PHY 122 LAB 5: Density (linearized plot)

Introduction

In this lab we will determine the density of clay by weighing a set of hand-made spheres. We fit a model function for mass vs. diameter using a linearized plot and a log-log plot.

Procedure

Make a clay sphere about 1cm diameter and measure its diameter with the vernier calipers. Take 6 independent readings (roll the ball, change partners, etc) to establish uncertainty from the SDM of these readings. Be sure each lab partner takes caliper readings. Weigh the sphere and wiggle the gram slider to estimate errors. Repeat for a series of balls, from nominal diameters 1-7 cm.

Analysis

1. Working in GA, find the density of clay from a linearized plot (not log-log plot, which we do below) of mass and diameter (M,D) data.. You should deduce your own model function for this experiment, based on general knowledge. Error bars are implicit in the data if you simply plot all measurements.
2. Self-checks: Does your value for density pass the smell test (i.e. Is it reasonable, within say a factor of 2)? Look up the density of materials you know are lighter/heavier.
3. Log-log in GA: A pure power law can be linearized using log-log axes (note "ln" is base-e and "log" is base-10 -either will work, with ln giving somewhat better "resolution", but being tougher on the brain to interpolate) Calculate ln(D) and ln(M) and plot these transformed variables in GA. Do this by DATA \ NEW COLUMN\ CALCULATED. Then select these new columns for the plot. Find the exponent (and its uncertainty) in the power law from the slope of the log-log plot. Does this fit with your model function?
4. Log-log by hand: Plot your data by hand on log-log paper (supplied in lab). This is now base-10. Find the exponent of the assumed power law from the slope of the line.

Report

Make a single summary table of all results. You need not tabulate all measurements here, if your original data are reasonbly neat.

Prelab Quiz PHY122 Lab5

Name_____ Section time/day_____

1. Make a log-log plot of the data below using Graphical Analysis or Excel. In Excel, this is done with XY-scatter plot, then change both axes to log scale.
2. Find the value and units of the constants A and n from the slope and intercept of your log-log plot, assuming the functional relation $y(x)=Ax^n$. Ignore errors (yay!)

x(apples)	y(oranges)
1	3.00E+00
2	7.50E-01
4	1.88E-01
8	4.69E-02
16	1.17E-02
32	2.93E-03
64	7.32E-04
128	1.83E-04
256	4.58E-05