7.2 PROPER PLOTS

We call graphs constructed according to the following rules **proper plots**.

- Caption with a **brief description.** The restating of "d versus t" or "distance versus time" or even "The relationship between distance and time" does not constitute a proper caption. The caption should give information about the graph to allow the graph to stand alone, without further explanation. It should include information about the problem that does not appear elsewhere on the graph. For example, instead of stating "distance versus time," better choices would be "Lindbergh's Flight Across the Atlantic" or "The Flight of Voyager I" or "Walking between Classes across Campus, Fall 2008." When including a graph as part of a written report, place the caption below the graph.
- **Label both axes clearly.** Three things are required unless the information is unavailable: category (e.g., Time), symbol used (t), and units [s]. Units should accompany all quantities when appropriate, enclosed in square brackets [ ].
- **Select scale increments (both axes) that are easy to read and interpolate between.** With a few exceptions, base your scale on increments of 1, 2, 2.5, and 5. You can scale each value by any power of 10 as necessary to fit the data. Avoid unusual increments (such as 3, 7, 15, or 6.5).

Increment	Sequence				
1	0	10	20	30	40
5	0.05	0.10	0.15	0.20	0.25
2.5	−2500	0	2500	5000	7500
2	6×1^{-5}	8×10^{-5}	1×10^{-4}	1.2×10^{-4}	1.4×10^{-4}

In this final case, reading is easier if the axis is labeled something like Time (t) [s] $\times 10^{-4}$ so that only the numbers 0.6, 0.8, 1.0, 1.2 and 1.4 show on the axis.

- **Provide horizontal and vertical gridlines** to make interpolation easier to aid the reader in determining actual numerical values from the graph.

When minor gridlines are present, the reader should be able to easily determine the value of each minor increment. For example, examine the graphs shown in Figure 7-1.

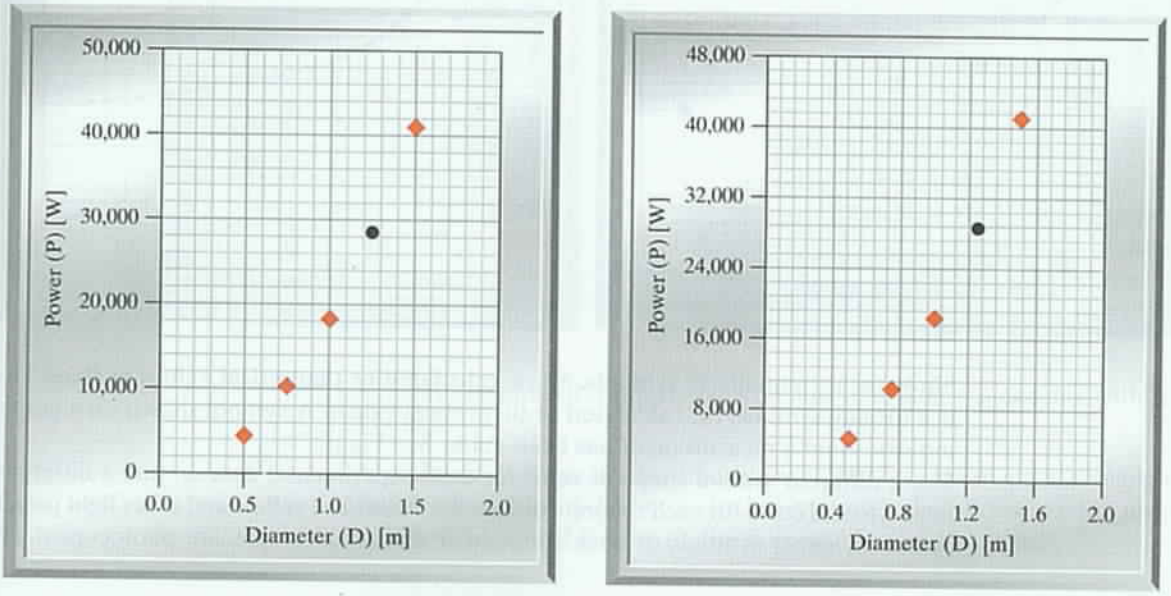

Figure 7-1

In which graph is it easier to determine the abscissa value for the black point? In the graph on the left, the increment can easily be determined as 0.1 meters. In the graph on the right, it is more difficult to determine the increment as 0.08 meters.

