Cool Off, Will Ya!
Investigating Effect of Temperature Differences between Water and Environment on Cooling Rate of Water

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Water has many fascinating properties due to its structure and is a fundamental molecule needed for life. This report will investigate one of these properties, water's cooling rate. We notice in our lives that a cup of water at room temperature seems to have a relatively stable temperature, implying that the cooling rate is close to zero, while a cup of water that was boiling rapidly cools down. Therefore, we hypothesize that the cooling rate of water increases as the temperature difference between the water and the room increases.

In order to conduct this experiment, we will heat water to certain temperatures, and measure the temperature of the water over a period of 25 seconds. Our manipulated, or independent, variable would therefore be the initial temperature of the water, which would have a direct influence on the temperature difference between the water and the room. However, it is very difficult to directly measure the cooling rate of water. Instead, we will take temperature readings of water over a period of 25 seconds and find the average cooling rate by studying this data. By finding a linear regression for these simple plots, we could find a "tangent line" to the overall cooling of water, which could tell us the cooling rate of water at a specific temperature.

In general, thermodynamic experiments are rather difficult to control for, as most of the action takes place at a microscopic level of the molecules. However, there are several macroscopic variables that we can control for. One of the most important ones is the volume of water and the surface area of the water. These two variables are closely linked together, as it is very difficult to change one without changing the other. We understand that an increased volume of water would result in more thermal energy in the water. Because we do not fully understand the correlation between total thermal energy and the rate of cooling, it would be best to control this value. Thankfully, this is an easy variable to control for, as the only thing it requires is for us to measure the same amount of water in each trial. As we also do not know the effect of surface area on the cooling rate, it is advisable to keep it controlled. However, if we use the same volume of water and the same container in each trial, by simple geometry we realize that the surface area of the water must be constant between every trial.

Other important controls include the purity of the water. We are only interested in testing the properties of pure water, not water with any other solutes dissolved in it. Because dissolved solutes could potentially impact the rate of cooling, we shall keep our water completely free of any solute.

One of the more difficult items to control for is the temperature of the room, or the outside temperature. Because our lab investigates cooling rate of the water as dependent on the temperature difference of the water and the room, and because the only variable that we can easily manipulate is the initial temperature of the water, we must keep the room temperature as constant as possible. Other experimenters or environmental conditions could potentially have influence on this factor. However, as the room is very large, we are able to make the assumption that the overall temperature of the room is as controlled as it can be.

Additional controls include using the same thermometer and the same experimentation equipment each time in order to minimize differences in thermometer calibrations. We will also use the same amount of thermal insulation from the containers for the waters, using only three paper cups every trial.

One factor that is extremely difficult to control for is the amount of wind blowing on the cups. Because it is possible that blowing on water would increase the cooling rate, we will try to minimize this by performing the experiment in as isolated of an environment as possible. However, this factor is somewhat beyond our control, and cannot be eliminated entirely.

The range of data that we will collect will proceed from 40 degrees Celsius to 80 degrees Celsius, which allows for five different conditions. The reason we begin at 80 degrees Celsius is that above that temperature, the evaporation of water becomes too quick to handle. It is very difficult to handle water that is above this temperature without personal injury for the experimenters. In addition, water that is above this temperature has a high likelihood of becoming steam, which would be a transfer of energy that we do not want to study.

The reason that we will study the temperature of the water over a 25 second time period is in order to gain a sufficient change in temperature for the experiments that begin at lower temperatures. If we use too short of a timeframe, the change in temperature would not be significant enough to be used. Of course, if we need to accommodate for the lowest temperatures, we must use the same time frame for the highest temperatures as well.

We will use five trials for this lab in order to obtain a statistically significant amount of data to conduct standard deviations upon. In addition, because of the volatility that is in thermodynamic labs, five trials would mitigate some of the random error in the temperature changes as a result of forces outside of our control.

Materials:

- Vernier Stainless Steel Temperature Probe ($\pm 0.1°C$)[1]
- Thermometer ($\pm 0.1\ °C$)
- 250 mL Beaker
- 100 mL Graduated Cylinder
- Water
- Hot Plate

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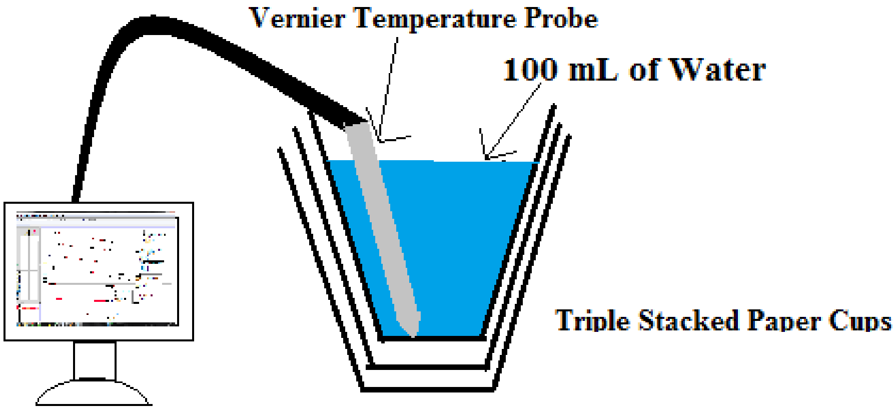
[1] Vernier.com

- LoggerPro Interface
- Three Paper Cups

Procedure:

1) Connect the Vernier Stainless Steel Temperature Probe with the Logger Pro Interface.
2) Pour 100 mL of water into the 250 mL beaker
3) Place a thermometer in the beaker and place the beaker on the hot plate. Begin heating the water.
4) When the thermometer reads roughly 85 degrees Celsius, remove beaker from the hot plate.
5) Measure 50 mL of water using the 100.0 mL graduated cylinder.
6) Pour the water into the three paper cups that are stacked together (see fig. 1)
7) When the temperature probe reports a reading of 80 degrees Celsius, begin recording data. Record data for 120 seconds.
8) Pour the water back into the 250 mL beaker and return to step 3. Repeat 4 more times.
9) Repeat steps 3-8 four more times with starting temperatures of 70, 60, 50, and 40 degrees Celsius.

Illustration:



Data Collection:

Raw data was collected using the Vernier Stainless Steel Temperature Probe and processed with Microsoft Excel and Logger Pro 3.8.5.1 Due to the large data set of 1250 data points, only a representative sample will be shown here. Please see appendices for more information.

Cooling of Water with Initial Temp of 80 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	79.3	79.7	79.6	79.9	79.7
0.5	79.2	79.6	79.5	79.9	79.7
1.0	79.2	79.5	79.5	79.8	79.7
1.5	79.1	79.5	79.4	79.7	79.7
2.0	79.1	79.4	79.4	79.7	79.7
2.5	79.1	79.4	79.4	79.7	79.6
3.0	79.0	79.4	79.3	79.6	79.5
…	…	…	…	…	…
23.0	76.8	77.7	77.5	76.9	77.3
23.5	76.7	77.7	77.5	76.8	77.2
24.0	76.7	77.6	77.4	76.8	77.2
24.5	76.6	77.6	77.3	76.8	77.2
25.0	76.6	77.5	77.3	76.7	77.1

This raw data is not very useful to us, because the focus of this investigation is finding the correlation between the rate of cooling and the initial temperature. Therefore, we must determine the rate of cooling for each trial. We complete this by graphing each of our trials and assuming that over the short time period of 25 seconds, the cooling rate is roughly linear. We use a linear regression and record the slope, which has units of $\frac{°C}{second}$, and use it as our cooling rate. Please see the appendix for the data tables, as well as the graphs used to formulate these values.

In addition, because there were variances in the initial temperature, we use the average of the initial temperatures here. The formula for average is given by

$$Initial\ Temperature_{Average} = \frac{T_1 + T_2 + T_3 + T_4 + T_5}{5}$$

For the first temperature, this is:

$$Temp_{Average} = \frac{79.3 + 79.7 + 79.6 + 79.9 + 79.7}{5}$$

$$Temp_{Average} = \frac{398.2}{5}$$

$$Temp_{Average} = 79.6°C$$

By using this method, we must also calculate the error. This error can be found using the formula for standard deviation, which is given as[2]:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{5}(x_i - \mu)^2}{5}}$$

Using these values, we calculate the following:

$$\sigma = \sqrt{\frac{(79.3 - 79.6)^2 + (79.7 - 79.6)^2 + (79.6 - 79.6)^2 + (79.9 - 79.6)^2 + (79.7 - 79.6)^2}{5}}$$

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[2] “Standard Deviation and Variance”

$$\sigma = \sqrt{\frac{(-0.3)^2 + 0.1^2 + 0 + 0.3^2 + 0.1^2}{5}}$$

$$\sigma = \sqrt{\frac{0.20}{5}}$$

$$\sigma = 0.2\ °C$$

Therefore, the following data table is produced:

Initial Temperature vs. Rate of Cooling						
		Rate of Cooling (°C per second)[3]				
Initial Temp (°C)	Error (°C)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
79.6	0.2	0.109	0.082	0.091	0.136	0.110
69.9	0.1	0.061	0.049	0.065	0.058	0.076
59.8	0.2	0.037	0.035	0.049	0.041	0.041
50.0	0.2	0.029	0.024	0.020	0.030	0.009
39.8	0.3	0.013	0.017	0.014	0.011	0.007

The primary reason we currently use three significant figures in the rate of cooling is a testament to the precision of the thermometer we used. Our initial recorded temperature values have a precision of three significant figures, and the time reported also have three significant figures. In our earlier data, we were able to use three significant figures in calculating the line of regression, which implies that we may use three significant figures here as well.

We will now calculate the average rates of cooling and the error for each initial temperature using the same method as described above. Therefore,

$$Rate\ of\ Cooling_{Average} = \frac{(R_1 + R_2 + R_3 + R_4 + R_5)}{5}$$

For the initial temperature of 79.6 degrees, we can calculate that

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[3] Note: We do not include an uncertainty in this figure, as calculated through the linear regression. Instead, we realize that the standard deviation of these numbers will have a greater uncertainty, which will therefore be used in later calculations and in the next data table.

$$Rate\ of\ Cooling_{Average} = \frac{0.109 + 0.082 + 0.091 + 0.136 + 0.110}{5}$$

$$Rate\ of\ Cooling_{Average} = \frac{0.528}{5}$$

$$Rate\ of\ Cooling\ Average = 0.106\,\frac{°C}{second}$$

In order to find the error, we also apply the standard deviation method:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{5}(x_i - \mu)^2}{5}}$$

$$\sigma = \sqrt{\frac{(0.109 - 0.106)^2 + \cdots + (0.110 - 0.106)^2}{5}}$$

$$\sigma = \sqrt{\frac{0.003^2 + (-0.024)^2 + (-00.15)^2 + 0.03^2 + 0.004^2}{5}}$$

$$\sigma = \sqrt{\frac{0.001726}{5}}$$

$$\sigma = 0.019\,\frac{°C}{second}$$

This produces the following data table:

Initial Temperature vs. Rate of Cooling			
		Rate of Cooling (°C per second)	
Initial Temp (°C)	Error (°C)	Average	Error
79.6	0.2	0.106	0.019
69.9	0.1	0.062	0.009
59.8	0.2	0.041	0.005
50.0	0.2	0.022	0.008
39.8	0.3	0.012	0.003

At this point, we must consider another factor in our experiment. Our initial hypothesis was not to compare the initial temperature, but to consider the difference between room temperature and the initial temperature of the water, or

$$\Delta T = Temp_{water} - Temp_{Room}$$

To clarify, we define ΔTemperature in this situation to be a measure of how much warmer the water is as compared to the room. This is not a measure of the absolute value of the difference between the two temperatures.

