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| Standard | A | B | C | D | E |  | Important Notes to Students & Teachers on Achieving the ‘A’ Standard | |
| ***Hypothesis*** | Formulates/states a relevant, testable hypothesis that describes a quantifiable relationship between the dependent and independent variables.  (4) | Formulates/states a relevant, testable hypothesis that describes a relationship between the dependent and independent variables.  (3) | Formulates/states a testable hypothesis that includes the dependent and independent variables.  (2) | Identifies one or more relevant variables.  (1) | Does not meet the requirements of a D grade.  (0) | A hypothesis is a testable (falsifiable), scientific statement upon which your experiment is based, linking a change in the independent variable to a response in the dependent variable. Phrase as an "*if/then/because*" statement.  i.e. *if I [state measurable change] to [independent variable], then [state second measurable change] should be observed for [dependent variable], because [statement about theory behind experiment].* | |
| ***Planning & Conducting Investigation***  *(Introduction, Equipment & Method)* | Plans and conducts investigations, identifying appropriate variables and explaining how they are controlled.  (4) | Plans and conducts investigations, identifying and controlling appropriate variables.  (3) | Plans and conducts investigations identifying and controlling some variables.  (2) | Plans investigations without controlling variables.  (1) | See above.  (0) | **Be sure to include the following in your report:**   * A brief introductory paragraph or so detailing the theory behind the experiment, such as a short paragraph on the theory of rolling friction, would be appropriate. Be sure to discuss relevant variables (see rubric). * Any pre-lab questions you were asked to complete (if applicable). | |
| Describes experimental method in detail, with labelled diagrams of setup.  (4) | Describes the experimental method. Includes diagram of setup.  (3) | Briefly outlines the experimental method.  (2) | Describes an experimental method that lacks detail.  (1) | See above.  (0) | Method: Detail the steps your group took in the experiment. Be explicit.  Equipment: List the equipment you used. Draw the experimental setup and label your diagram(s). Figure should be at least one-third of a page in size. | |
| ***Organisation of Data***  *(Results)* | Accurately collects valid and reliable data. Consistently organises and processes data accurately, including uncertainty of measurement.  (8-7) | Accurately collects appropriate data. Often organises and processes data accurately.  (6-5) | Collects data. Organises and processes data with minor errors or omissions.  (4-3) | Collects insufficient or inappropriate data. Organises and processes data with significant errors or omissions.  (2-1) | See above.  (0) | **Be sure to include the following in your report:**   * Provide relevant measurements, with uncertainties, used to test the assumption of negligible rolling friction of the ramp (Part 1). * Provide relevant measurements, with uncertainties, used to determine the speed at the bottom of the ramp. * Provide relevant measurements, with uncertainties, used to determine the average friction force of the carpet (Part 2). * Provide relevant measurements, with uncertainties, used to determine how average friction force of the carpet changes with the mass if the trolley (Part 2). | |
| Presents data logically in a range of forms, including graphs, tables, and diagrams.  (4) | | Presents data in basic graphs, tables, and diagrams.  (2) | Presents data that is unclear, insufficient and lacks appropriate processing.  (1) | See above.  (0) | **Be sure to include the following in your report:**   * Uncertainties can be represented graphically using error-bars (must show how they were calculated – see ‘Analysis of Data’). | |
| ***Analysis of Data***  *(Discussion)* | Comprehensively explains trends using quantitative data, where appropriate, as evidence to draw conclusions that relate to the hypothesis.  (8-7) | Explains trends using some quantitative data, where appropriate, and uses evidence to draw conclusions that relate to the hypothesis.  (6-5) | Describes trends in data and draws simple conclusions that may not link to the hypothesis.  (4-3) | Identifies trends in data incorrectly or overlooks trends and draws simple conclusions that are not always supported by the data or are not related to the hypothesis.  (2-1) | See above.  (0) | **Be sure to include the following in your report:**   * Provide relevant calculations used to test the assumption of negligible rolling friction of the ramp (Part 1). * Provide relevant calculations used to determine the speed at the bottom of the ramp. * Provide relevant calculations used to determine the average friction force of the carpet (Part 2). * Provide relevant calculations used to determine how average friction force of the carpet changes with the mass if the trolley (Part 2). * Provide relevant calculations demonstrating the propagation of uncertainties as appropriate. | * State assumptions made (if any) at each stage of calculation.   *\*If you need to perform the same calculation repeatedly for different data points, you may provide one fully-worked sample calculation and provide the results of the remaining calculations of the same type in an appropriate format (i.e., table, graph). You may repeat this for each separate set of calculations that you need to perform.*   * Explain your results and what you can infer from them (i.e. state whether your results support your hypothesis and explain why or why not, with reference to your results). |
| ***Evaluation of Experiment***  *(Discussion)* | Evaluates the experimental method and provides specific and relevant suggestions to improve the reliability of the data collected.  (8-7) | Evaluates the experimental method and provides relevant suggestions to improve the reliability of the data collected.  (6-5) | Provides general suggestions to improve the reliability of the data collected.  (4-3) | Provides suggestions to improve the reliability of the data collected that may not be feasible.  (2-1) | See above.  (0) | **Be sure to include the following in your report:**   * Identify any potential sources for *systematic and random* error. * Comment on the validity (a fair test of the hypothesis) and reliability (consistency of results upon repeat experimentation - reproducibility) of the experiment. Usually links back to control variables. * Suggest improvements to the experiment to improve validity and reliability. Usually this is discussed in terms of improving accuracy and precision, or reducing uncertainty size. Sample calculations should be provided to show how uncertainty size would be reduced. | |
| ***Communication*** | Communicates detailed information and concepts logically and coherently.  (4) | Communicates information and concepts logically.  (3) | Communicates information and concepts simply.  (2) | Communicates information ineffectively.  (1) | See above.  (0) | Normally, you would also ensure you include any post-lab questions you were asked to complete after the discussion (not applicable for this investigation). | |
| Consistently uses appropriate terminology and conventions.  (4) | Often uses appropriate terminology and conventions.  (3) | Sometimes uses appropriate terminology and conventions.  (2) | Rarely uses appropriate terminology and conventions.  (1) | See above.  (0) | **Relevant Conventions:**   * References: Make note of any relevant references used in this investigation. Attempt to use a formal referencing convention (Chicago/Harvard/APA). * Diagrams should be numbered as ‘Figure 1’, ‘Figure 2’, etc., with description immediately below the figure. * Tables should be numbered as ‘Table 1’, Table 2’, etc., with description immediately above the table. | |