Lab 6: Guide/Rubric

JOHN JAY COLLEGE OF CRIMINAL JUSTICE, THE CUNY
MAX BEAN

For Lab 6, you are responsible for ***all ten sections*** of the formal report:
Cover Page, Abstract, Intro, RQ, DC, Diagram, Analysis, Uncertainty, Conclusion, Appendices

Cover Page:
This is a general list for ***all*** JJay Physics formal-report cover pages:

1. Title of Lab
2. Date
3. Lab section number (e.g. PHY203.01.L1) & group number (e.g. Group A)
4. List of authors in alphabetical order, by last name

Abstract:
This is a general list for ***all*** JJay Physics formal-report abstracts:

1. ***Optional, as needed***: one introductory sentence (often unnecessary).
2. Research questions, using the ***same wording*** as in the RQ section.
3. 1-2 sentences about methods—this is an ***overview***, do not go into detail.
4. Clearly stated answers to ***each RQ***. If these answers are numbers, include an uncertainty interval.
5. 1-2 sentences about the degree to which error & uncertainty affect your conclusion: i.e. how confident are you about your conclusion, given the amount of error & uncertainty in your data?

Introduction:
See Intro section from the Lab 5 Guide/Rubric.

Research Question:

1. Please use the ***GIVEN*** research questions from ***the lab instructions***.
2. Notice that there are THREE research questions—you will need to include (and, later, answer) ***all three***.
3. Notice that there are a couple choices for each question. There's no wrong choice, but please choose.

Data Collection:

1. Initial set-up of pendulum;
2. What a trial consisted of: how the pendulum was set in motion and what was measured;
3. How you tested the effect of angle—how many values, how many trials at each value, etc.
4. How you tested the effect of mass and length
   (NOTE: if the steps are exactly the same, feel free to just say that—***no need to repeat everything you already said***);
5. How you tested two extra values for length and (***very briefly***) why.
6. State where ***each data set*** can be found in the appendices.

Main Diagram:

1. all objects involved in the experimental setup (bob, string, ring-stand);
2. path of bob as in one full cycle;
3. all spatial variables and constants (length(s), distance(s), & angle(s));

Analysis:

Kinematics & Newton's Laws:

1. What forces are acting on the bob & what direction do they point, when bob is first released?
2. State where FBDs can be found in appendices.
3. Discuss choice of coordinate axes.
4. State which force is broken into components and why.
5. Refer to diagrams in appendices that show how these components are found.
6. Introduce Newton's Second Law of Motion (with equation, properly formatted).
7. Apply this equation to the bob to find tangential acceleration.
8. Describe path of bob—what type of curve?
9. Explain how distance was calculated (this might take a couple sentences and an equation or two).
10. Explain why it is ***not*** possible to use distance and acceleration to predict period.
11. Transition: why we must turn to the trial data.

Analysis of Trial Data:

12. State how raw trial data was averaged.
13. Explain where graphs can be found in appendix.
14. Describe graphs and explain which variable had the largest effect on period.

Explanation of Results ("Why?"):

(You may choose to present steps 15-18 as a *prediction* instead, and put it before the "Analysis of Trial Data"—the choice is yours.)

15. Explain why mass has no effect on period.
16. Explain why length has a significant effect on period.
17. Explain the two ways in which angle affects period.
18. Explain why these two effects cancel out.

Finding a Mathematical Function ("How?"):

19. Introduce the aim of finding mathematical function to relate dependent var. to ind. var.
20. Describe curve of length-period graph & identify type of function.
21. Describe how coefficient was found and state numerical coefficient.
22. Refer to relevant graph(s) in appendix.

***** Extra-Credit: *If you can*, include the items below. *****

23. Identify one physical constant that ought to appear in a calculation of period.
24. Identify one mathematical constant that ought to appear in a calculation of period.
25. Use dimensional analysis (units) to justify why the physical constant must be taken to the negative ½ power (square-root of reciprocal)
26. Extract this constant to find remaining portion of coefficient.
27. State how this remaining portion relates to mathematical constant from step 23.
28. Provide final function, including mathematical and physical constants.

Uncertainty:

1. List each measurement device used in the lab, what measurements it was used for, and the associated measurement uncertainty interval.
2. State which method of uncertainty calculation was used.
3. State where in appendices uncertainty calculations and intervals can be found.
4. Provide uncertainty interval for key values relevant to RQ (points on length-period graph).
5. **Extra-Extra-Credit:** find a method to calculate uncertainty for the coefficient on $\boldsymbol{l}$ in your $\boldsymbol{l}$-**T** function (from Analysis item #21) and state this uncertainty interval

Conclusion:

1. State answer to first RQ.
2. Compare this to pre-experiment prediction & discuss.
3. State three-part answer to second RQ:
    a. Why mass has no effect;
    b. Why angle has very little effect;
    c. Why length has a significant effect.
4. State answer to third RQ, including final function equation.
5. Discuss how error & uncertainty might affect your conclusion.

Appendices:

1. pure & component FBDs (including pos. & neg. directions);
2. diagram showing how components of mg were found;
3. expanded Newton's 2nd Law equations;
4. calculations to find $\boldsymbol{a_{tan}}$ and distance for one period;
5. optional: failed/incorrect kinematics prediction of $\boldsymbol{T}$.
6. all raw data, separated into three tables, one for each independent variable;
7. three graphs, showing period as a function of each independent variable:
    a. both axes clearly labeled, with units;
    b. scale consistent and beginning from zero on both axes;
    c. best-fit trend lines for each graph;
8. *optional (if you used linearization to find coefficient)*: a fourth linearized graph of $\boldsymbol{l}$-*vs.*-$\boldsymbol{T}$.
9. *optional*: any calculations necessary to break down coefficient of $\boldsymbol{l}$ in $\boldsymbol{l}$-$\boldsymbol{T}$ function.
10. uncertainty calculations & intervals for all measured & calculated values.