The room temperature was measured to be 25.2 degrees Celsius. Therefore, for the first temperature we have:

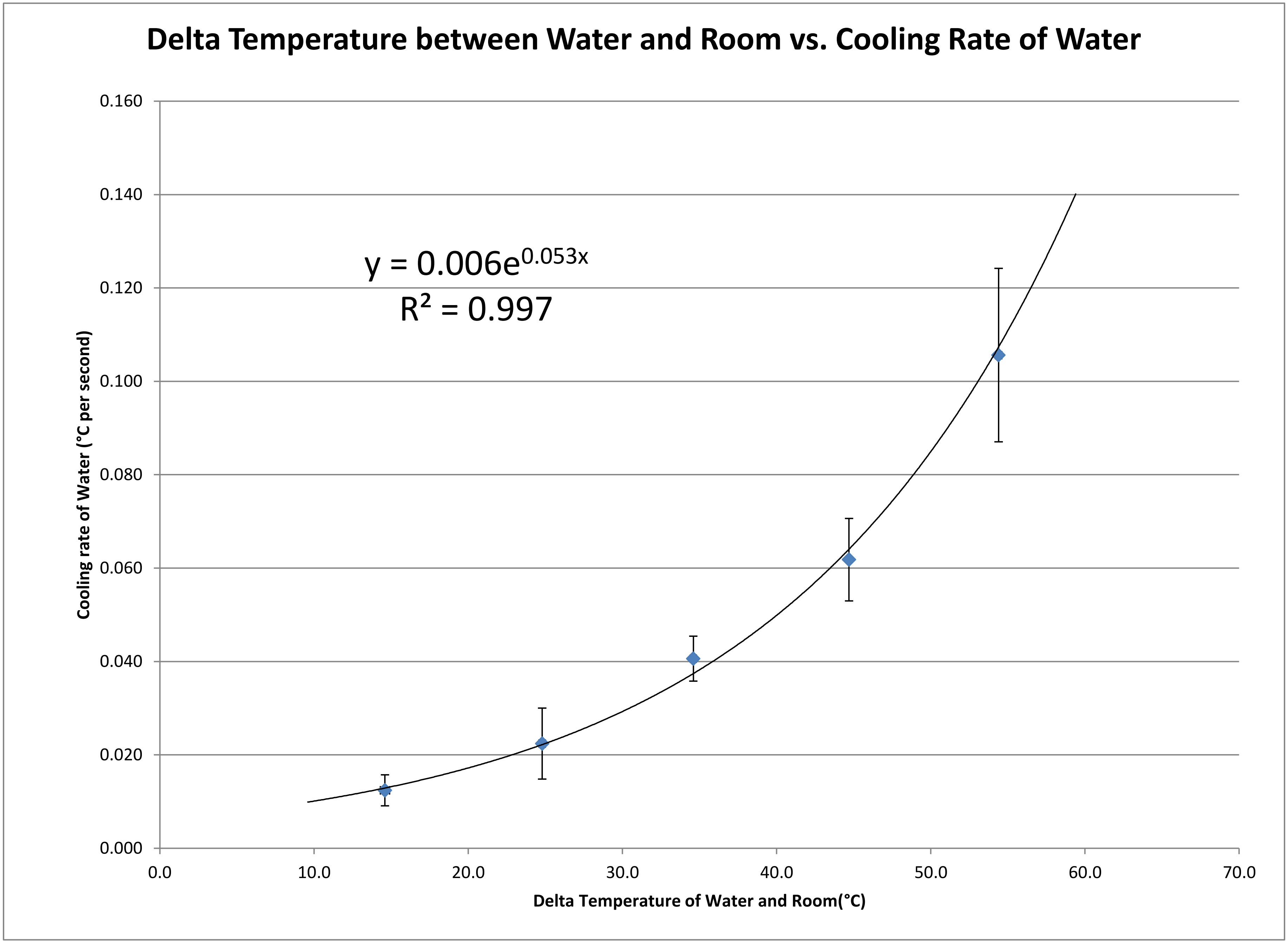
$$\Delta T = 79.6 - 25.2$$

$$\Delta T = 54.4\,°C$$

Replacing these values in the data table, we have:

Initial Temperature vs. Rate of Cooling			
		Rate of Cooling (°C per second)	
Delta Temp (°C)	Error (°C)	Average	Error
54.4	0.2	0.106	0.019
44.7	0.1	0.062	0.009
34.6	0.2	0.041	0.005
24.8	0.2	0.022	0.008
14.6	0.3	0.012	0.003

And by graphing this data, we get the following:

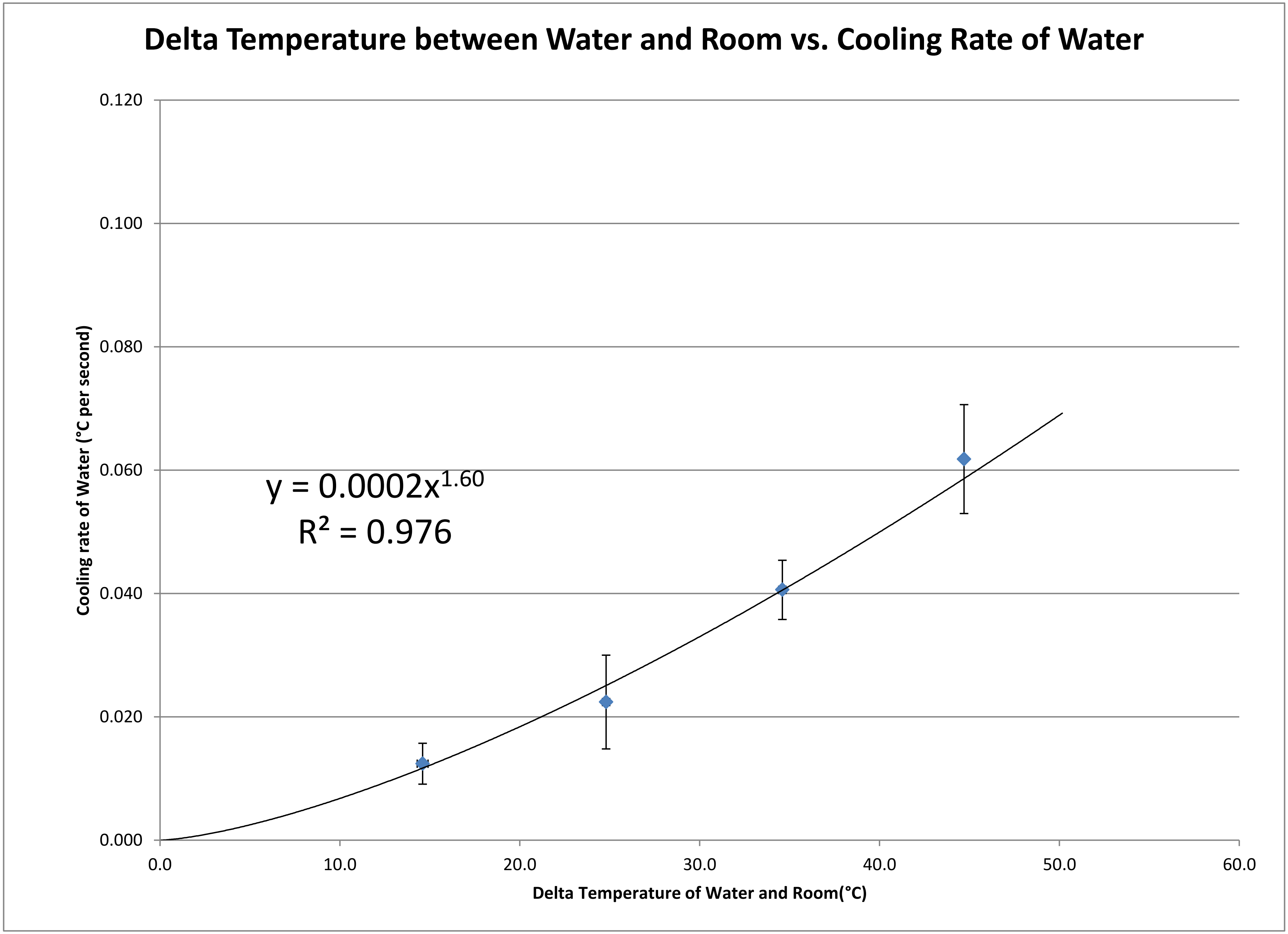

Delta Temperature between Water and Room vs. Cooling Rate of Water
y = 0.006e^0.053x
R² = 0.997
Cooling rate of Water (°C per second)
0.160
0.140
0.120
0.100
0.080
0.060
0.040
0.020
0.000
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
Delta Temperature of Water and Room(°C)

Note: There are error bars in the x-direction, but because of the precision that the starting temperatures were recorded at, this error is not easily seen on the graph.

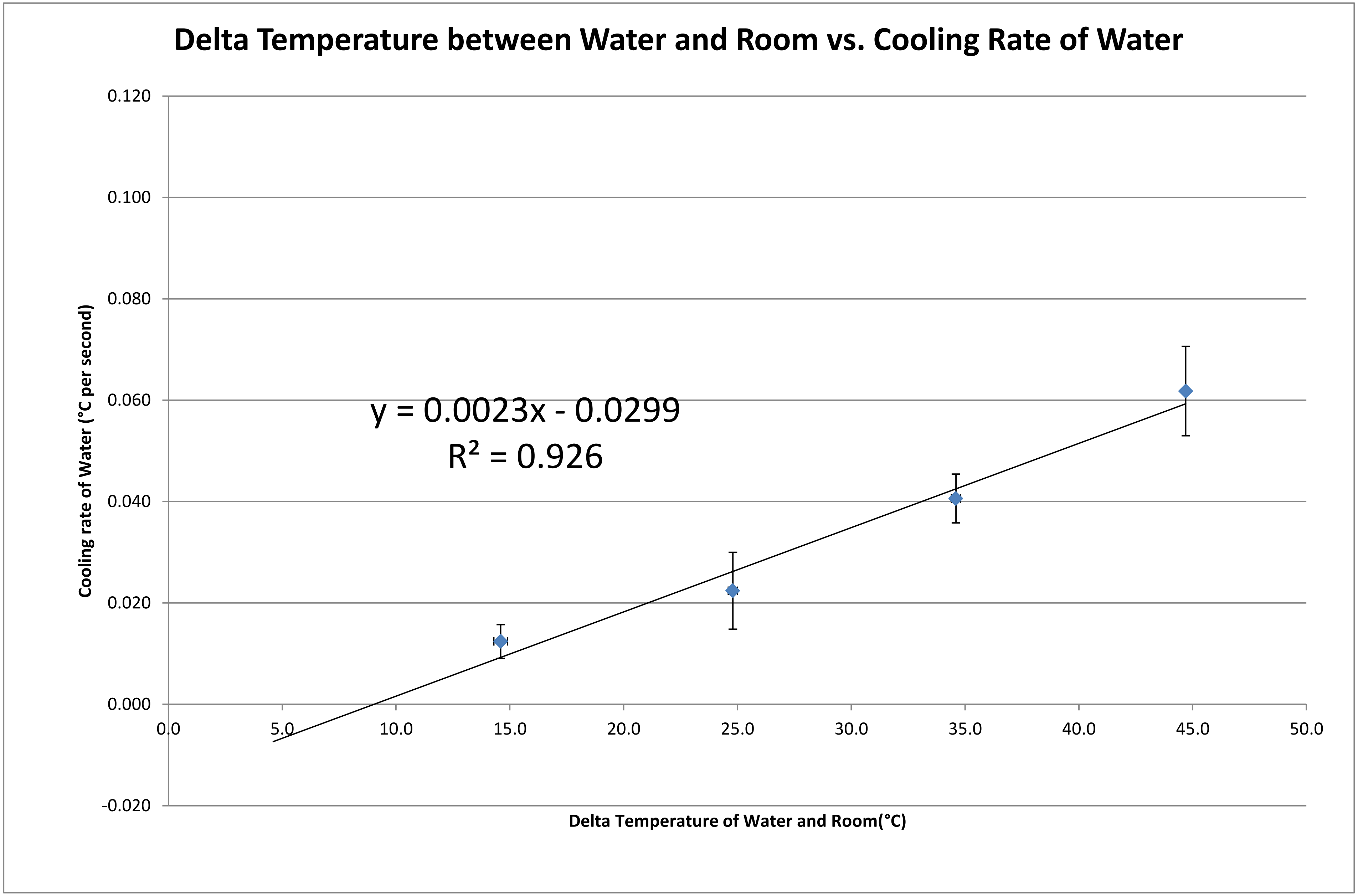
Upon review, this graph could not possibly make sense. In this graph, y is the cooling rate of the water and x is the delta temperature between the water and the room. The best fit line is an exponential curve, with a y intercept at $(0, 0.006)$. Although the y-intercept makes sense, as when the water is at room temperature, the rate of cooling is very close to zero, the asymptote found as $x \rightarrow -\infty$ does not make sense. It implies that even if the water is cooler than the surroundings, it will continue to cool, albeit at a very minimal rate.

The implications for this would therefore violate the Second Law of Thermodynamics, which states that the transfer of thermal energy moves from regions of higher thermal energy to regions of lower thermal energy. In other words, it should move from higher temperature to lower temperature. The interpretation of $x < 0$ in this graph is that the water is cooler than the surroundings around it. Therefore, the water should no longer continue to cool. Instead, it should gradually heat up. Our exponential regression does not allow for this to happen, as while the domain for our regression consists of all possible ΔTemperature between the water and the surroundings, the range of our regression is limited to $y > 0$, not allowing for the room to transfer energy to the water. Therefore, this regression is incorrect.

In reprocessing this data, we shall use a power regression. See the graph on the next page.

