AP Physics 1 Lab Guideline

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LAB NOTEBOOK REQUIRED: Your greatest asset in the laboratory is a notebook. Write down anything you think of in your notebook. You never know what you might discover along the way. A spiral notebook is fine. Keep your notes together. We will be attaching our notes to the back of each lab so loose leaf is okay too.

For each activity or lab:

1. Discuss the experimental problem/question and experimental design for your lab including the measurements you need to make.  
   (Remember, there is no ONE way to do a lab – rather a variety of methods can yield meaningful information)
2. Perform your experiment and record data.
3. Analyze your data and show explicitly with equations or graphs how the measured quantities are used to achieve your task and/or how you will confirm the validity of your results.
4. Write a conclusion. Include sources of uncertainty and error and discuss specifically *how* they affect the value for the unknown quantity you are ultimately measuring.
5. Suggest possible extensions to the lab.

At the end of each lab or activity, each team will present the results to the group including:

1. A prepared write-up with the following elements: Lab Title, Problem/Question, Hypothesis (if appropriate), experimental design, data, analysis (equations, graphs, calculations as appropriate), conclusion

LAB WRITE-UPS MUST INCLUDE

1. Title, demographic info
   1. The usual heading applies: name, date, period, lab title, etc
2. Purpose/Problem/Objective/Question
   1. Explicitly state the goal of the lab. What is being examined here? This could be set out as a statement or as a question.
3. (Hypothesis)
   1. What is the predicted outcome? What do you expect to find when you perform the experiment? There will usually be an established conceptual or mathematical reason behind a good hypothesis. A good hypothesis is more than a hunch!
4. Materials
   1. List what equipment you used in your experiment. Include any parts used in setting up any kind of apparatus used in the experiment. Also include what measuring devices you are using.
5. Procedure/Experimental Design
   1. Describe step by step how to perform the experiment. How did you use the equipment listed in the Materials section? Write it so that any generally intelligent kid in another class could do it. Be clear about what to do in each step – details can be important!
   2. What measurements were taken? Include symbols for each measurement (define your variables, in other words)
6. Diagrams (photograph or drawn picture of lab setup)
   1. This is always necessary. Diagrams describe so much that you can sometimes almost get away with nothing more than a picture to describe your setup. You can draw your setup or you can take a photo of your setup and put that here. Label the diagrams and photos as necessary and include a caption describing it.
7. Data (table[s])
   1. You will be collecting lots of data, so it will help to organize it all, especially when graphs are involved. Make as many data tables as are necessary for your analysis. Be sure to include variables, units, and organization that clearly separates each trial or item being investigated. Each graph must have its own data table associated with it included in the data section.
8. Analysis (math, graphs, etc)
   1. Calculations: Include here any math you use to solve the problems involved in the labs. Solve as you would any other problem, including your givens, known equations, substitutions, and solution with units. Make your process clear here to indicate to the reader how your conclusions were reached.
   2. Assumptions: List assumptions here explicitly: are you relying on any constants? Are you assuming negligible friction? Include anything like that explicitly.
   3. Graphs: include scale on each axis, labels (with units) on each axis, actual data points, best-fit lines, and slope calculations. If your initial graph was non-linear, include that as well. All graphs should be done by hand on graph paper that will be attached to the typed lab.
9. Discussion and Conclusion
   1. Point out what proportionalities were discovered in detail.   
      Here’s an example: “The constant slope of the *Current vs. 1/Resistance* graph indicates that the current running through the light bulbs was directly proportional to the inverse of their resistances when the voltage across them was held constant. From this it is concluded that the current through a resistor is inversely proportional to its resistance value when under a constant voltage.”
   2. Explicitly address the initial question/problem (verbal and mathematical models – show *both* ways) – “inversely related” (unclear) is NOT the same as “inversely proportional” (specific)  
      (answer: Writing a conclusion might feel like rewording the question with the answer in it.)
      1. Did you find what you were looking for?
      2. How valid were your results? (error analysis: %error and standard deviation)
      3. Suggest further research: how can you results be used for further inquiry – for follow-up experiments?  
         For example: Can you get better results at higher speeds, using different materials, using different sensors, etc. and how will these changes result in improved data?
   3. Use the passive voice (3rd person), do not use personal pronouns (no “I”, “we”, “me”)
      1. You’re talking about the measurements, not about yourself
   4. Avoid emotional responses to the lab: “fun and interesting” doesn’t help us understand the results of the experiment any better.
   5. Avoid these words: prove, obviously, basically, “it turns out”, “human error”, miscalculation, (probably), maybe, faulty equipment, “messed up”
   6. Consider using these words: show, indicate, suggest, infer, (“data are”, “datum is”)
10. Uncertainty analysis (sometimes called “Error Analysis”) must be included:
    * 1. Find percent difference (show calculation in analysis section)
      2. Find standard deviation (show calculation in analysis section)
      3. Describe major sources of uncertainty
      4. Describe how each source of uncertainty changes the value you are measuring: higher or lower value than actual – *and why* (reference mathematical relationships here)  
         For example: (after establishing in detail how the measurement methods led to increased time values) “Because the measured time values were increased by 0.5 seconds each, each calculated speed was decreased since time and speed are inversely proportional in this calculation. An increase of 0.5 seconds would lead to a decrease of…” – include numerical details specific to your experimental data.
    1. Follow-up Experiments: Describe what other investigations could be conducted using the same setup or with modifications to obtain more accurate or more precise results.
    2. Quantify: Your conclusion must have numerical values in it that describe amounts: not that there were or weren’t uncertainties, but how much uncertainty and how it affected the results. Use your percent difference and standard deviation.
11. Handwritten Notes
    1. This is just a record of your notebook use. These are not part of your report, so they should not be referenced in the typed portion. These don’t have to be pretty, since they’re what you were using to scratch down your initial thoughts in the lab. This just encourages you to jot down what’s happening when you’re in a lab setting. Describe any observations you make, any notes to consider for later, any details you notice, anything that comes to mind.

