest, as well as some additional points / configurations that might be of interest without wasting time on unnecessary procedures |
| Compare experimental data and results to appropriate theoretical models | • No comparison made, or comparison made to nonsensical models | • Weak comparison of data to appropriate model | • Adequate comparison made to appropriate model | • Thorough comparison conducted between sufficiently varied data set and detailed model  
• Theoretical model is sufficiently detailed to provide insight into Driving Question |
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<tbody>
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<td></td>
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<td>• Comparison of data made to model that doesn’t include some important relationships among key variables</td>
<td>• Model includes important relationships among key variables, though some minor details are missing</td>
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| Explain observed differences between model and experiment (bad model, bad measurements, noise, etc.) | • Differences are not identified or are incorrectly explained  
• Neither the possibility of using the wrong model nor of collecting erroneous data has been identified | • Most differences are correctly identified, but many are poorly explained  
• Explanation of differences does not consider use of wrong model or possibility of having erroneous data | • All major differences are identified; only a few minor differences have been ignored  
• Both model and data have been explored as possible sources of error | • All relevant differences have been identified  
• Potential weaknesses in both model and data collection procedure have been identified, but both are well done |