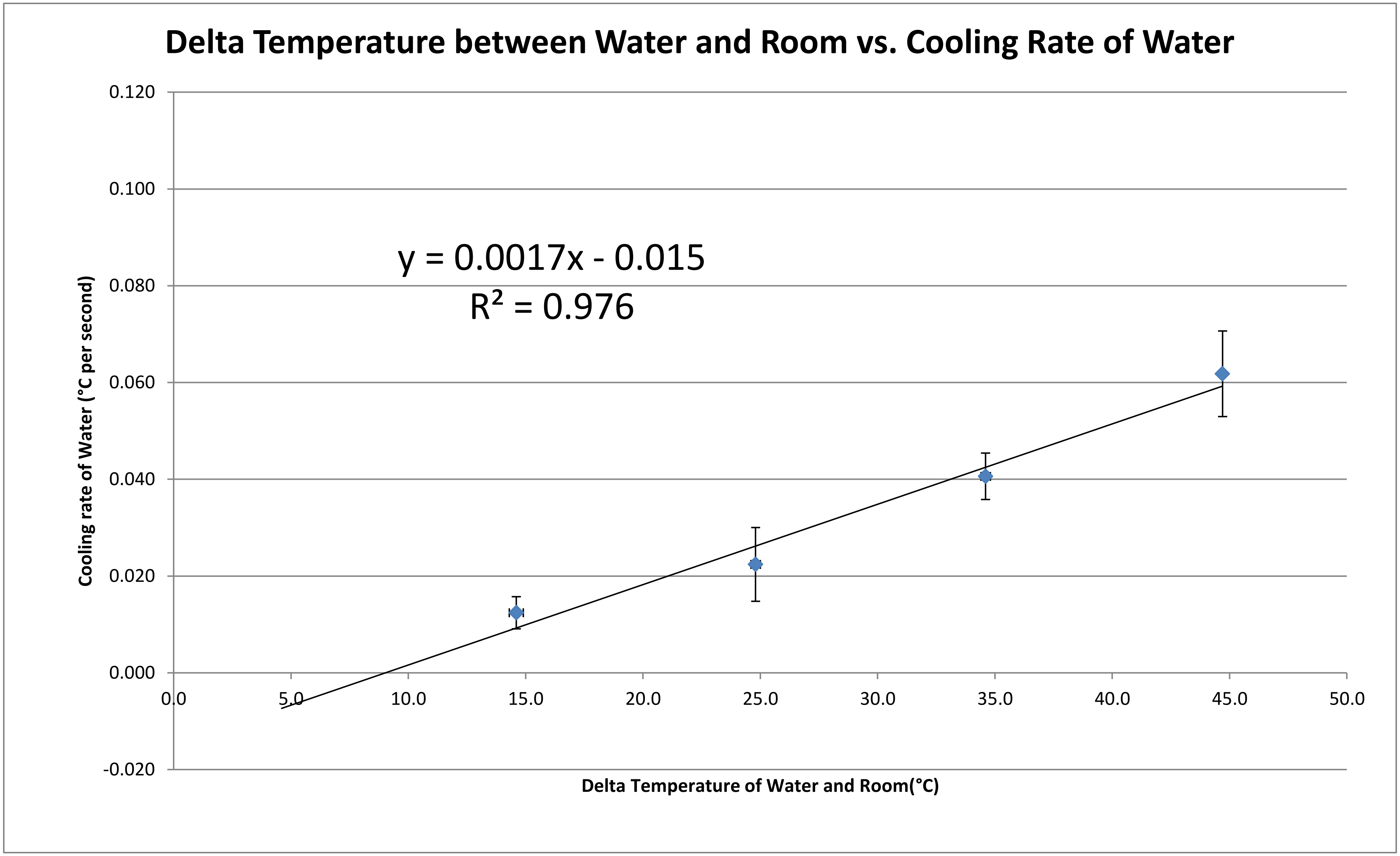

Delta Temperature between Water and Room vs. Cooling Rate of Water
0.120
0.100
0.080
0.060
0.040
0.020
0.000
Cooling rate of Water (°C per second)
y = 0.0002x^1.60
R² = 0.976
0.0
10.0
20.0
30.0
40.0
50.0
60.0
Delta Temperature of Water and Room(°C)

Although this graph also passes through all of the error regions, it implies something very similar to what we witnessed with the exponential regression. If the power regression truly implies a correlation of $y \propto x^{1.6}$, with $y = \frac{dTemp}{dtime}, x = time,$ the range of the function is limited to $\{x|x \geq 0\}$, which is not a valid assumption. If the water was cooler than the room, our function would stop working altogether. The purpose of these labs is not to devise an equation that only works for a small range, but to generalize the equation. Therefore, a final attempt will be made to appropriately model the data. See the next page for a linearized graph of our data.


Delta Temperature between Water and Room vs. Cooling Rate of Water
0.120
0.100
0.080
0.060
0.040
0.020
0.000
-0.020
Cooling rate of Water (°C per second)
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Delta Temperature of Water and Room(°C)
y = 0.0023x - 0.0299
R² = 0.926

With this graph, we have a more understandable correlation that is suitable for the range and domain of physical values. As the range and domain are $\{y|y \in \infty\}, \{x|x \in \infty\}$, all suitable values in the physical world are accounted for. However, the line of best regression does not pass through all of the error regions of our data. This would imply that our data is not statistically significant enough, and cannot be used to generalize a relationship.

However, we will use this opportunity to consider that the last data point, where $\Delta T = 54.4°C$, is an outlier from this regression. The full physical explanation for this discrepancy will be discussed in the conclusion and analysis. If we choose to drop this point, we get the following graph and regression:


Delta Temperature between Water and Room vs. Cooling Rate of Water
y = 0.0017x - 0.015
R² = 0.976
Cooling rate of Water (°C per second)
0.120
0.100
0.080
0.060
0.040
0.020
0.000
-0.020
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Delta Temperature of Water and Room(°C)

This graph is not perfect, but it does pass through each of the error regions of the data points. In analyzing this graph, we first understand that the domain and range of the best fit line is suitable for our scope and investigation, fitting the ranges for physical values at $\{y|y \in \infty\}, \{x|x \in \infty\}$. The slope of this linear graph is small and positive, which implies that for every one unit increase in the x direction, there will be a 0.0017 unit increase in the y direction. In translating these values to our data, it shows that for every one degree Celsius increase in ΔTemperature (as defined above), the rate of cooling will increase by $0.0017\,\frac{°C}{second}$.

This regression has a y intercept of $(0, -0.015)$, which poses confusion. Negative cooling rates have not yet been clarified. We shall define that if the cooling rate is negative, then the transfer of thermal energy moves from the room to the water, or that the water is being *heated*. An interpretation of this graph would be that when the water is at the same temperature as the room, it would slowly be heated. This statement will later be discussed in the error of this report.

The x-intercept for this graph is at $(8.82, 0)$, which implies that when the water is $8.82\ °C$ warmer than the room, the net movement of energy is halted. Again, this statement will be further examined in the error section of our report.

Data Processing:

The next step is to calculate the lines of minimum and maximum slope for this regression. If they differ too radically, such as between a positive and a negative slope, then our data would most likely show no correlation.

The maximum slope is determined from the maximum uncertainty values of the highest and lowest points, so that the two points responsible for this calculation would be: $(x_{min} + Uncert,\ y_{min} - Uncert)$ and $(x_{max} - Uncert, y_{max} + Uncert)$. Using our data, these two points would be (14.6 + 0.3, .012-.003) and (44.7-0.1, 0.062+0.009), giving us the points (14.9, 0.009) and (44.6, 0.071). As the equation for slope is $m = \frac{y_2 - y_1}{x_2 - x_1}$, we can process by

$$m = \frac{(0.071 - 0.009)}{44.6 - 14.9}$$

$$m = \frac{0.062}{29.7}$$

$$m = \frac{0.0021(°C)}{second}$$

The minimum slope is similarly calculated, but with reversed signs in regards to adding or subtracting the uncertainty. Therefore, the points should be $(x_{min} - Uncert,\ y_{min} + Uncert)$ and $(x_{max} + Uncert, y_{max} - Uncert)$, or (14.6 - 0.3, 0.012+0.003) and (44.7+0.1, 0.062-0.009), giving us the points (14.3, 0.015) and (44.8, 0.053). Again, calculating for slope by

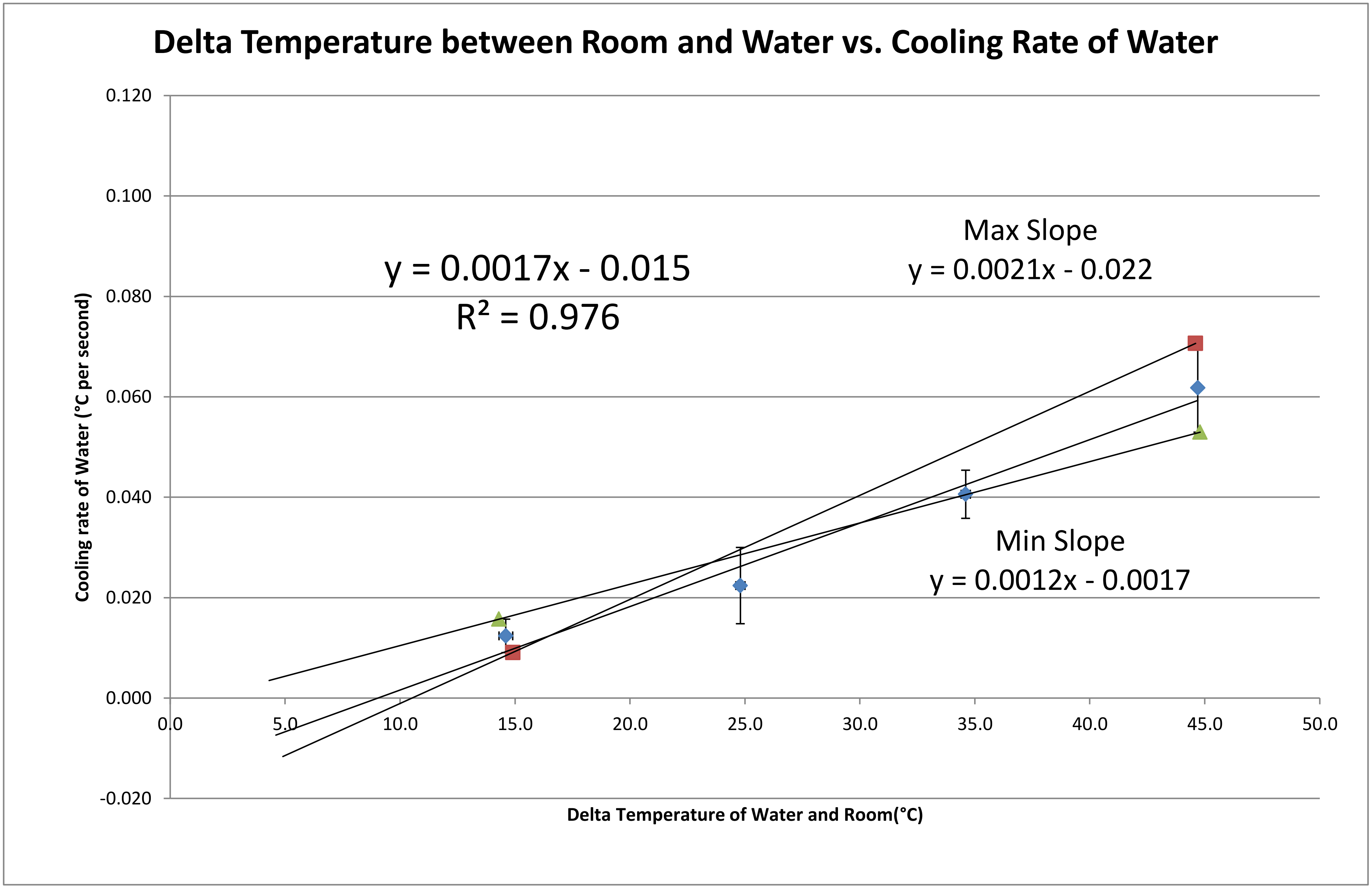
$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

$$m = \frac{0.053 - 0.016}{44.8 - 14.3}$$

$$m = \frac{0.37}{30.5}$$

$$m = 0.012\frac{(°C)}{second}$$

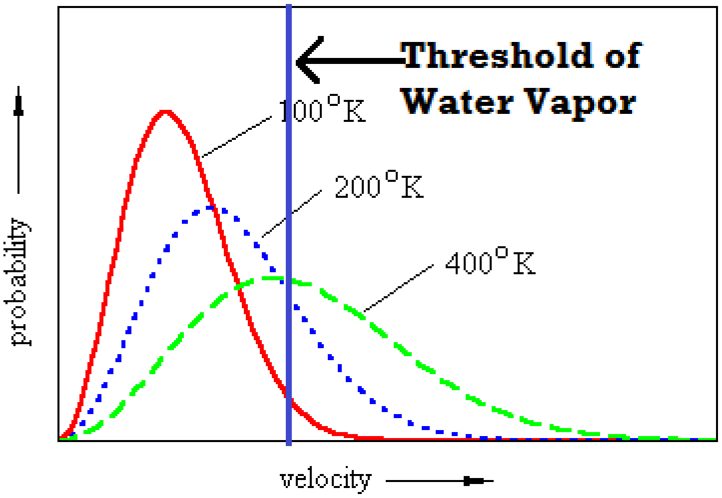
Putting all of this information together, the following graph is produced:


Delta Temperature between Room and Water vs. Cooling Rate of Water
Cooling rate of Water (°C per second)
0.120
0.100
0.080
0.060
0.040
0.020
0.000
-0.020
0.0
5.0
10.0
15.0
20.0
25.0
30.0
35.0
40.0
45.0
50.0
Delta Temperature of Water and Room(°C)
y = 0.0017x - 0.015
R² = 0.976
Max Slope
y = 0.0021x - 0.022
Min Slope
y = 0.0012x - 0.0017

Conclusion:

The most pressing situation to understand for our regressions is the reason why we chose to identify the $\Delta T = 54.4\ ^\circ C$ point to be an outlier. Our analysis for this is not so much rooted in a mathematics, but physics. For this experiment, our aim was to merely understand the relationship between the cooling rate between water and the room due to conduction of thermal energy. One of the assumptions we made in doing this experiment was that all water would remain as water, and have properties of such. However, this is not necessarily true.

Maxwell-Boltzmann diagrams are useful in understanding the probability distribution for a water molecule. They represent the probability that a single water molecule has sufficient kinetic energy to "escape" and become water vapor.



