How does the length of a pendulum affect its period?

Theory suggests that for a pendulum of length **L** on the earth, the period of oscillation **T** is given by the following formula (provided that the amplitude of the oscillation is small).

$$T = 2\pi\sqrt{\frac{L}{g}} \quad \rightarrow \quad T^2 = \frac{4\pi^2}{g}L$$

By changing the length (L) and measuring the period (T) of a pendulum and plotting a suitable graph (ask if not sure) you are going to verify this relationship and calculate **g**, the acceleration due to gravity. This value can then be compared with the actual value of **g**.

Use a range of lengths from 20 cm to 120 cm in increments of 10 cm. If there is time repeat your measurements.

Independent variable: Length
Dependent variable: Period
Controlled variable: Mass, **amplitude**.

1. Do the experiment (changing L and measuring T), remembering to write appropriate sig. fig. and uncertainties.
2. Plot a graph of T^2 (y-axis) against L (x-axis).
3. Add the line of best and the max and min gradient lines.
4. Find the gradient of the line. The gradient should be equal to $4\pi^2/g$.
5. Use your gradient to find g with appropriate significant figures and extract its uncertainty from the max a min gradient lines of best fit.
6. Compare this with the theoretical value (9.81 $m.s^{-2}$).

To learn to use excel for processing of data and graph plotting follow the video (notice I do not use the same variables!!) attached to the assignment on MB.

This assignment will be used to assess your collection, processing, and presentation of scientific data.

Here are the elements that your submission must have:

Description of measurements
This need to:

- Be concise.
- Detail precautions taken to reduce the impact of sources of errors

Raw data table (only directly measured data)
Key points to consider:

- Clear headings with units
- Independent variable usually goes in first column
- The uncertainties of the measurements. If the entire data set has the same uncertainty add it in the heading; if not, add a separate column.
- Adequate significant figures for data and uncertainties. Uncertainties generally rounded to 1 sig. fig. (watch out for exception and column consistency) and matching decimal place with data.

- Concise and consistent. Same decimal places within columns. Sig. fig. and uncertainty need to be consistent with the measuring devices and methodology used to collect the data.

Processed data table
Add a processed data table with the results of the calculations that lead to the final data that will be plotted. Same key points as previous data table. Careful with sig. fig., the numbers are rounded in the display, but they are not in intermediate steps of calculations.

Final Graph
Key points to consider:

- scale is adequate so that the graph is easily readable.
- independent variable is in the horizontal axis
- final graph is linearized (choose appropriate axis so that the best fit line is straight)

The graph should have:

- descriptive title
- labeled axes with units
- error bars
- lines of best fit (including max a min gradient lines)
- clear legends
- equations of best fit

Numerical results
Calculation of g and its uncertainty. Percentage comparison with the theoretical value. Discuss its accuracy.

Example of final graph: