

Problem Solving in Physical Chemistry Introduction to Mathcad Part 5. Arrays of Values

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edited for Mathcad 12 by

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Insert a text region containing your Name

Save this file to your personal storage device using a suitable file name.

A. Mathcad indices, and subscripts of arrays normally begin at zero.

You can define the range of an index. At the right type the following

i:=0;5
i=

i:= 0.. 5

B. Subscripts are created with the [key.

At the right define the values of x_i by typing

$x[i:1+2*i$

and show the values of x by typing

x=

C. There are several mathcad functions that work with arrays. Average or mean is one. Find the mean of the x-values in part (b). Hint: insert the math function with the Math Choose pull-down menu; alternately, use Help Index Search Average.

Save your work on your personal storage media.

D. You can also enter individual values of an array. Do this by typing the following

y[0:6.55
y[1:9.20
y[2:12.19
y[3:14.51
y[4:18.20
y[5:20.12

What is the average of y-values?

E. Make a graph of y_i versus x_i .
On the same graph plot $-7 \cdot x_i + 50$ versus x_i .

F. Mathcad will make a least squares fit of a straight line to data in the form of an x-array and a y-array. Use the slope and intercept functions to fit a straight line to the x,y data of parts (b) and (d).

At the right try typing

a:slope(x,y)
b:intercept(x,y)
a=
b=

Save your work.

G. Finally, make a plot to show both the

data points x_i, y_i , and the least squares fit straight line $f(z)=a*z+b$].

Graphs can be formatted.
Double-click on the graph to obtain the formatting menu.
Show points (x_i, y_i) without lines connecting them but show the function $f(z)$ as a smooth line.

You can also stretch the graph to be larger or smaller. Select the graph by dragging the pointer into the region. It will have a dotted line around it. Position the mouse arrow at a border of the graph so that a double arrow appears; then hold down the mouse button and drag.

Save your work. Make it a habit to save often.

Here are some additional problems to work, print and submit for grading.

1. Make two isotherms of the ideal gas. Assume one mole of gas, a range of volumes 10 liter to 20 liter, and plot P vs V for $T=150\text{K}$ and $T=300\text{K}$ **on the same graph**. [Hint: define the function $P(V,T):R*T/V$, define the range $V:10*\text{liter}, 10.1*\text{liter}; 20*\text{liter}$, and graph both $P(V, 150*\text{K})/\text{atm}$ and $P(V, 300*\text{K})/\text{atm}$ versus V.] CAUTION $R:8.314*\text{joule/K}$.

What units does Mathcad select by default for the graph of P ? [Note: you can plot $P(V, 150*\text{K})/\text{atm}$ versus V/liter to obtain more conventional units.]

B. Repeat the previous exercise to plot P versus V for a van der Waals gas. Plot three isotherms ($T=290\text{K}$, 304K , and 315K) for one mole of carbon dioxide. Use $V:80*\text{mL}, 81*\text{mL}; 250*\text{mL}$. The van der Waals constants for CO_2 are $a=3.592*\text{liter}^2*\text{atm}$,

$b=0.04267 \cdot \text{liter}$.

The critical temperature of CO_2 is 304K.

Read your graph to answer the following.

What is the critical pressure [in atm]?

What is the critical volume [in mL]?

Tip: reading the graph is easy if you format it to include grid lines, and increase the number of grids on the y-axis to 10 and on the x-axis to 5.

Save your work and submit for grading as directed by your instructor.