

NOTE: Use engineering format for problems 1 and 2, and use non-engineering format discussed for problems 3 through 6. This is an individual assignment. You must complete the assignment on your own, although you may discuss the problems with other class members (but no copying of work).

1. A two-gallon (0.00757m^3) tub contains water at 43°C . If you insert a fishtank heater that draws 1.3A of electric current at 12V , then how long will it take for the heater to increase the water temperature to 46°C ? Assume no heat loss or gain through the wall of the tub or at the surface of the water. $t=1.69\text{hrs}$
2. A fishtank is 1.8 inches in diameter and contains water 2.5 inches deep. If you heat the water using a 20Ω resistor and a 12V power supply, then how long will it take to heat the water up by 3°C ? $t=3.03\text{min}$

Note: Include ALL units in calculations. Use consistent SI units! For example, you should use ...

- kilograms (kg) for mass
- meters (m) for length
- volts (V) for voltage
- amps (A) for current
- seconds (s) for time

First Law of Thermodynamics

For a system with water being heated by a heater:

$$\Delta E = Q - W$$

$$\rho \cdot \text{Vol} \cdot C_p \cdot \Delta T = V \cdot I \cdot t$$

Remember:

Density of water (ρ) = $1000\text{kg}/\text{m}^3$

$0.001\text{ m}^3 = 0.264\text{ gal}$

$C_{p\text{water}} = 4180\text{ J}/(\text{kg}\cdot^\circ\text{C})$

3. Fill in the table below.

data type	# of bits	range	example of how you would use the data type
boolean			
byte			
int			
long			
float			
char			

4. Research the acronym ASCII. What is the purpose of the ASCII code?

5. Write a sketch to use your thermistor to collect 75 temperature data points using a for-loop. Move your temperature sensor around to try to make the values change as data is collected. Include screenshots of your sketch and your serial monitor with your homework.
- Things to print in the for-loop (print the things below on one line for each iteration):
 - The iteration number (the value of the counter each time through the loop).
 - The analog version of the temperature collected for the current iteration (this should be an integer stored in an "int" variable).
 - The temperature in °C for the analog value above (this should be a floating point number stored in a "float" variable).
 - The current minimum value of temperature in °C (this number will probably get smaller as the 75 data points are collected).
 - The current maximum value of temperature in °C (this number will probably get larger as the 75 data points are collected).
 - Things to print after the for-loop is completed:
 - The final minimum value (that is, the absolute minimum temperature in °C for the 75 data points collected).
 - The final maximum value (that is, the absolute maximum temperature in °C for the 75 data points collected).
 - The average value of temperature in °C with the maximum and minimum values removed from the computation (this is computed after the for-loop is completed). You can use the following equation:

$$T_{avg} = \left[\left(\sum_{i=0}^{74} T_i \right) - T_{min} - T_{max} \right] / 73$$

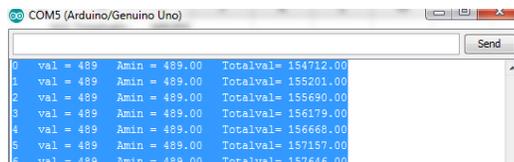
Or ...

$$T_{avg} = \frac{T_0 + T_1 + T_2 + T_3 + \dots + T_{74} - T_{min} - T_{max}}{73}$$

6. Using the data collected in question 5, create an Excel spreadsheet to check your values. Format the spreadsheet properly using column headings, units and other formatting elements (such as borders and shading) to improve the appearance. Print out a copy of the spreadsheet to include in your homework.

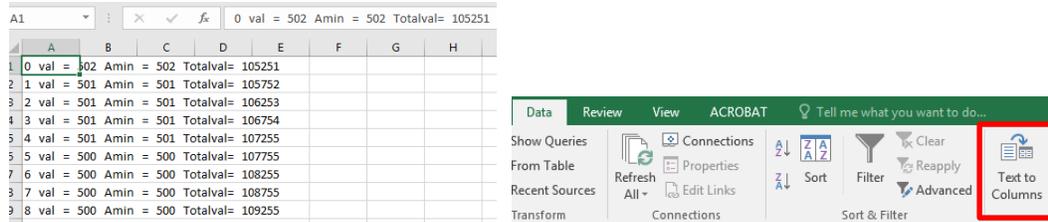
Importing Data Tip: Follow this procedure to help you import and organize the data from your Serial Monitor in Excel.

- a. Copy data (Ctrl + C)

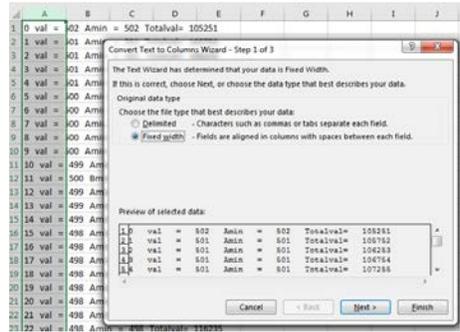


- b. Paste the data into Excel (Ctrl + V)

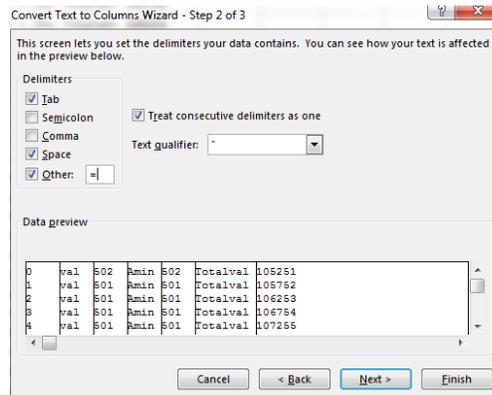
- c. If the contents of each row are in one cell and not broken up into individual cells, you can split the data into different columns using Text to Columns in the Data tab



- d. Highlight the column that contains the data. Click Text to Column which will open a window.



- e. Check the Delimited box, then press Next.
- f. Choose all Delimiter options that you would like to be used to separate data. You may also want to set some of your own by checking other and typing in a character (e.g., =).



- g. Click Next for a preview, if the data is separated in your desired manner, click Finish.

Printing Tip: If the data spans multiple pages, you can scale the document when you print. **Print→Settings→Fit All Rows on One Page** (click on the “No Scaling” drop-down menu to see the “All Rows on One Page” option). However, if the numbers get too small to read when scaling the page, it is better to print the data over two pages.