Maxwell Boltzmann Diagram for Water[4] *Note: Threshold line is not to scale.*

Temperature is a measurement of the average kinetic energy of a molecule, or the average velocity of each molecule. It makes sense for some of the molecules have a higher velocity of the average, allowing for them to escape the beaker and mix with the room air.

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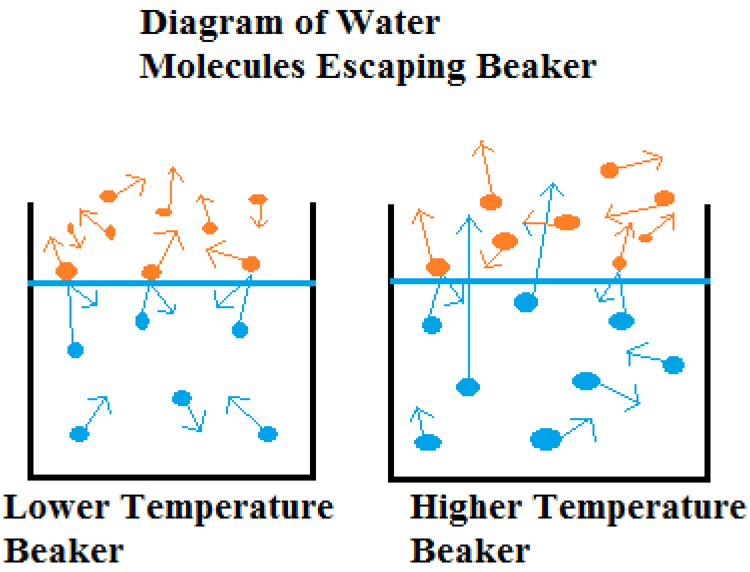
[4] McCarron, Tanner

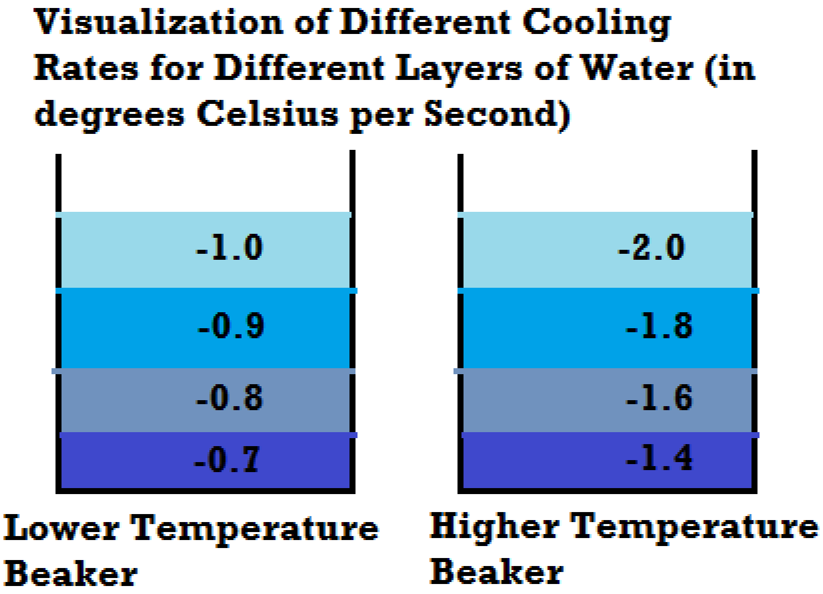
This type of cooling deals with how molecules of water would carry energy directly into the air, rather than the transfer of energy from the water molecules to the energy molecules. At a temperature of 80 degrees Celsius, water molecules have a significant probability of carrying away kinetic energy from the water beaker, which we believe leads to the outlier point.



Note: Orange molecules represent gas; blue molecules represent water.

In conducting further analysis of our y and x intercepts, we realize that there must still be a substantial amount of error. The Zeroth Law of Thermodynamics allows for the use of temperature to measure the flow of thermal energy. When two systems are in thermal equilibrium, where the net flow of thermal energy is zero, the two systems should have the same temperature. For our data, this would imply that when $\Delta Temperature$ is zero degrees, the rate of cooling should be zero. However, our x intercept shows that when the water is warmer than the room by $8.82\,°C$, thermal equilibrium is already achieved. Alternatively, when the temperature of the room and the water are the same, the water would be heating up at a rate of $0.015\frac{°C}{second}$. Again, this does not make sense.

One possibility for this error is that the thermal energy inside of the cup is not fully dispersed. When considering the model for cooling, we generally assume that the temperature at the bottom of the cup is the same as the temperature at the bottom of the cup. However, without constant stirring of the water, we cannot guarantee this to be true. The digital thermometer that is used could possibly detect faster rate of cooling near the top of the water. This is a non-systematic error, as the temperature layer separation is most apparent when the cooling rate is higher.


Visualization of Different Cooling Rates for Different Layers of Water (in degrees Celsius per Second)

This error would therefore cause reporting of the rate of cooling to be too high when the cooling rate is elevated, meaning that the slope should be smaller than calculated.

Another possibility for error is that in measuring the water temperature, we allowed for the probe to rest against the bottom of the paper cup. This was done with the assumption that the paper cup would be a good thermal insulator and not transfer a significant amount of heat to the temperature probe. However, upon further review, it is likely that paper cup had a slightly lower temperature than the water, and was more resistance to cooling than the water. This error would systematically shift all of the rates of cooling downwards. This error would therefore partially explain why our y-intercept is lower than the ideal condition.

We find that our data reveals a trend where the rate of cooling is directly dependent on the initial temperature of the water. If we allow T to be the temperature of the water and t to be the time elapsed, we can state that $\frac{dT}{dt}$ is the rate of change of temperature per time, which would be equivalent to the rate of cooling. This can be modeled by:

$$\frac{dT}{dt} = k \cdot T$$

Interestingly, we have seen this formula before. The above formula is commonly used to teach calculus students how to separate variables in order to solve differential equations. There, this formula is provided as Newton's Law of Cooling, which corresponds to the ideas that we have presented.

We could continue to interpret the slope in this situation, or the constant of cooling, for water. This constant is most likely related to the strength of intermolecular forces between the water molecules, which allow for a higher heat capacity, and thus a slower rate of cooling. However, because of the large amount of error that we have seen above, we are unable to come to a definite conclusion for the value of k for water. The errors in our experiment prevent a valid numerical value from being reported.

One of the most significant errors that we encounter is determining the exact cooling rate for water at a specific temperature. In our process, we take the first 25 seconds of temperature data and attempt to find the line of best fit. However, in an ideal situation, the cooling rate would instantaneously change for every single different temperature that the water is at. Therefore, our calculations are, at best, approximations. Although this approximation becomes more exact as the temperature decreases, and the change in the cooling rate slows down, there is still a considerable amount of error.

A potential improvement is to not measure the change in temperature over some amount of time, but rather the amount of time some change in temperature takes. Therefore, instead of taking data for the 25 seconds as we did here, we could calculate the amount of time it takes for the water to decrease by one degree Celsius. This would provide more accurate estimates for the true cooling rate of water at a specific temperature.

Another potential improvement is to place a watch glass on top of the beaker to prevent steam from escaping, thus allowing for better control of the transfer of heat. However, this would drastically change our experiment, as by limiting the amount of air that the water is in contact with, we allow for the air temperature to change as the water temperature cools. Because that would ruin one of the fundamental assumptions of our lab, this improvement should not be implemented.

A rather simple but effective improvement would be to use a ring stand to position the temperature probe in the middle of the water without touching any of the paper cup sides. This allows for a more accurate measure of only the temperature of the water without interference from the paper cups.

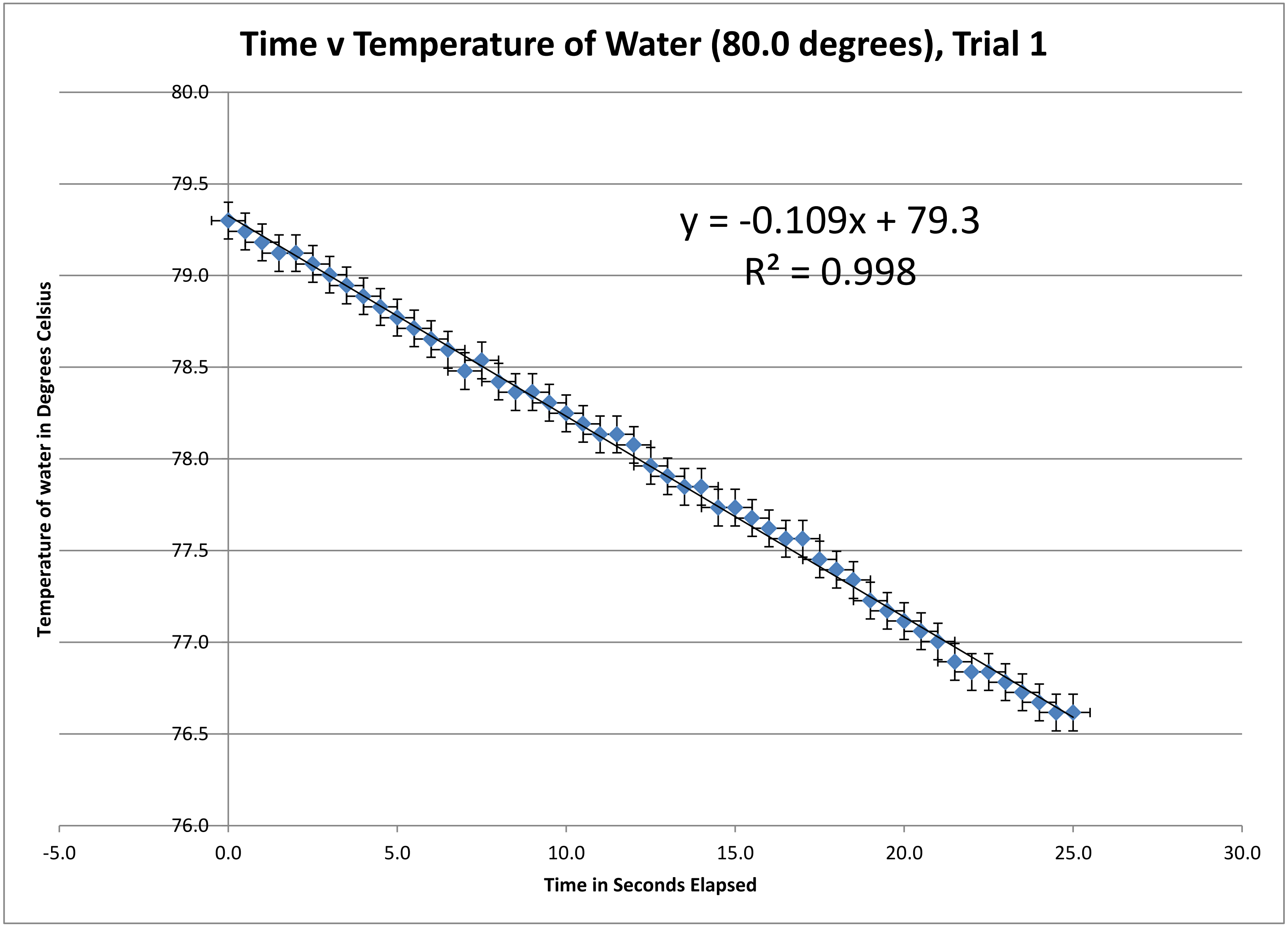
Another improvement that could be made is to conduct the lab in a more isolated condition to better control the temperature of the room as well as limiting the amount of wind blowing on the surface of the water. A larger, emptier room would allow for better control of these errors, as the volume of the room would absorb any increase in kinetic energy, and the stillness of the room would decrease the amount of wind in the room.

