Numbers in Science

Introduction

This first "lab" is a warm-up to give you, or remind you of, all the understanding you will need to handle numbers in the subsequent PHYS 1301 labs. In scientific labs you measure things and then represent and calculate with the results of your measurements. In today's session you will only be representing and calculating with numbers (data) that are already provided.

This lab session is done individually and is PASS/FAIL. You must answer within the session time all the questions below correctly to receive any credit and it will be full credit. You should seek help from the instructors whenever you get stuck and to verify that your answers are correct. Write your working and answers in your lab notebook. A cheat-sheet for fractions, powers, and scientific form is at the end of this manual.

Fractions & Powers

1. **Without using a calculator, rewrite as a single fraction**
   (a) **(2/3) – (-5/6)**
   (b) **(-6/7) x (3/2)**
   (c) **7/(3(3/7))**

2. **Without using a calculator, evaluate**
   (a) $32^{1/5}$
   (b) $27^{-1/3}$
   (c) $3^3/2^{-2}$
   (d) $(2^2)^4$

Scientific Form

3. **Without using a calculator, evaluate in scientific form**
   (a) **0.00125**
   (b) **20700**
   (c) $(2.5 \times 10^6) \times (2 \times 10^{-12})$
   (d) $(1.25 \times 10^4)/(5 \times 10^{-3})$
   (e) $(4 \times 10^6)^{1/2}$
   (f) $3 \times 10^{10} + 3.07 \times 10^{12}$

4. **Rewrite in scientific form without prefixes on the units**
   (a) **0.01 mm**
   (b) 22 kms^{-1}
   (c) 144 nm^2

<u>Tables</u>

Always put data from your measurements neatly in tables (use a ruler for vertical lines; your notebook already has horizontal lines). Label the column headings and don't forget the units. For example

Trial	Diameter (cm)
1	4.5
2	4.7

5. Represent the following data pairs in a table

(distance, time) = {(2.7cm, 5.9s), (2.9cm, 6.8s), (3.3cm, 7.5s)}

<u>Calculations</u>

Often you will need to repeat the same calculation several times using data that you have measured. You should always <u>clearly</u> show the general formula or idea you are using and display the actual steps of the calculation for at least one set of data. For example

$$\text{height } y = \tfrac{1}{2} g\, t^{\,2}$$

$$y = 0.5 \text{ x } 9.8 \text{ x } (0.6)^2 = 1.764 \text{ m}$$

6. Using a calculator, calculate the speed for each of the data-pairs in question 5 and add a 3rd column to your table to represent the results

<u>Graphs</u>

Graphs are good for seeing trends in data. You should draw <u>on the graph paper</u> in your lab notebook. Draw axes <u>with a ruler</u> and label the quantity (and its units) being represented on each axis. Decide the scale for each axis so that the graph is a large as possible for your data range and label several regularly-spaced values of the quantity on each axis. Do all this before you plot data.

7. Plot points on a graph to represent the distance-time data from your table.

A trend in the data can be highlighted on a graph by drawing the best smooth line among the data points. Although there are precise mathematical fitting techniques to do this, in the PHYS 1301 labs you will do this conceptually (by eye). Do not force the line to go through each data point exactly; nearby points should scatter evenly either side of the line.

8. Draw the best straight-line through the data on your graph