Student Name (Last) (First) Section

BOROUGH OF MANHATTAN COMMUNITY COLLEGE
SCIENCE DEPARTMENT. GENERAL PHYSICS (PHY 110)

Laboratory Experiment 2

A rewrite of the experiment in the manual. All data is the same, just more needed explanations.

READING AND DRAWING SIMPLE GRAPHS

Partners names

OBJECTIVES

To familiarize the students with reading, interpreting and drawing simple graphs.

APPARATUS

Graph paper, pen/pencil, straightedge/ruler, protractor (optional), calculator.

INTRODUCTION

There are many reasons for drawing graphs in the natural and social sciences. One of them is being able to present experimental results in a way which can be easily, clearly and quickly understood by ourselves and others. A graph should allow someone to interpret the measured data correctly and easily. Graphs, quite often, allow someone to recognize relations, and perform interpolations and extrapolations of these relations between the variables represented. In Physics, graphs are used very extensively in order to compare theoretical predictions with experimental data. Graphs are also used in order to find an "average" among the measurements, thus improving the accuracy of the set of data collectively versus each individual measurement.

GRAPHING INSTRUCTIONS

When drawing graphs there are several things that one must have in mind:

1. The graph should occupy most of the available space. For the purposes of PHY 110, this means that the graph should occupy at the very least 60% of the graph paper page, unless your Instructor explicitly tells you otherwise.

2. Draw two axes that are perpendicular to each other. In a graph A versus B, quantity A (dependent variable) should be represented on the vertical axis, and quantity B (independent variable) should be represented on the horizontal axis.

3. Choose the numerical scales on each of the two axes independently, so as to satisfy point 1.

$$\textbf{Slope} = \frac{\mathbf{y_2 - y_1}}{\mathbf{x_2 - x_1}} = \frac{(15-4)\ (units)}{(4-1)\ (units)} = \frac{11\ units}{3\ units} = 3.67\ units \qquad \textbf{Slope} = \frac{\mathbf{y_2 - y_1}}{\mathbf{x_2 - x_1}} = \frac{(4-12)\ (units)}{(6-2)\ (units)} = \frac{-8\ units}{4\ units} = -2\ units$$

above. The two axes do not have to intersect at their corresponding origins.

4. Label each axis with the physical quantity it represents and the units in which each quantity is measured.

5. Label, with units, the graph so that it is self-contained. A reader unfamiliar with the experiment should be able to get a good idea about the results of the experiment (data) by just

looking at the graph.

6. Put carefully the data points on the graph.

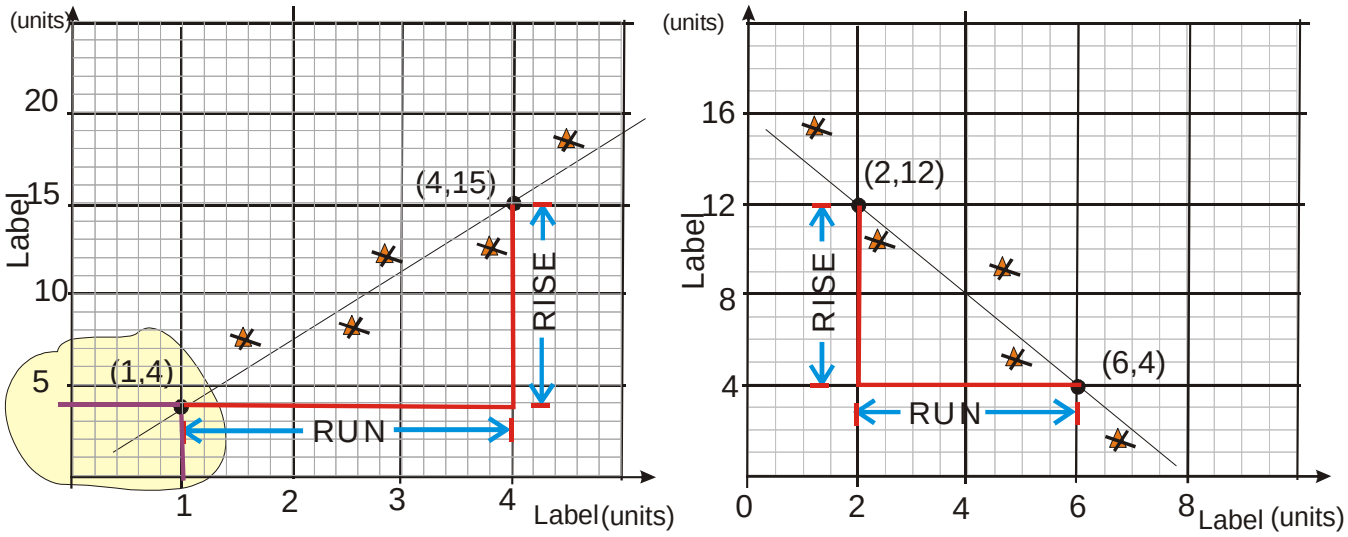
7. The graphs of PHY 110 are, almost always, straight lines. To draw a straight line, use your eyes ("eye-ball") and draw the line that gives the best, in your opinion, idea about the distribution of the data points . Notice that this line does not have to "pass" or "touch" any of the data points. This line should not be "perfectly" vertical either, if you have chosen a good scale on the horizontal axis.