- **Provide a clear legend** describing each data set of multiple data sets shown. Do not use a legend for a single data set. Legends may be shown in a stand-alone box or captioned next to the data set. Both methods are shown in Figure 7-2.

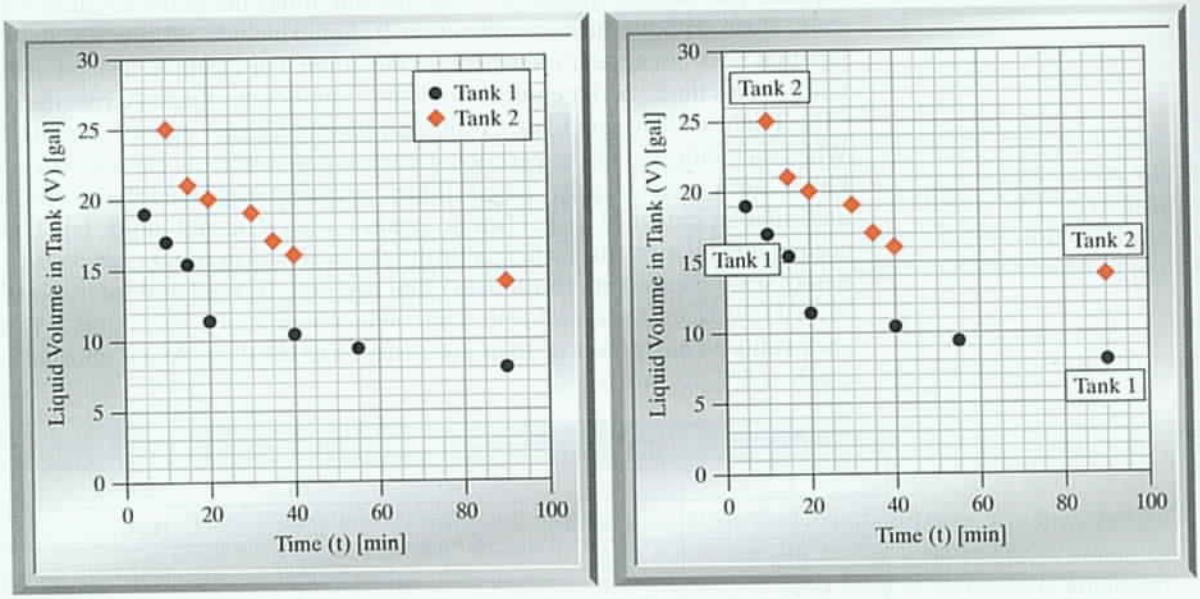

Figure 7-2

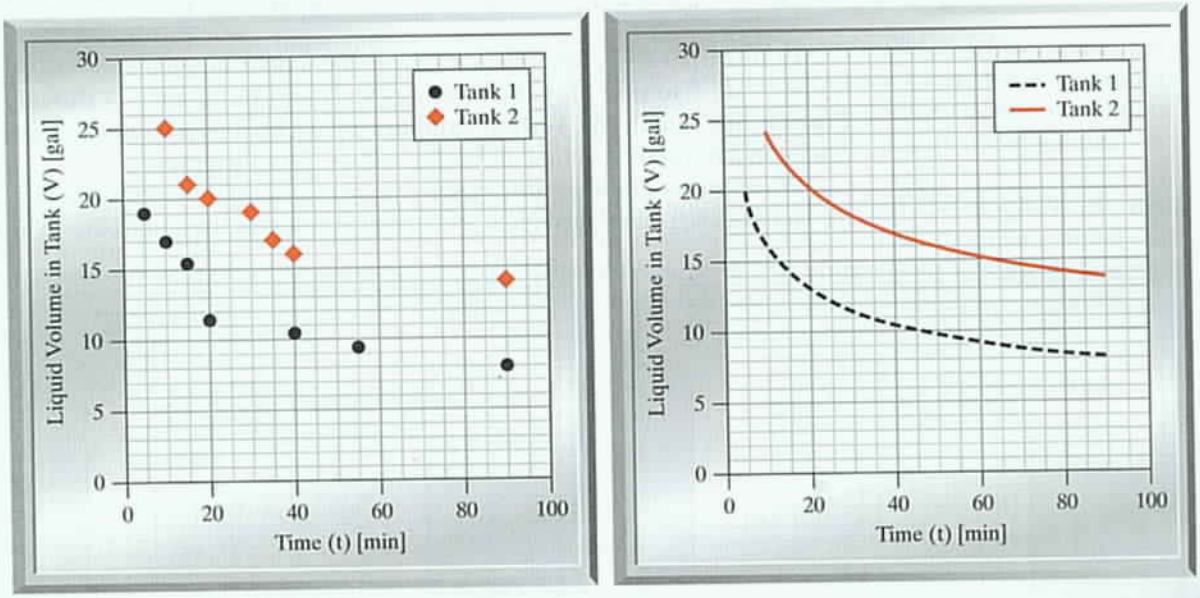

Figure 7-3

- **Show measurements as symbols. Show calculated or theoretical values as lines.** Do not display symbols for calculated or theoretical values. A symbol shown on a graph indicates that a measurement has been made. See Figure 7-3.
- **Use a different symbol shape or color** for each experimental data set and a different line style and color for each theoretical data set. **Never use yellow and other light pastel colors** for either symbols or lines. Remember that when graphs are photocopied, all

