

Rubric for Grading Individual Student Newton's Second Law Lab Reports (60 pts total)

Part I: Experimental Design and Data Outcomes (6 points for including the same lab records 06 already submitted by your lab group)

Part II: Discussion and Conclusion (54 points)(see rubric below)

Scientific Ability	Complete (3)	Needs improvement (2)	Inadequate (1)	Missing (0)
Start with lab 05:				
Is able to restate the research question for lab 05 for clarity.	Research question is included and correctly stated.	Research question is included but incorrectly stated.	Not applicable.	No attempt is made to restate the research question.
Is able to describe <u>how</u> the experiment with applied force as the IV addressed the research question and what claim (resulting model) can be made. The acceleration vs. applied force graph and its error bars are referred to in the discussion.	A discussion is included with adequate <i>reasoning or justification</i> for <i>how</i> the evidence (graphed data) supports the claim. Error bars, their size, and the equivalency criterion are discussed with respect to how the hanging weight affects the acceleration.	A discussion is included but <i>some</i> details are missing or inaccurate.	A discussion is included but <i>many</i> details are missing or inaccurate.	No discussion is included.
Is able to describe <u>how</u> the experiment with mass of cart as the IV addressed the research question and what claim (resulting model) can be made. The acceleration vs. mass of cart graph and its error bars are referred to in the discussion.	A discussion is included with adequate <i>reasoning or justification</i> for <i>how</i> the evidence (graphed data) supports the claim. Error bars, their size, and the equivalency criterion are discussed with respect to how the mass of cart affects the acceleration.	A discussion is included but <i>some</i> details are missing or inaccurate.	A discussion is included but <i>many</i> details are missing or inaccurate.	No discussion is included.
Is able to state both resulting models from lab 05 using appropriate variables and with units on constants.	Final experimental mathematical model is stated in terms of appropriate variables, with units included on all constants.	Mathematical model is left in terms of x and y rather than appropriate variables; or units are missing.	Mathematical model is left in terms of x and y rather than appropriate variables and units are missing.	The mathematical model is missing.
Is able to discuss how the data and claims of at least 2 other groups supports or refutes the group's findings.	Provides the data and claims from at least 2 other groups. Thoroughly discusses how these support or refute their own group's findings.	Response partially incomplete and/or with some errors.	Response not complete or includes errors.	No attempt is made to include or discuss the data and claims from other groups.
Is able to provide the relevant theoretical equation for this investigation and discuss how the experimental mathematical	Theoretical equation is provided and the discussion for how the mathematical model produced in lab supports the theoretical	Theoretical equation is provided, but the attempt made to discuss how mathematical model produced in lab supports the	Theoretical equation is provided, but no attempt is made to discuss how mathematical model	Theoretical equation is not provided. No attempt is made to discuss how mathematical model

Scientific Ability	Complete (3)	Needs improvement (2)	Inadequate (1)	Missing (0)
model supports, or does not support, the theoretical model. Included is a discussion of what C_1 and C_2 physically represent in the lab set-up.	model is complete and accurate. Results from curve fitting are included.	theoretical model is lacking appropriate detail, such as no discussion about what C_1 and C_2 physically represent.	produced in lab supports the theoretical model.	produced in lab supports the theoretical model.
Is able to discuss confidence in collected data (measurements) and how likely another researcher would measure similar values under same conditions.	Confidence in collected data is thoroughly discussed in terms of size of error bars and reproducibility of results.	Response partially incomplete and/or with some errors.	Response not complete or includes errors.	No attempt is made to discuss confidence in collected data.
Is able to discuss confidence in mathematical models provided by Excel.	Confidence in model from Excel is discussed in light of how well the trendline passes through the data points and their associated error bars.	Response partially incomplete and/or with some errors.	Response not complete or includes errors.	No attempt is made to discuss confidence in provided model from Excel.
Is able to discuss confidence in mathematical models based on the findings of other lab groups as well as scientific theory.	Confidence in model is discussed in light of other groups' experimental models as well as scientific theory.	Response partially incomplete and/or with some errors.	Response not complete or includes errors.	No attempt is made to discuss confidence in resulting model.
Shift discussion to lab 06:				
Is able to restate the research question for lab 06 for clarity.	Research question is included and correctly stated.	Research question is included but incorrectly stated.	NA	No attempt is made to restate the research question.
Is able to describe how the experiment with tilt of track or resistance as the IV addressed the new research question and what claim can be made. Various graph(s) and the resulting models are referred to in the discussion.	A discussion is included with adequate <i>reasoning or justification</i> for how the evidence supports the claim.	A discussion is included but <i>some</i> details are missing or inaccurate.	A discussion is included but <i>many</i> details are missing or inaccurate.	No discussion is included.
Is able to discuss whether the patterns observed between changes in the IV and changes in both C_1 and C_2 make physical sense in light of the theoretical model.	A discussion is included with adequate <i>reasoning</i> for how the observed patterns make physical sense in light of the theoretical model.	A discussion is included but <i>some</i> details are missing or inaccurate.	A discussion is included but <i>many</i> details are missing or inaccurate.	No discussion is included.
Is able to discuss whether the data and claims of at least one other group aligns with the group's findings for lab 06.	Provides the data and claims from at least 2 other groups. Thoroughly discusses how these support or refute their own group's findings.	Response partially incomplete and/or with some errors.	Response not complete or includes errors.	No attempt is made to include or discuss the outcomes from other groups.

Scientific Ability	Complete (3)	Needs improvement (2)	Inadequate (1)	Missing (0)
Is able to describe the outcomes from at least one other lab group who tested a different IV. In addition, is able to discuss whether the patterns they observed between changes in the IV and changes in both C_1 and C_2 make physical sense in light of the theoretical model.	A discussion is included with adequate <i>reasoning</i> for <i>how</i> the observed patterns make physical sense in light of the theoretical model.	A discussion is included but <i>some</i> details are missing or inaccurate.	A discussion is included but <i>many</i> details are missing or inaccurate.	No discussion is included.
Is able to identify random and systematic errors and discuss how they may have separately impacted the resulting experimental model(s).	All possible random and systematic errors are correctly identified. A thorough discussion is included for how errors may have impacted the resulting experimental models.	Reasonable attempt is made to identify errors but discussion for how errors may have impacted the resulting model is lacking in detail.	Attempt to identify errors is lacking or no discussion is included for how errors may have impacted the resulting model.	No attempt is made to identify errors. No discussion is provided for how errors may have impacted the resulting model.
Is able to wrap up report with a discussion about how to improve the experiment if it were to be repeated.	Discussion is appropriate for the report and may vary between reports. It may include a discussion about reducing error, testing other variables, how conditions on model could be extended, etc.	Response partially incomplete and/or with some inaccuracies.	Response not complete or includes inaccuracies.	No attempt is made to discuss how to improve the experiment.
Is able to use proper spelling, grammar, and punctuation , as well as to properly cite references when applicable (including the work from other lab groups).	No spelling or grammatical errors are found in the report and all references are properly cited, including the work from other lab groups.	There are a few spelling and grammatical errors throughout the report or references are included but essential ones are missing.	There are multiple spelling and grammatical errors throughout the report or references are included but essential ones are missing.	There are many spelling and grammatical errors throughout the report and references are needed but not included.
References are included, as needed, such as for the work of other lab groups or the theoretical model.	References are included and use the APA style.	References are included but APA style is not used.	More than one reference that should have been included is missing.	All references that should have been included are missing.