GRAPHING

A graph is a pictorial representation of experimental data such as a series of measurements. The object of a graph is to represent a trend that is occurring over a range of values rather than a single result.

GUIDELINES FOR CONSTRUCTION OF A GRAPH

1. **Construct a table of the data**. Arrange the data in increasing numerical order so that the minimum and maximum values for each variable can be determined. The values of the independent variable, the one that the experimenter is able to control, will be plotted on the x-axis and the values of the dependent variable, the one being measured or determined in the experiment, will be plotted on the y-axis.

2. **Use graph paper**.

3. **Title the graph**. The title should be located at the top of the graph. The title should be a brief but clear description of the relationship represented by the graph.

4. **Draw the axes clearly on the graph paper using a ruler**. The vertical axis is called the y-axis or the ordinate and the horizontal axis is called the x-axis or abscissa.

5. **Tell what each axis represents** by labeling it with the name of the variable plotted on that axis followed by the proper units. If the values on the axis are expressed in exponential notation, then list them as "x 10^n " on the axis.

6. **Label the scale on each axis clearly** and in a regular fashion. Look at the minimum and maximum values of the data and choose the next lowest and largest even numbers (usually some multiple of 10 or 100, if possible) as the range to be represented by the scale. The scale does not have to start at zero. Each line on the graph should represent the same fractional unit of the scale. Do not include the units with each label on the scale, the units are listed with the labels for each axis.

7. **Plot each data point on the graph clearly** as a small, dark dot. Draw a small circle or square around each dot to indicate the uncertainty in the measurement and to make that data point apparent to anyone who reads the graph.

8. **Draw the best smooth curve or straight line through the points**. Try to go through as many points as possible, but *do not connect the points*. If the line or curve is extended past the range of the measured values, this extrapolation is indicated by a dashed line.

9. If the slope of the line is required (remember that the slope can only be calculated from a straight line), choose two points from the graph, not the data. Try to find points where the line passes through some intersection of labeled subaxes. Remember that the slope is defined as the "rise over the run" or the change in the y-axis term divided by the change in the x-axis term:

$$slope = \frac{y}{x}$$

For two points, (x_1, y_1) and (x_2, y_2), the equation for the slope is:

$$slope = \frac{y_2 - y_1}{x_2 - x_1}$$

An example of a properly constructed graph is illustrated in Figure G-1. This is a graph showing the vapor pressure of water at various temperatures. The data for this graph is listed in Table G-1. Refer to the guidelines, above, while examining the graph.

Table G-1. Vapor pressure of water between 0 and 100°C

Temperature °C	Vapor pressure mm Hg
0.0	4.6
10.0	9.2
20.0	17.5
30.0	31.8
40.0	55.3
50.0	92.5
60.0	149.4
70.0	233.7
80.0	355.1
90.0	525.8
100.0	760.0