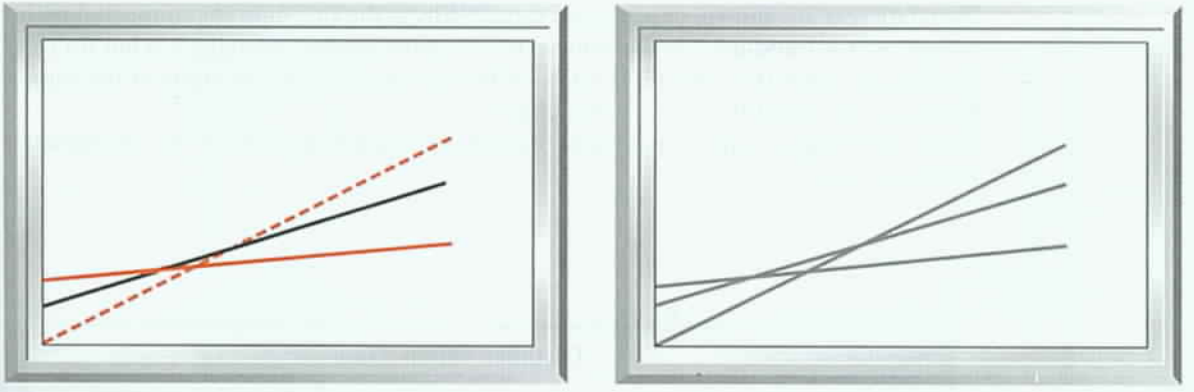

Figure 7-4

colored lines become black lines. Some colors disappear when copied and are hard to see in a projected image. For example, in Figure 7-4, left, it is much easier to distinguish between the different lines than in the figure on the right.

- **Produce graphs in portrait orientation** whenever possible within a document. Portrait orientation does not necessarily mean the graph is distorted to be taller than it is wide; it means that readers can study the graph without turning the page sideways.
- **Be sure the graph is large enough to be easily read.** The larger the graph, the more accurate the extracted information.