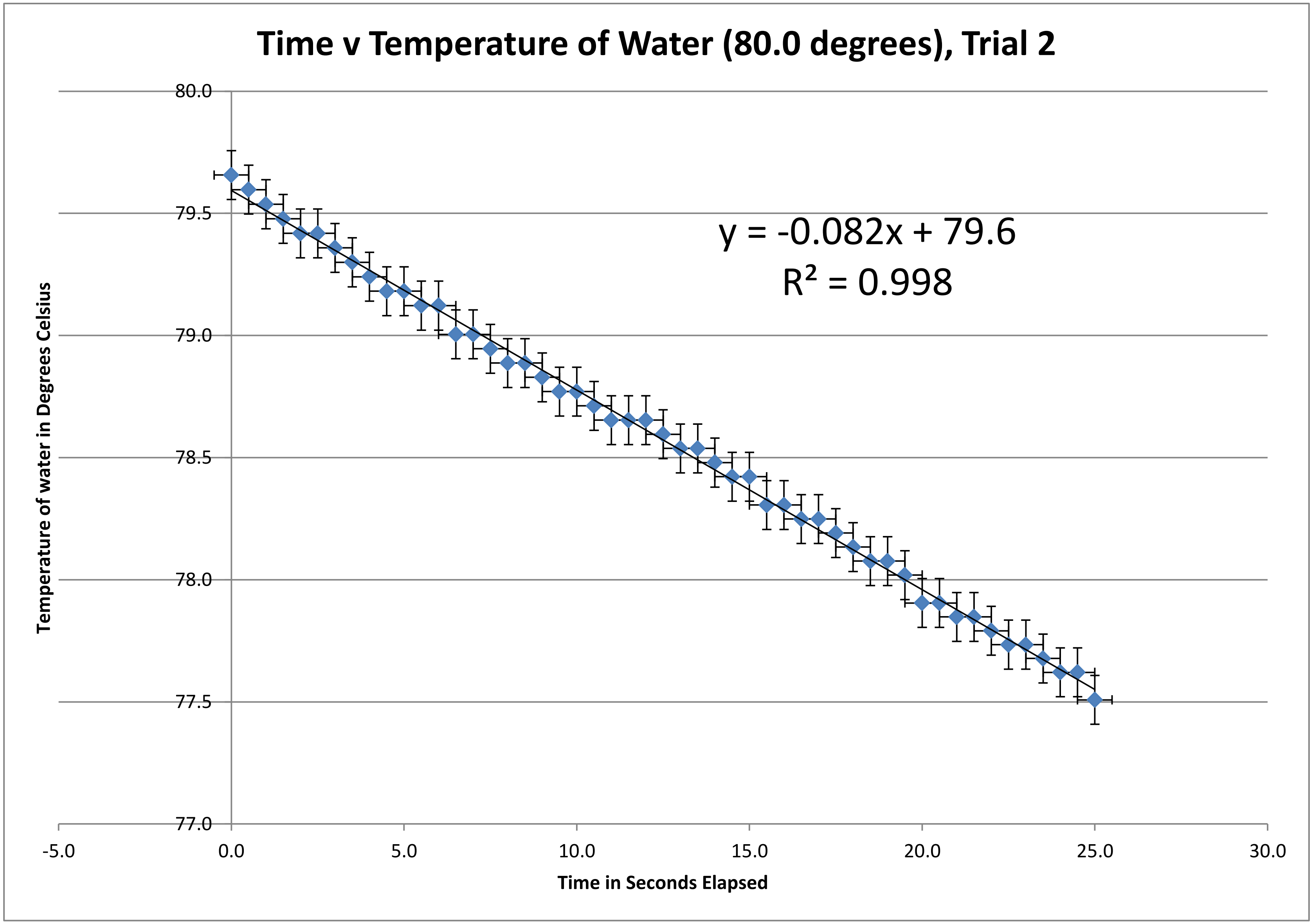
In conclusion, this was a difficult lab to control for the random nature of thermodynamics. Yet, we have done our best in presenting a design that would properly evaluate the relationship between the cooling rate and the difference in temperature between water and its surroundings. Through our experiment, we analyzed several different types of regressions and studied each end behavior to determine whether if it would be a match for our model. Although there are several improvements that would allow for more accurate calculations water's constant of cooling, our current laboratory conditions are sufficient to show the general trend for the two variables.

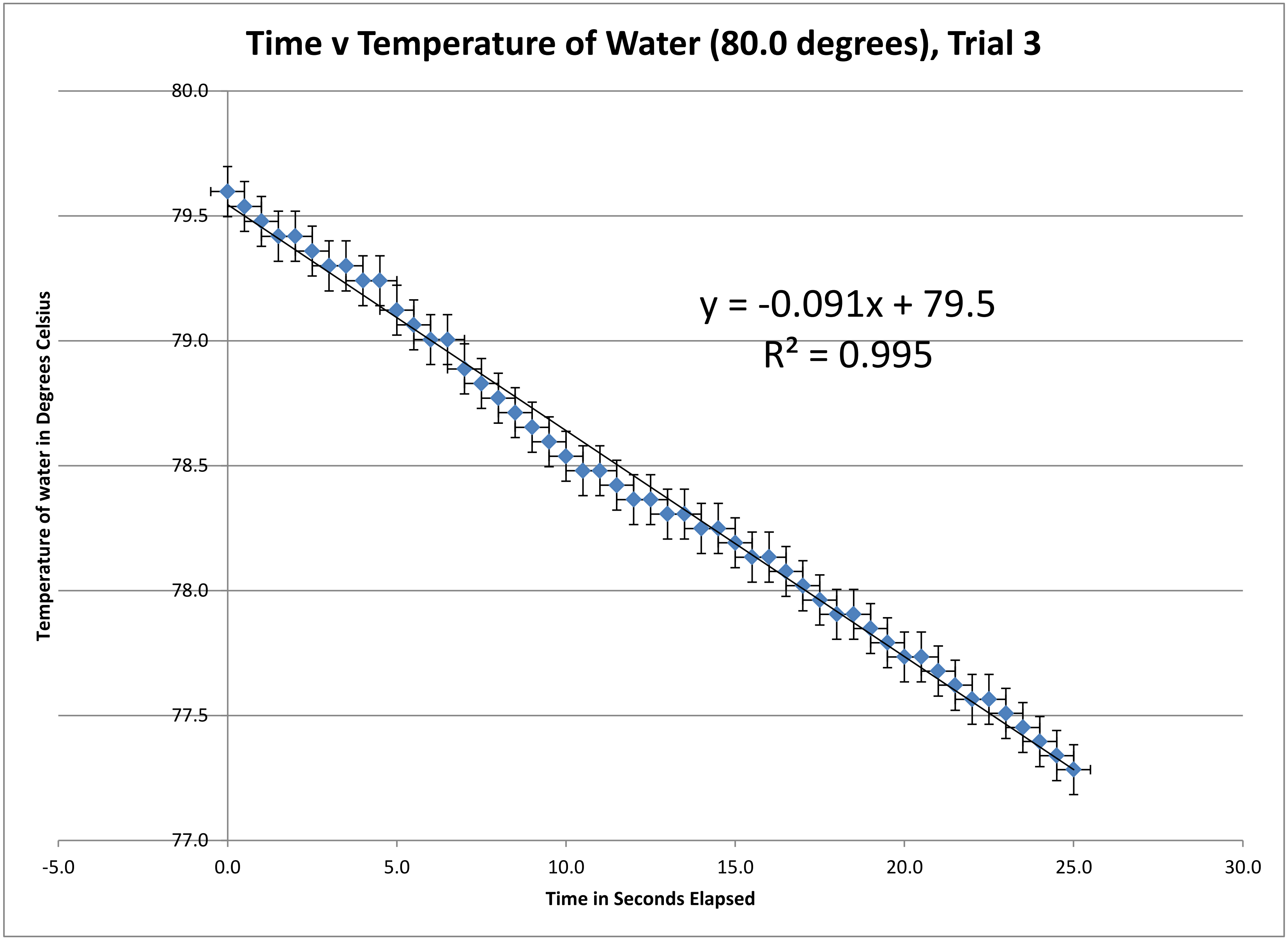
Appendix I: 80.0 degrees Celsius Data:

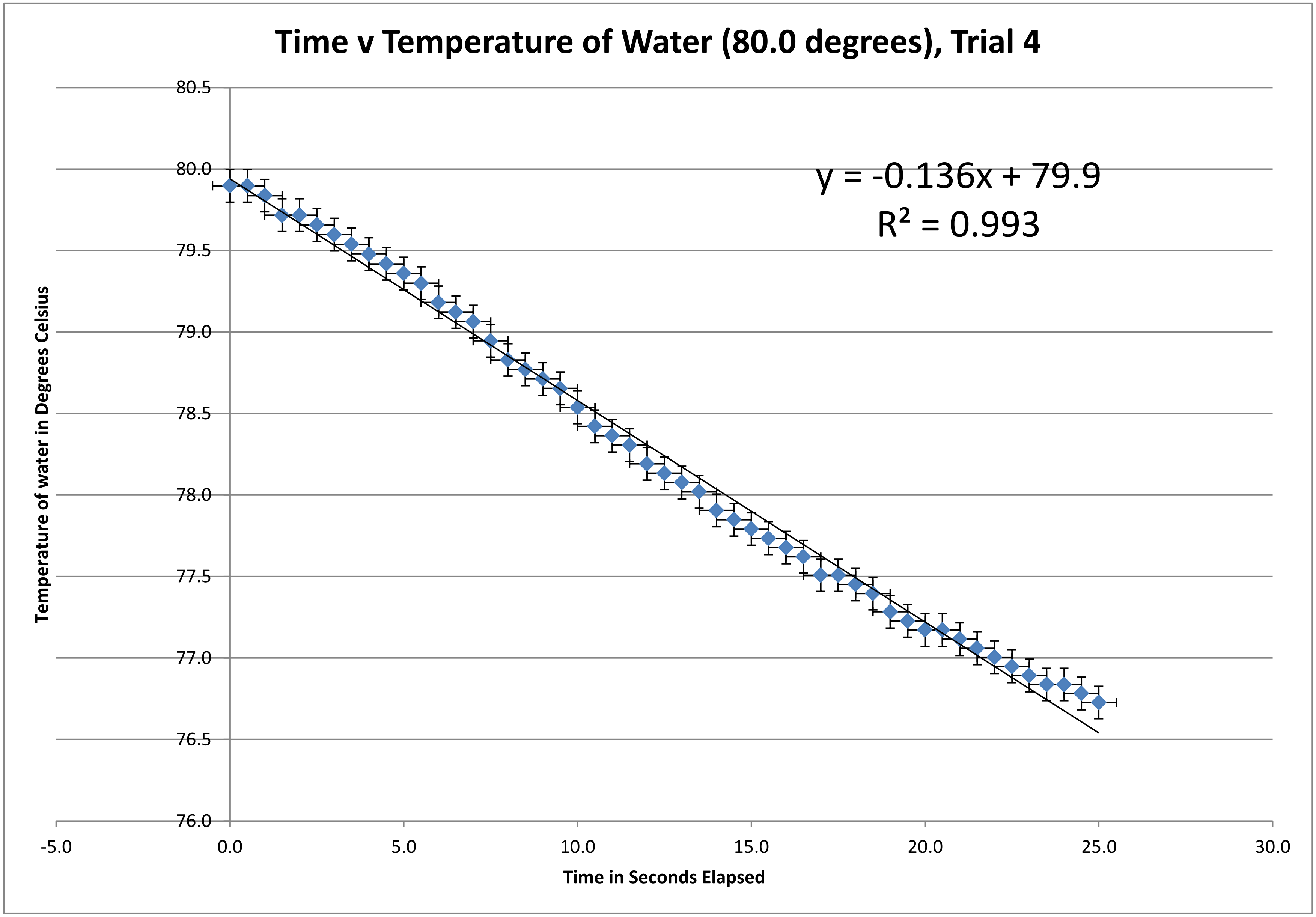
Cooling of Water with Initial Temp of 80.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	79.3	79.7	79.6	79.9	79.7
0.5	79.2	79.6	79.5	79.9	79.7
1.0	79.2	79.5	79.5	79.8	79.7
1.5	79.1	79.5	79.4	79.7	79.7
2.0	79.1	79.4	79.4	79.7	79.7
2.5	79.1	79.4	79.4	79.7	79.6
3.0	79.0	79.4	79.3	79.6	79.5
3.5	78.9	79.3	79.3	79.5	79.5
4.0	78.9	79.2	79.2	79.5	79.4
4.5	78.8	79.2	79.2	79.4	79.4
5.0	78.8	79.2	79.1	79.4	79.3
5.5	78.7	79.1	79.1	79.3	79.3
6.0	78.7	79.1	79.0	79.2	79.2
6.5	78.6	79.0	79.0	79.1	79.2
7.0	78.5	79.0	78.9	79.1	79.1
7.5	78.5	78.9	78.8	78.9	79.1
8.0	78.4	78.9	78.8	78.8	79.1
8.5	78.4	78.9	78.7	78.8	78.9
9.0	78.4	78.8	78.7	78.7	78.9
9.5	78.3	78.8	78.6	78.7	78.8
10.0	78.2	78.8	78.5	78.5	78.8
10.5	78.2	78.7	78.5	78.4	78.7
11.0	78.1	78.7	78.5	78.4	78.7
11.5	78.1	78.7	78.4	78.3	78.5
12.0	78.1	78.7	78.4	78.2	78.5
12.5	78.0	78.6	78.4	78.1	78.5
13.0	77.9	78.5	78.3	78.1	78.4
13.5	77.8	78.5	78.3	78.0	78.4
14.0	77.8	78.5	78.2	77.9	78.3
14.5	77.7	78.4	78.2	77.8	78.2
15.0	77.7	78.4	78.2	77.8	78.2