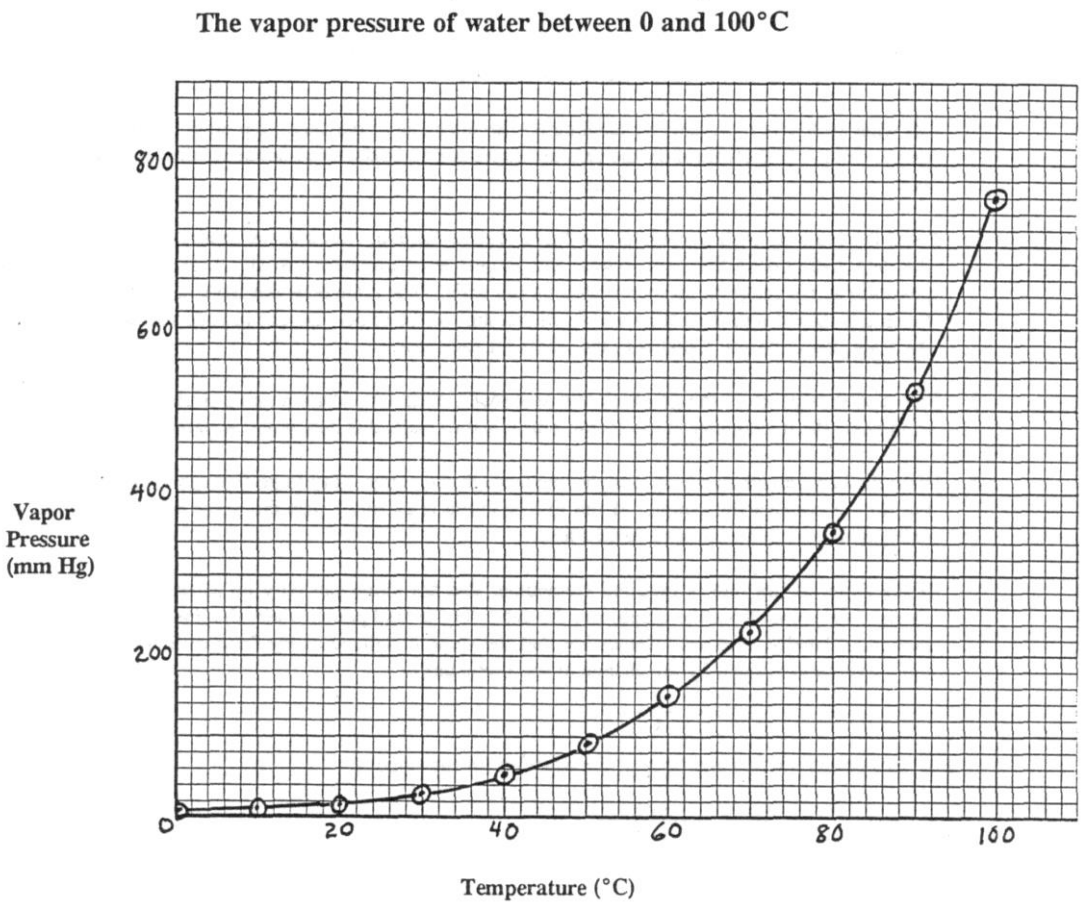
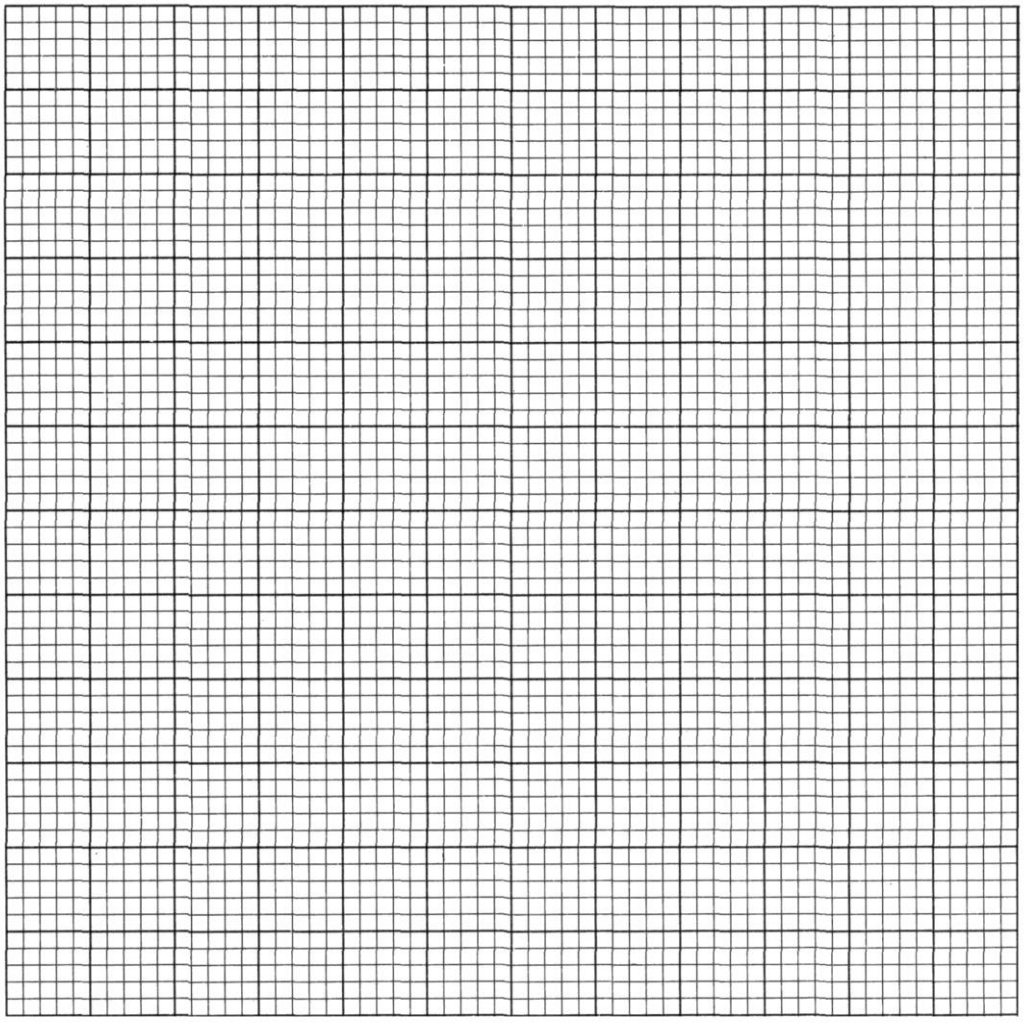


Figure G-1. This is an example of a properly constructed graph. Notice the descriptive title, the well labeled axes, the circled data points, and the smooth curve representing the trend in vapor pressure.