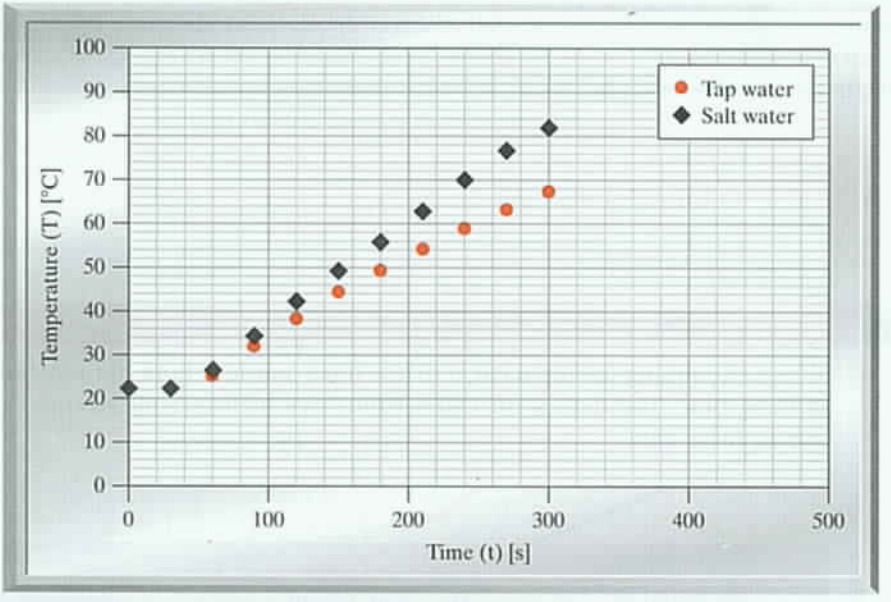

Figure 7-5 Example of a proper plot, showing multiple experimental data sets.

Below is an example of a poorly constructed plot. Some problems with this plot are listed below:

- It is a plot of distance versus time, but is it the distance of a car, a snail, or a rocket? What are the units of distance—inches, meters, miles? What are the units of time—seconds, days, years? Is time on the horizontal or vertical axis?

- Two data sets are shown, or are there three? Why is the one data set connected with a line? Is it a trendline? Is the same data set shown in the triangles? What do the shaded and open triangles represent—different objects, different trials of the same object, or modifications to the same object?
- Lack of gridlines and strange axis increments makes it difficult to interpolate between values.

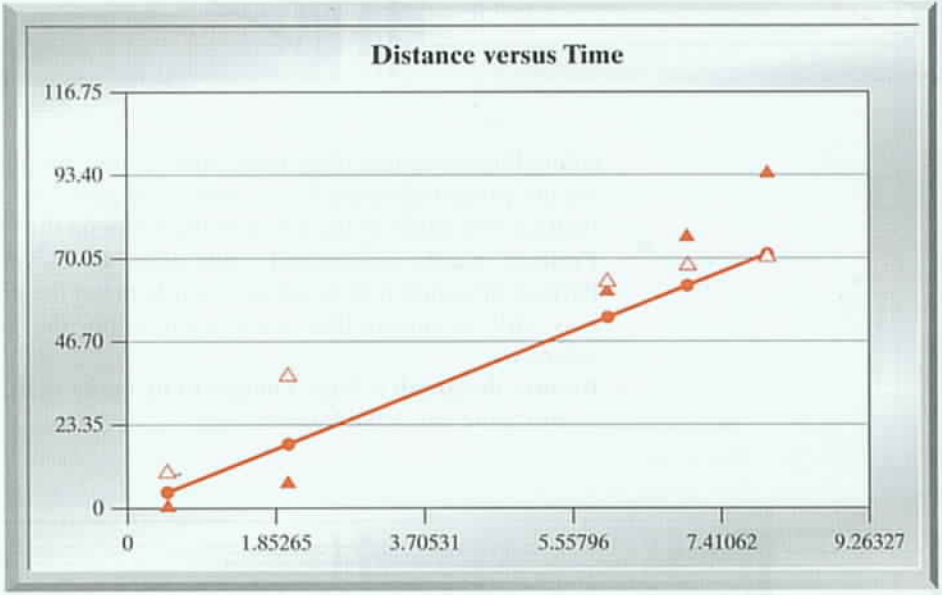

Figure 7-6
Example of poorly constructed graph.