Lab Reports for Honors Physics

With Specific Comments on Lab 5

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October 26, 2002

Introduction

I want to start by making some general comments about the purpose and philosophy of lab work in this course. The purpose to learn the methodology of making measurements and what it means to make a measurement and then come to some physical conclusion. Another purpose of the exercise is to learn how to present your results in a technical report. This is learned skill and one that is very important for your careers in almost any field. You will often be judged by the clarity and exactness of your technical writing.

The point of doing simulations is to test your analysis procedures. This is something scientists do all the time. The idea is that in a simulation you define the input so you know what to expect. For example, in the rolling cylinders lab simulations with Interactive Physics you can specify the angle and the moment of inertia divided by the mass times radius squared. The data generated by IP can be analyzed by the same procedure you use to analyze the real data (using the motion detector). This gives you confidence in your procedure or indicates that you need to understand any discrepancies.

The lab experience should not be a burdensome one. At the end of the semester I would like you to feel that you have actually learned some useful skill. So I would like to encourage you to re-do the lab reports and re-submit. Please ask me about questions you may have..

I hope that by the end of the semester you will also have learned how to present a lab result or report on a technical paper in front of an audience. This is another important skill.

General Comments about Write-ups

1. When you refer to 'data' be aware that the word is a plural noun. Hence 'the data are analyzed' rather than 'the data is analyzed' or 'the data were collected' rather than 'the data was collected.'

2. When you present data in a plot <u>always</u> show the data as points or markers. <u>Do not connect the points with lines</u>. It you show a fit curve superposed on the data, make sure that the curve and data points are distinguishable. It may be a good idea to use different colors for the fit curve and the data – although this is not essential. If you have different sets of data on the same plot, you should use different markers for the data points. Keep in mind that when the plot is printed on a non-color printer, the different sets of data should be distinguishable.

3. Use an equation editor to produce your equations. Equations should centered (horizontally) on the page and should be numbered. MS Word does have a built-in equation editor.

4. If there is a discrepancy between a measurement and an expected result, try to understand the discrepancy. You do not need to report on all of your false starts in the write-up but if you cannot account for the discrepancy then you should at least honestly report the discrepancy and rule out possible reasons for the discrepancy that you considered.

Specific Comments about Lab 5

The Determination of the Angle

One of the problems peculiar to this lab is the determination of the angle. The indicator on the ramp is not very exact so it is easy to make a significant error on the determination of the angle. One of the goals of the lab is to determine:

$$\beta = \frac{I}{mr^2}$$

where I is the moment of inertia of a cylinder, m is the mass and r is the radius. What you actually measure is the acceleration:

$$a = \frac{g\sin\theta}{1+\beta}$$

and:

$$\beta = \frac{g\sin\theta}{a} - 1$$

for small θ, $\sin\theta \approx \theta$. You could easily make an error by a factor of 2 for angles near a degree. So the procedure I suggested was to use the measurement using the solid cylinder for which we know that $\beta = 1/2$ and then use this to determine $g\sin\theta$ for the other measurements.

There is also some interesting information in the time dependence of the total energy. The total energy can be written as:

$$E = \frac{1}{2}mv^2 + \frac{1}{2}I\omega^2 + mg\sin\theta(L - x)$$

where L is largest value of x (at the bottom of the ramp). The quantities x and v are reported by Logger Pro. We can rewrite this as:

$$\frac{E}{m} = \frac{v^2}{2}(1+\beta) + g\sin\theta(L-x)$$

You know that this is a constant. So having determined $g\sin\theta$, you can determine β by finding the value for which the above quantity is indeed a constant (with time).

Determination of Acceleration

The acceleration is the key quantity in this Lab. You have three methods to determine the acceleration: from the dependence of position, velocity and acceleration vs time as reported by Logger Pro. How consistent is the determination of acceleration using these three methods. Comment on discrepancies. You might want to present the values of the acceleration from the three methods for each of the cylinders in a table.

The same procedure should be followed for the data generated from Interactive Physics. How reliable is the determination of acceleration. Is one of the procedures better than the others?

Calculating Expected β

I provided a note – a PDF file – showing the dimensions and composition of the cylinders. As far as I can tell no one actually calculated the moments of inertia.