Practice Exercise: Prepare a graph from the following data. You may use the grid, provided below, or you may use *Excel* to generate the graph.

Table G-2. Solubility data for potassium nitrate in water at various temperatures.

Temperature °C	Solubility g/100 g H_2O
0	13.3
10	20.9
20	31.6
30	45.8
40	63.9
50	85.5
60	110.
70	138
80	169
90	202
100	208



GRAPHING PRACTICE

The following two problems are designed to give you practice in constructing graphs using the computer program *Excel*. Complete these graphs using the computers available in the chemistry laboratory, display them on the computer screen, but **do not print these graphs** unless directed to do so by your instructor.

Graph A: The laboratory director of your agricultural research organization has asked you to investigate the overall market for different types of beans. After many hours of work in the library you have found the world consumption of eight different types of beans for the year 1993. The data are shown in the chart below;

World Bean Consumption Data for 1993

Bean Type	Consumption (Billions)
Navy	2.94
Army	1.52
Air Force	0.83
White	3.27
Kidney	4.11
Garbanzo	1.05
Black	1.02
Pinto	3.83

You decide that the best way to show your boss the results of your work is to prepare a couple of graphs based on the found information. **Your assignment** is to use *Excel* to prepare two graphs based on this data: a bar chart illustrating relative numbers and a pie chart showing percentages of the whole.

Graph B: The data below are taken from the *Life* section of the August 11, 1998 edition of USA *Today*. The table shows the top ten movies for the previous week, the weekend box office take for each in millions of dollars and the total take for each movie since its release.

Movie Title	Weekend Take	Total Take
Saving Private Ryan	17.4	103.8
Snake Eyes	16.3	(new)
Halloween: H_2O	16.2	24.8
There's Something About Mary	9.6	76.6
The Parent Trap	8.1	32.4
Ever After	7.7	22.5
The Negotiator	6.5	25.0
The Mask of Zorro	5.5	71.6
Armageddon	5.3	172.8
Lethal Weapon 4	4.7	116.2

- Make a column chart showing the weekend take for the movies
- Make a column chart showing the total take since release for the movies
- Make a pie chart showing the distribution of the weekend take for the movies
- Make a pie chart showing the distribution of the total take for the movies

GRAPHING ASSIGNMENTS

Project 1: Turn this project in as a team

Based on the data provided below, do the following:

1. Decide on a research question that can be answered with the data presented. Not all of the data must be used to answer the question.

2. Make an organized data table to present all of the data. A data table should have the following:

   - A title
   - Columns and/or Rows labeled
   - Units attached on the columns and/or rows if necessary

3. Write a conclusion to the question your team asked. In other words, interpret your conclusion to the data.

4. Using Word on the computer, on the same piece of paper, you must have all of the following components
   1) the question
   2) the data table which can be inserted after the question
   3) your conclusion.

   Data: *Mortal Kombat* is considered a violent video game and *Bubsy* is considered a nonviolent video game. The subjects were 13-year-old boys and girls. Data was obtained from San Francisco University.

   Average Heartbeats per minute of boys and girls age 13
   1. 77 bpm (beats per minute)

   Average Heart Beats per minute Playing Video Games
   1. *Mortal Kombat*: 126 bpm for boys and girls together
   2. *Bubsy*: 105 bpm for boys and girls together
   3. *Mortal Kombat*: 121 bpm for boys
   4. *Bubsy*: 102 bpm for boys
   5. *Mortal Kombat*: 157 bpm for girls
   6. *Bubsy*: 120 bpm for girls

   Average Heartbeats per minute for Watching Video Games
   1. *Mortal Kombat*: 93.4 bpm for boys and girls together
   2. *Bubsy*: 94.7 bpm for boys and girls together
   3. *Mortal Kombat*: 87.5 bpm for boys
   4. *Bubsy*: 90.0 bpm for boys
   5. *Mortal Kombat*: 135 bpm for girls
   6. *Bubsy*: 118 bpm for girls

Project 2: Turn this project in as a team.

1. A science teacher was stranded out in the snow; here is the data that was collected on this teacher.

Time in the snow (hours)	Body Temperature (Degrees Fahrenheit)
0	98.6
2	98.2
4	97.8
6	97.4
8	97.0
10	96.6
12	96.2

2. Plot a graph, using Excel, for this data. Have your team decide on the most appropriate graph. A graph should contain the following:

   - A title
   - Both the x and y axis labeled
   - Units on the x and y axis
   - Appropriate unit increments on the x and y axis
   - The graph should fill the entire page when it stands alone (This is what you are to do with this project.) A graph may be smaller if it is inserted between text within a paper.

3. Answer this question based on the graph your team has made:

   What would the teacher's body temperature have been at 9 hours out in the snow?