

PhyzReference: Graphing Technique

PREPARE THE GRAPH SPACE

1. Use as much of the available graphing space as you can. Leave room for labeling the scale, quantity, and units of each axis.
2. Label the scale of each axis. Label the origin as 0 for both axes. Select a scale so that the range of data fills the graph. Make sure your scales are manageable. Maybe let four squares represent one whole unit of measurement (e.g., 1 meter or 1 volt). But don't make seven squares represent one unit. But again, fill as much of the page as is practical.
3. Label the quantity and units of each axis. Identify the quantity; abbreviate the units parenthetically. "Time (s)," or " x (cm)," for example.
4. Title the graph. You may choose to give the graph a descriptive title, such as "Motion of a Toy Car." But you should always include a title bearing the names of the quantities, such as "Position vs. Time." In such a title, the first quantity listed is the one represented on the vertical axis.

PLOT THE DATA

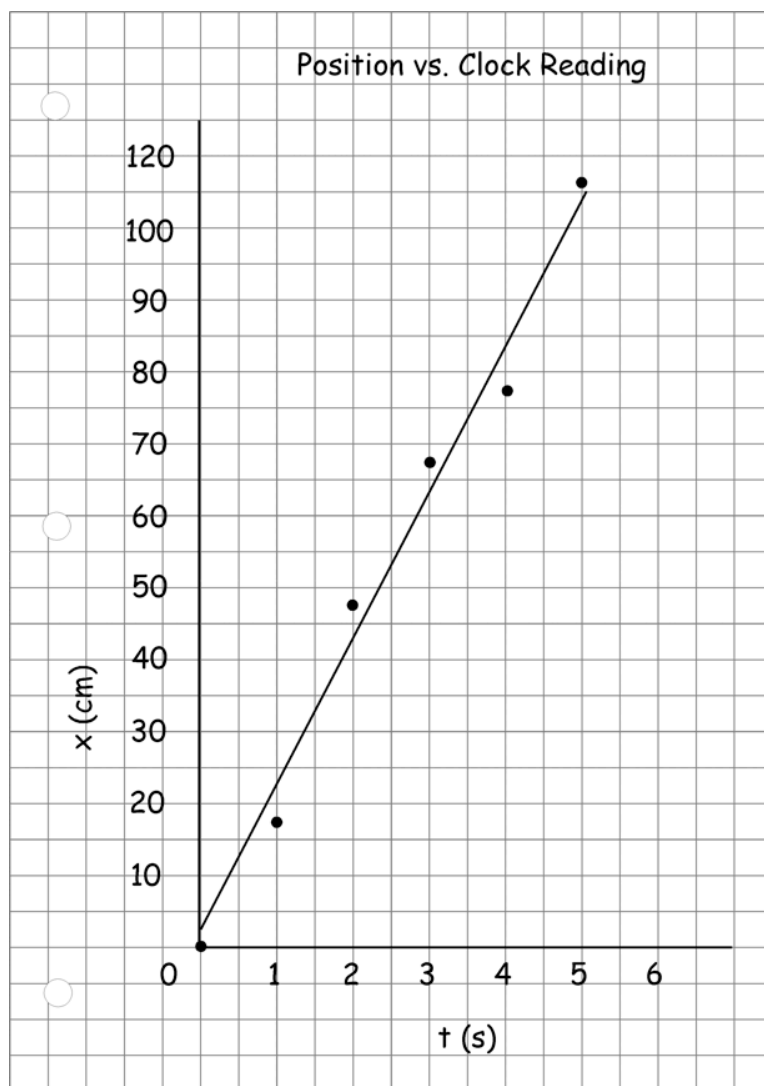
1. Make a small but visible mark at each data point. If the point (0, 0) is a valid data point, be sure to mark it, too.
2. Resist the urge to connect the dots.
3. When you are done, you will have a so-called "scatter graph."

DRAW A LINE OF BEST FIT FOR A LINEAR PLOT (IF ASKED TO DO SO)

1. A line of best fit is not found by connecting the data point dots. So do *not* connect the dots!
2. If plotting a linear "best-fit" line, make a single straight line that comes as close as possible to all the data points. The line may not pass through any of the actual data points (depending on the amount of scatter in the data). It need not pass through the origin or the final data point either.
3. If multiple plots are to be graphed on a single set of axes, be sure to label each best-fit line to distinguish it from the others.

USE THE LINE OF BEST FIT

1. Once the line of best fit has been drawn, use that line to calculate the slope.
2. Disregard the slope between any two particular data points. The line of best fit is the only line to use for data analysis. It is as if the original data no longer exists, and only the line remains.



PhyzReference: Error • Difference • Conversions

Percent Error

There are times when you want to compare a value found through experiment to an accepted (or standard) value. The absolute difference between the two isn't always useful. For example, an experimental value of gravitational acceleration (9.8 m/s²) that is off by 3 m/s² would be unimpressive. But an experimental value for the speed of light (299,792,458 m/s) that is off by 3 m/s would be very impressive!

A better measure of error is to compare the error to the accepted value. One way to do this is to calculate percent error. For a given experimental value and accepted value, the percent error is

$$\% \text{ Error} = \frac{\text{measured} - \text{accepted}}{\text{accepted}} \times 100$$

Some prefer to express percent error as a positive value only. If so, simply take the absolute value of the result from the equation above. Ask your instructor for guidance.

Percent Difference

There are occasions when you want to compare two measurements. Since both values are measured, neither can act as the accepted standard. For the percent difference calculation, the difference between the measured values is divided by their *average*.

The percent difference between two values, *a* and *b*, can be found by the following equation.

$$\% \text{ Difference} = \frac{|a - b|}{(a + b) / 2} \times 100 \quad \text{This simplifies to} \quad \% \text{ Difference} = \frac{|a - b|}{a + b} \times 200$$

Percent difference is expressed as a positive value.

Some Useful Conversion Factors

This list is by no means comprehensive. It includes several factors that may be useful in one or more of the lab activities.

centimeters and meters	1 cm = 0.01 m	and	1 m = 100 cm
inches and meters	1 in = 0.025 4 m	and	1 m = 39.37 in
feet and meters	1 ft = 0.308 4 m	and	1 m = 3.281 ft
yards and meters	1 yd = 0.914 4 m	and	1 m = 1.094 yd
grams and kilograms	1 g = 0.001 kg	and	1 kg = 1000 g
miles per hour and meters per second	1 mph = 0.447 m/s	and	1 m/s = 2.24 mph
cubic centimeters and cubic meters	1 cm³ = 0.000 001 m³	and	1 m³ = 1 000 000 cm³