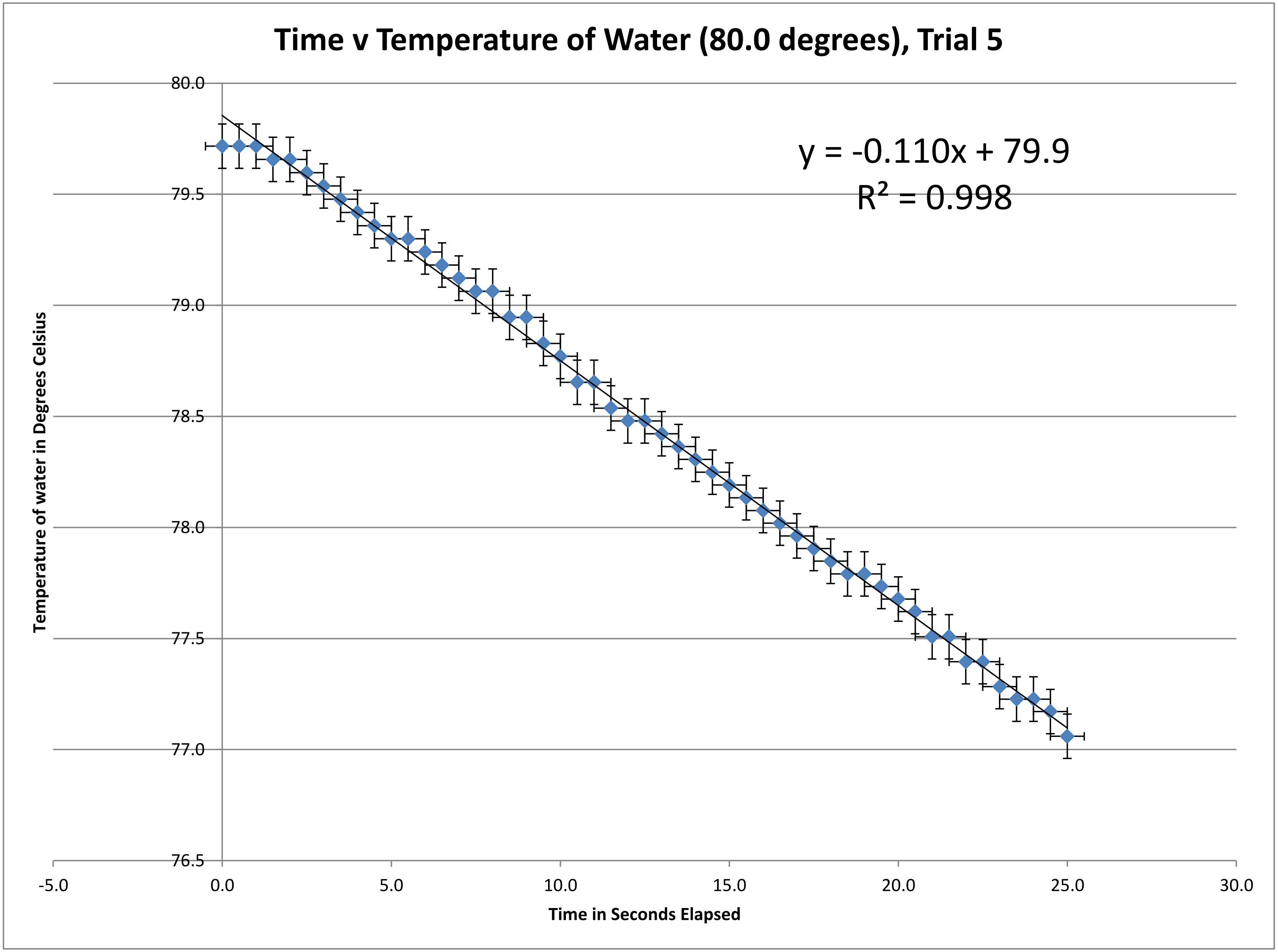
Cooling of Water with Initial Temp of 80.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
15.5	77.7	78.3	78.1	77.7	78.1
16.0	77.6	78.3	78.1	77.7	78.1
16.5	77.6	78.2	78.1	77.6	78.0
17.0	77.6	78.2	78.0	77.5	78.0
17.5	77.5	78.2	78.0	77.5	77.9
18.0	77.4	78.1	77.9	77.5	77.8
18.5	77.3	78.1	77.9	77.4	77.8
19.0	77.2	78.1	77.8	77.3	77.8
19.5	77.2	78.0	77.8	77.2	77.7
20.0	77.1	77.9	77.7	77.2	77.7
20.5	77.1	77.9	77.7	77.2	77.6
21.0	77.0	77.8	77.7	77.1	77.5
21.5	76.9	77.8	77.6	77.1	77.5
22.0	76.8	77.8	77.6	77.0	77.4
22.5	76.8	77.7	77.6	76.9	77.4
23.0	76.8	77.7	77.5	76.9	77.3
23.5	76.7	77.7	77.5	76.8	77.2
24.0	76.7	77.6	77.4	76.8	77.2
24.5	76.6	77.6	77.3	76.8	77.2
25.0	76.6	77.5	77.3	76.7	77.1


Time v Temperature of Water (80.0 degrees), Trial 1
y = -0.109x + 79.3
R² = 0.998
Temperature of water in Degrees Celsius
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed


Time v Temperature of Water (80.0 degrees), Trial 2
y = -0.082x + 79.6
R² = 0.998
Temperature of water in Degrees Celsius
80.0
79.5
79.0
78.5
78.0
77.5
77.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed


Time v Temperature of Water (80.0 degrees), Trial 3
y = -0.091x + 79.5
R² = 0.995
Temperature of water in Degrees Celsius
80.0
79.5
79.0
78.5
78.0
77.5
77.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed


Time v Temperature of Water (80.0 degrees), Trial 4
y = -0.136x + 79.9
R^2 = 0.993
Temperature of water in Degrees Celsius
80.5
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
76.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

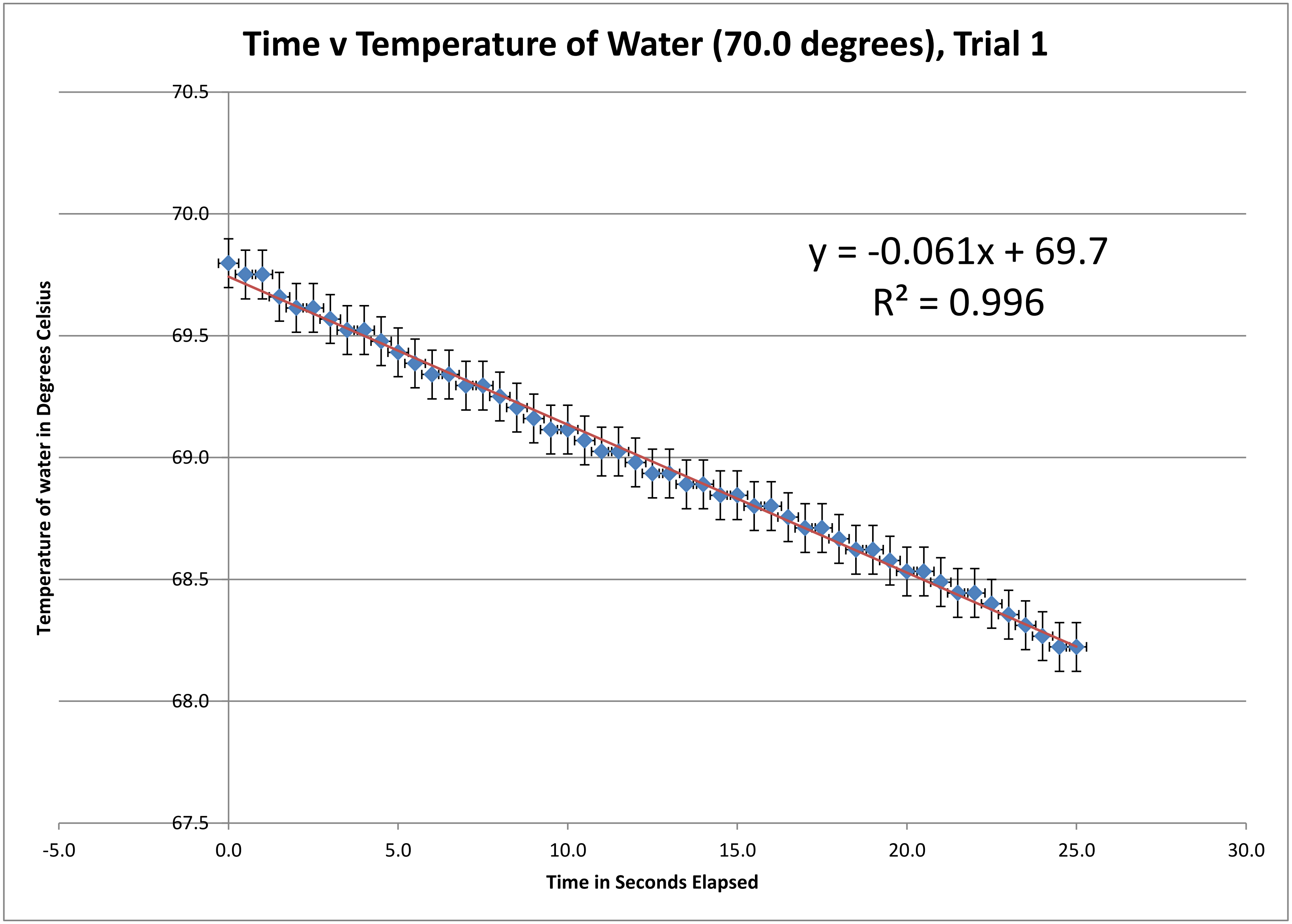

Time v Temperature of Water (80.0 degrees), Trial 5
y = -0.110x + 79.9
R² = 0.998
Temperature of water in Degrees Celsius
80.0
79.5
79.0
78.5
78.0
77.5
77.0
76.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

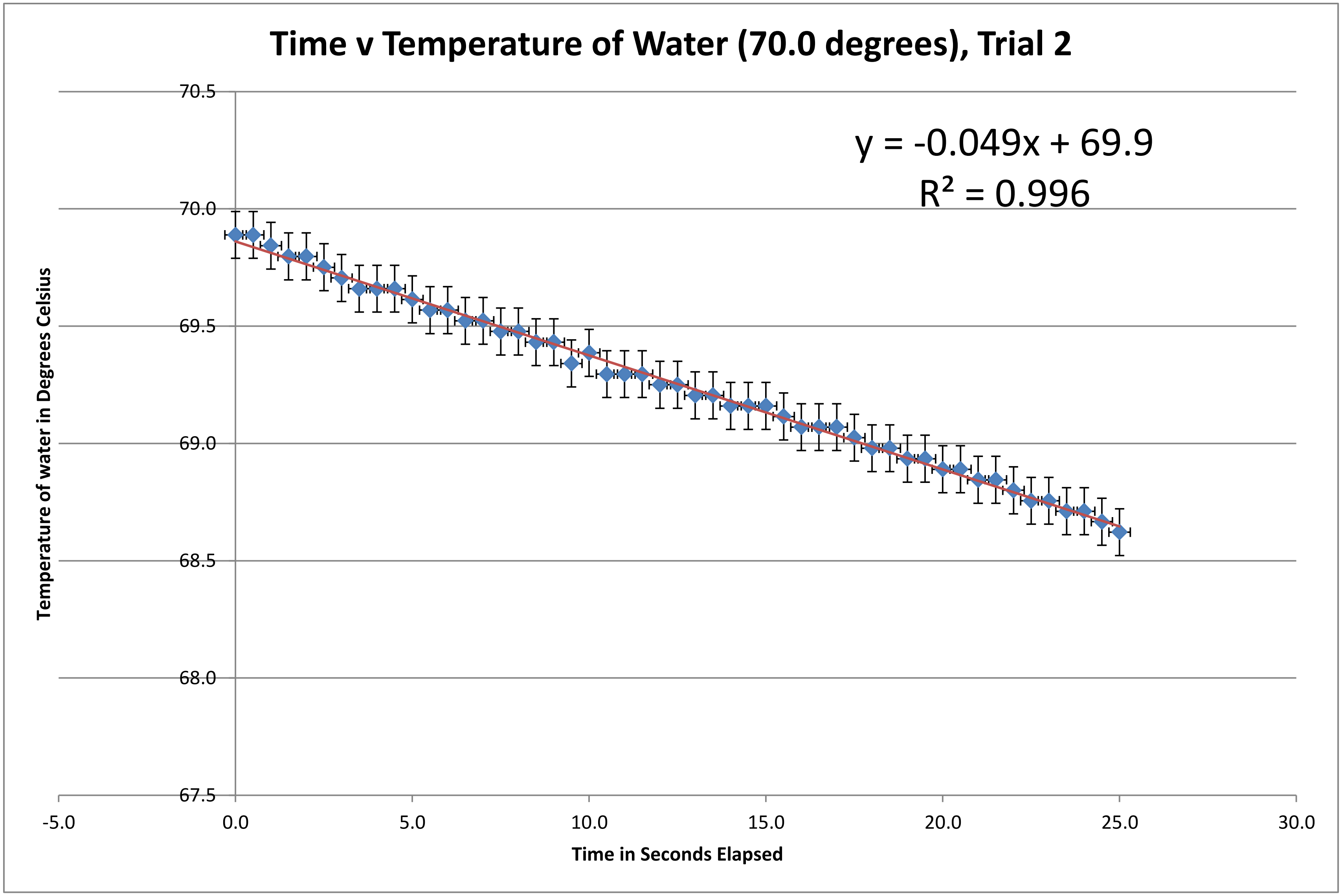
Appendix II: 70 degrees Celsius Data:

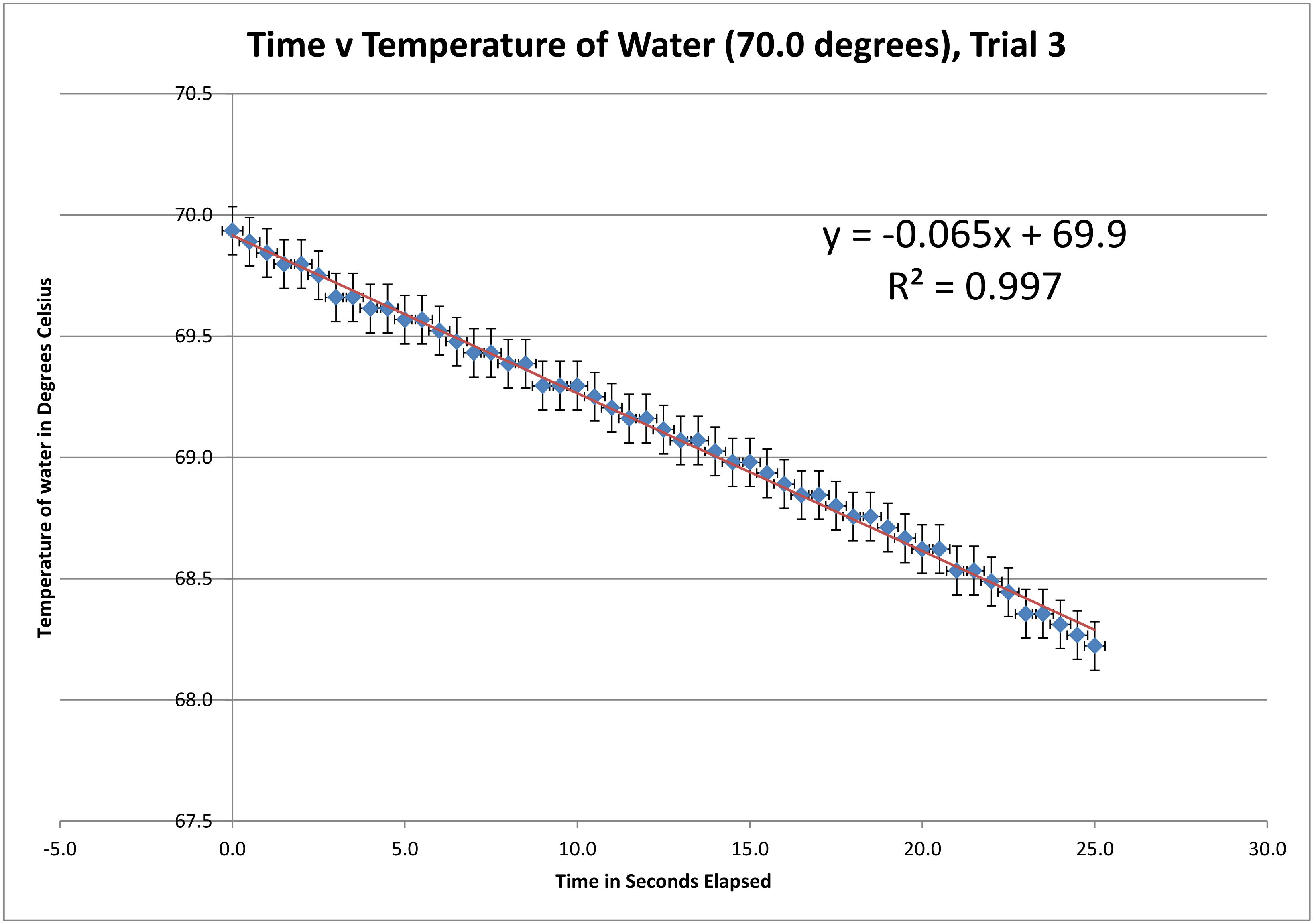
Cooling of Water with Initial Temp of 70.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	69.8	69.9	69.9	69.8	70.0
0.5	69.8	69.9	69.9	69.8	69.9
1.0	69.8	69.8	69.8	69.7	69.9
1.5	69.7	69.8	69.8	69.7	69.9
2.0	69.6	69.8	69.8	69.7	69.8
2.5	69.6	69.8	69.8	69.6	69.8
3.0	69.6	69.7	69.7	69.6	69.8
3.5	69.5	69.7	69.7	69.5	69.7
4.0	69.5	69.7	69.6	69.5	69.7
4.5	69.5	69.7	69.6	69.5	69.7
5.0	69.4	69.6	69.6	69.4	69.6
5.5	69.4	69.6	69.6	69.4	69.6
6.0	69.3	69.6	69.5	69.4	69.5
6.5	69.3	69.5	69.5	69.3	69.5
7.0	69.3	69.5	69.4	69.3	69.5
7.5	69.3	69.5	69.4	69.3	69.4
8.0	69.3	69.5	69.4	69.3	69.3
8.5	69.2	69.4	69.4	69.3	69.3
9.0	69.2	69.4	69.3	69.3	69.3
9.5	69.1	69.3	69.3	69.2	69.2
10.0	69.1	69.4	69.3	69.2	69.1
10.5	69.1	69.3	69.3	69.2	69.1
11.0	69.0	69.3	69.2	69.1	69.1
11.5	69.0	69.3	69.2	69.1	69.0
12.0	69.0	69.3	69.2	69.1	69.0
12.5	68.9	69.3	69.1	69.0	68.9
13.0	68.9	69.2	69.1	69.0	68.9
13.5	68.9	69.2	69.1	68.9	68.8
14.0	68.9	69.2	69.0	68.9	68.8
14.5	68.8	69.2	69.0	68.9	68.8
15.0	68.8	69.2	69.0	68.9	68.8

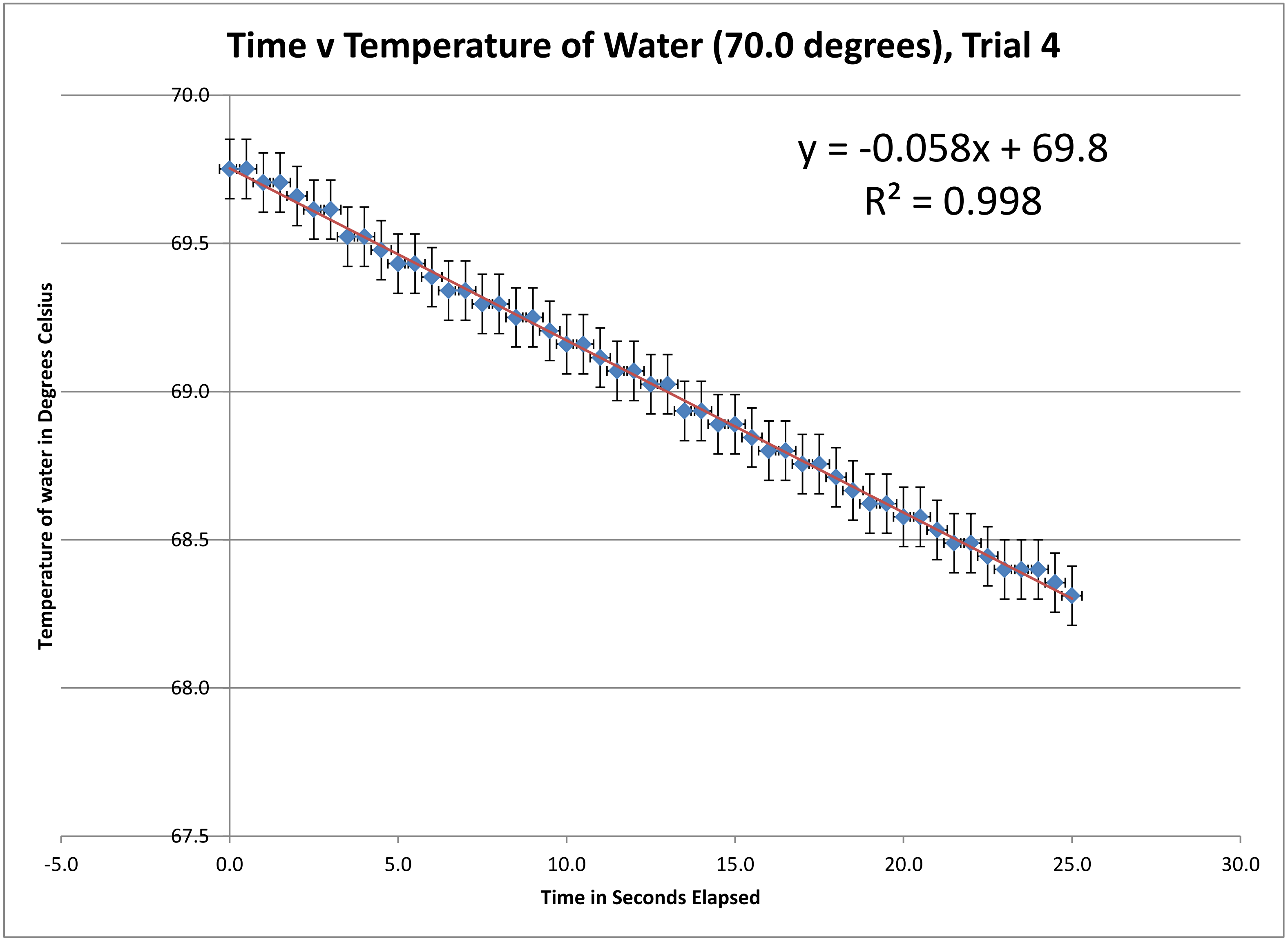
Cooling of Water with Initial Temp of 70.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
15.5	68.8	69.1	68.9	68.8	68.7
16.0	68.8	69.1	68.9	68.8	68.7
16.5	68.8	69.1	68.8	68.8	68.7
17.0	68.7	69.1	68.8	68.8	68.6
17.5	68.7	69.0	68.8	68.8	68.6
18.0	68.7	69.0	68.8	68.7	68.6
18.5	68.6	69.0	68.8	68.7	68.6
19.0	68.6	68.9	68.7	68.6	68.5
19.5	68.6	68.9	68.7	68.6	68.5
20.0	68.5	68.9	68.6	68.6	68.5
20.5	68.5	68.9	68.6	68.6	68.4
21.0	68.5	68.8	68.5	68.5	68.4
21.5	68.4	68.8	68.5	68.5	68.4
22.0	68.4	68.8	68.5	68.5	68.3
22.5	68.4	68.8	68.4	68.4	68.3
23.0	68.4	68.8	68.4	68.4	68.2
23.5	68.3	68.7	68.4	68.4	68.2
24.0	68.3	68.7	68.3	68.4	68.2
24.5	68.2	68.7	68.3	68.4	68.2
25.0	68.2	68.6	68.2	68.3	68.1

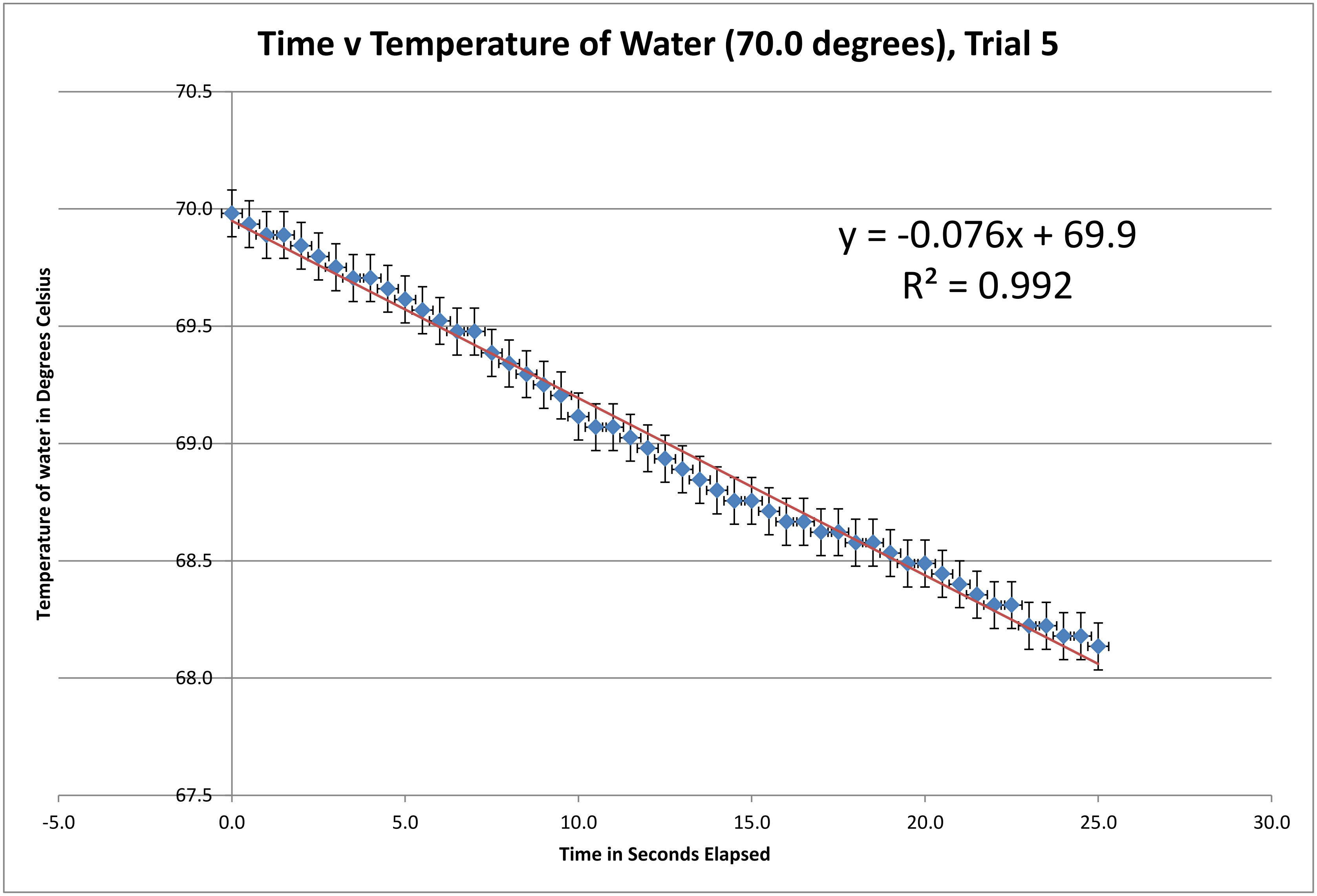
Note: The line of best fit from this point on is represented with a solid red line for viewing clarity.