8. For a graph which is a straight line, one is very frequently asked, to find the slope. For that, take two arbitrary, widely spaced points of the line with coordinates (x_1, y_1) and (x_2, y_2). Do not use any of the data points, unless they are on the line. For these two points calculate their "**run**" which is $\mathbf{x_2 - x_1}$, and their "**rise**" which is $\mathbf{y_2 - y_1}$. Then

$$\textbf{Slope} = \frac{\textbf{rise}}{\textbf{run}} = \frac{\mathbf{y_2 - y_1}}{\mathbf{x_2 - x_1}}$$

Do not forget to use appropriate <u>units</u>, if applicable, for the slope.

9. Notice that the slope can be either positive, zero or negative as in the following examples. We choose the points indicated by their (x, y) labels in each of the graphs. Note the distribution of data points about the line. **For this report, for reference points like (1,4) on the bottom of left graph, always label and make heavy horizontal and vertical lines from point to axes as shown .**



10. When the graph is not a straight line, it is a very simple curve. It should always be smooth, without any cusps ("corners") or discontinuities ("jumps" or "breaks"). For a curve, do not "blindly" connect all the dots. Use your judgement to draw a very simple, smooth curve.

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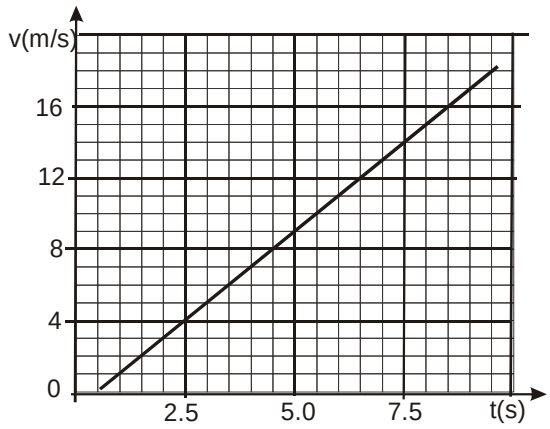
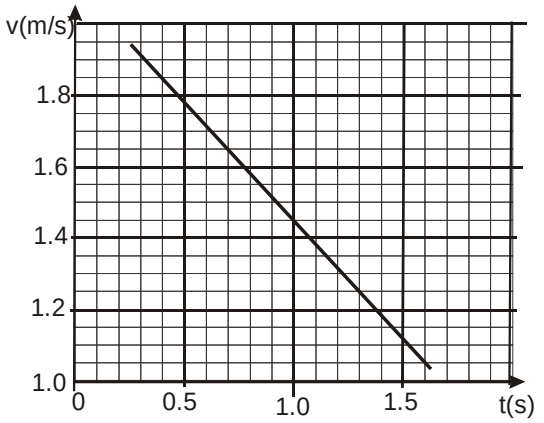
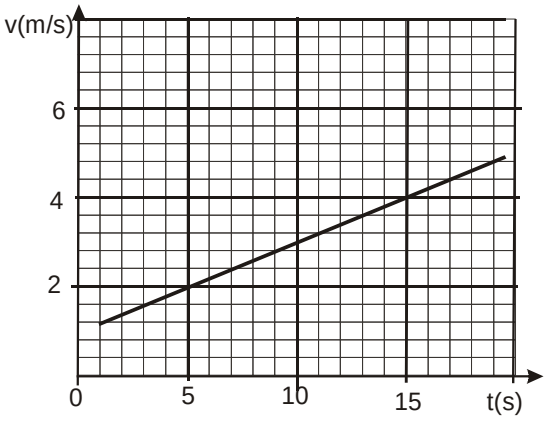
For each graph, answer the question(s) following it. Follow **9** above. Mark, label, sketch coordinate lines as shown for (1,4) in **9**. For slopes, show the construction of slopes in detail; mark and label points used, sketch the rise and run lines.



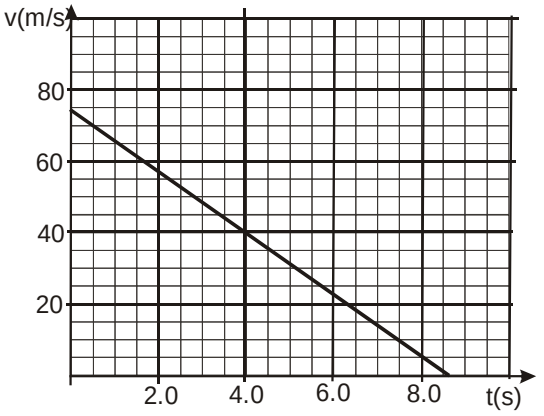
When t = 2.5 s, v is _____
number (units)



When v = 1.65 m/s, t is _____
number (units)



The slope of the line is _____
number (units)



The slope of the line is _____
number (units)

DRAWING GRAPHS

Each of the following two data sets represents a straight line. Draw a graph for each data set (first versus second line in each data set). Find ths slope of the straight line that you draw in each graph. Show the calculation on the slope on each graph paper for the corresponding case. Attach your graphs to the previous page.

F (N)	8.4	15.3	23.8	21.5	34.7	40.8
x (cm)	2.1	3.5	6.3	5.0	8.2	9.9

v (m/s)	0.65	1.31	1.87	2.56	3.7	0.9
t (s)	2.34	3.98	6.10	7.81	10.2	0.8