Time v Temperature of Water (70.0 degrees), Trial 1
y = -0.061x + 69.7
R² = 0.996
Temperature of water in Degrees Celsius
70.5
70.0
69.5
69.0
68.5
68.0
67.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed


Time v Temperature of Water (70.0 degrees), Trial 2
y = -0.049x + 69.9
R² = 0.996
Temperature of water in Degrees Celsius
70.5
70.0
69.5
69.0
68.5
68.0
67.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed


Time v Temperature of Water (70.0 degrees), Trial 3
y = -0.065x + 69.9
R² = 0.997
Temperature of water in Degrees Celsius
70.5
70.0
69.5
69.0
68.5
68.0
67.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

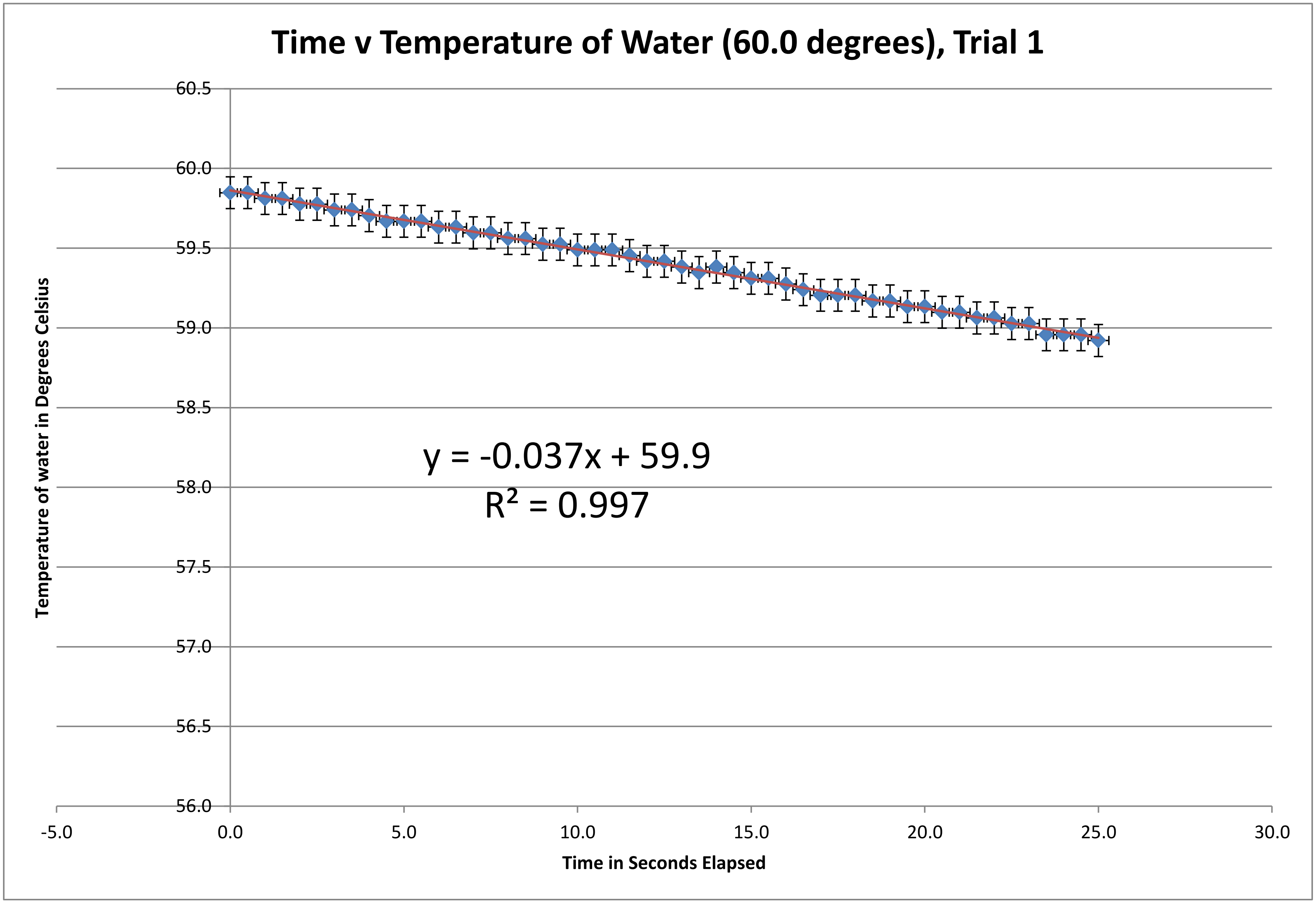

Time v Temperature of Water (70.0 degrees), Trial 4
y = -0.058x + 69.8
R² = 0.998
Temperature of water in Degrees Celsius
70.0
69.5
69.0
68.5
68.0
67.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

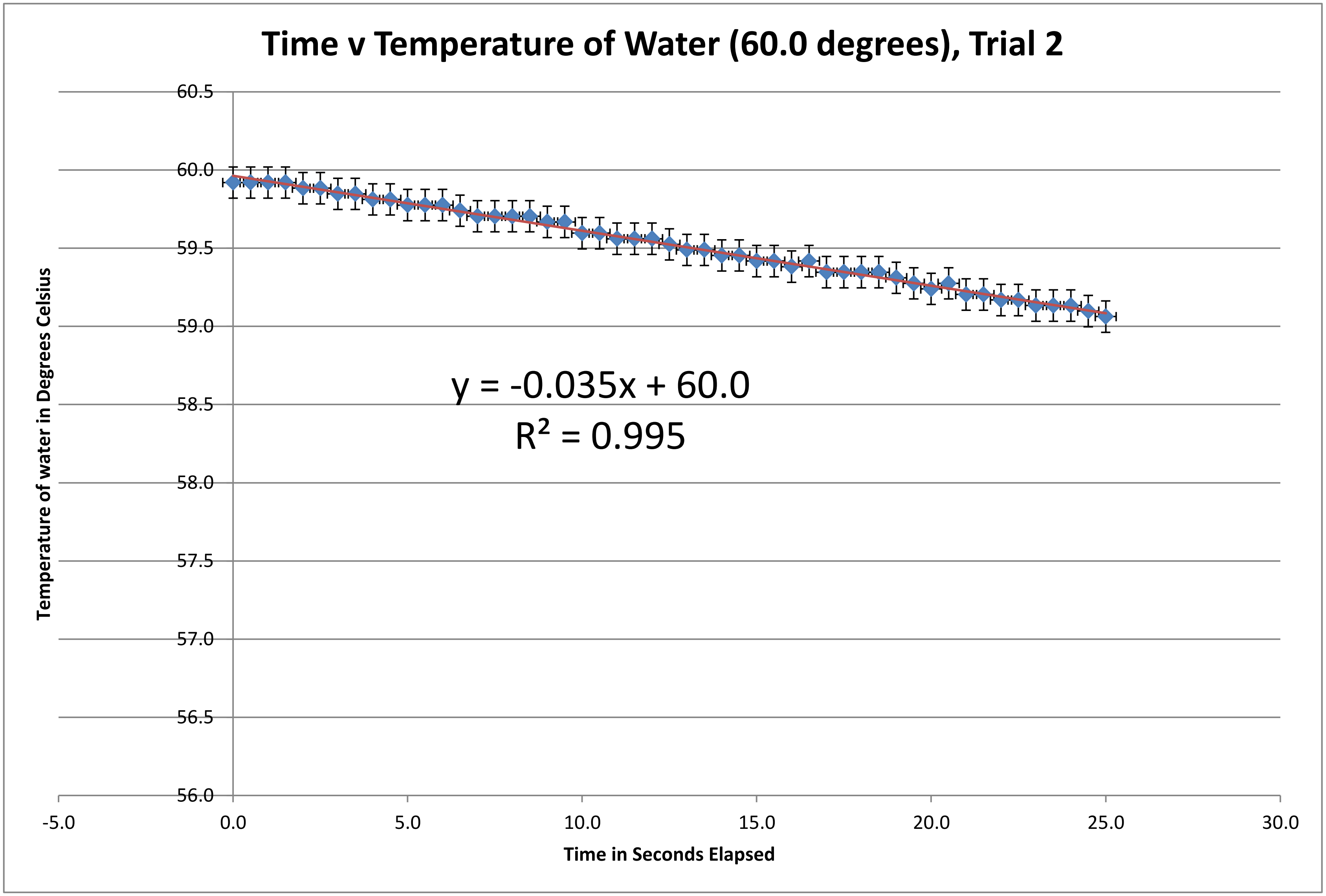

Time v Temperature of Water (70.0 degrees), Trial 5
y = -0.076x + 69.9
R^2 = 0.992
70.5
70.0
69.5
69.0
68.5
68.0
67.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed

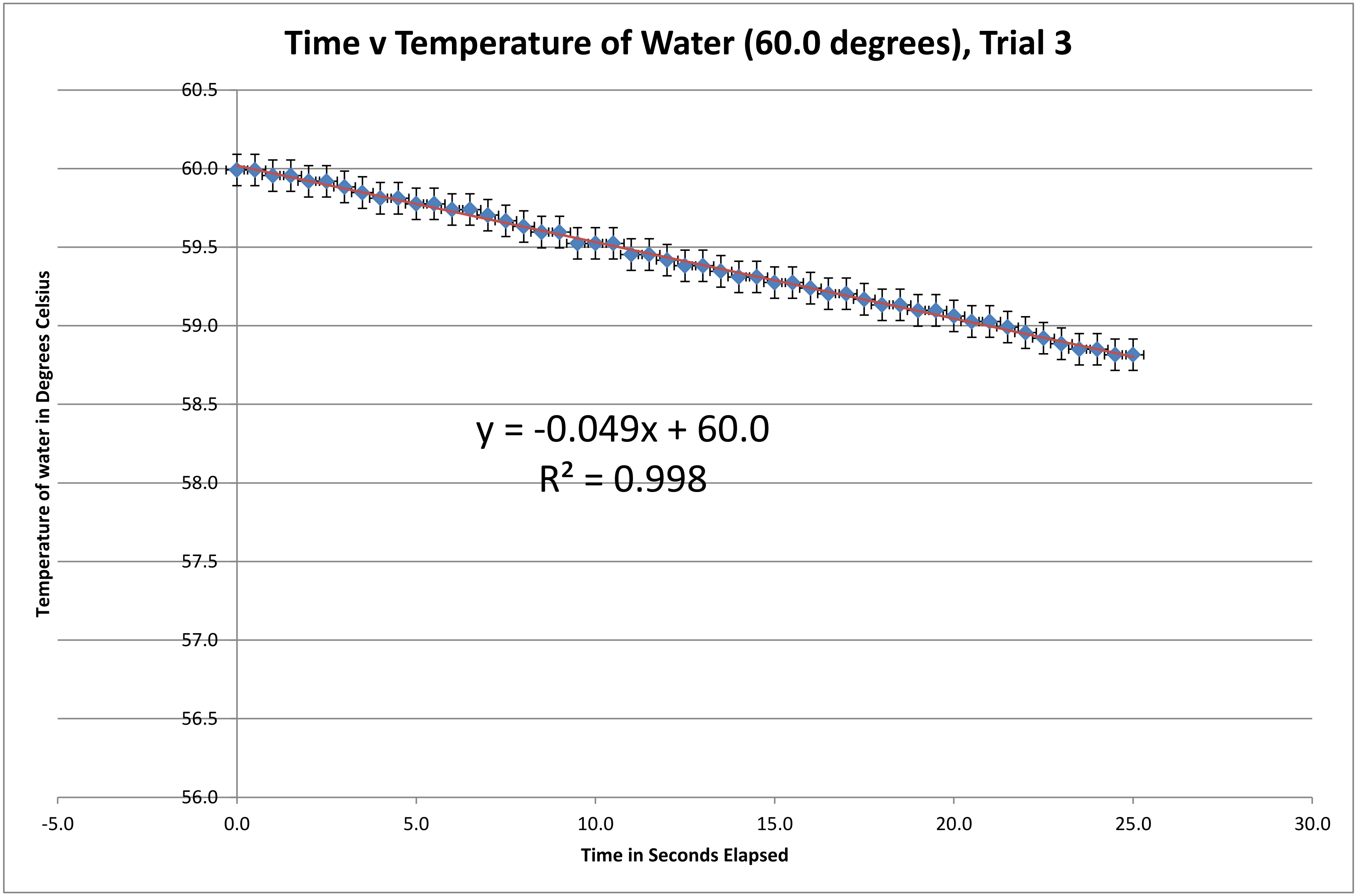
Appendix III: 60 degrees Celsius Data:

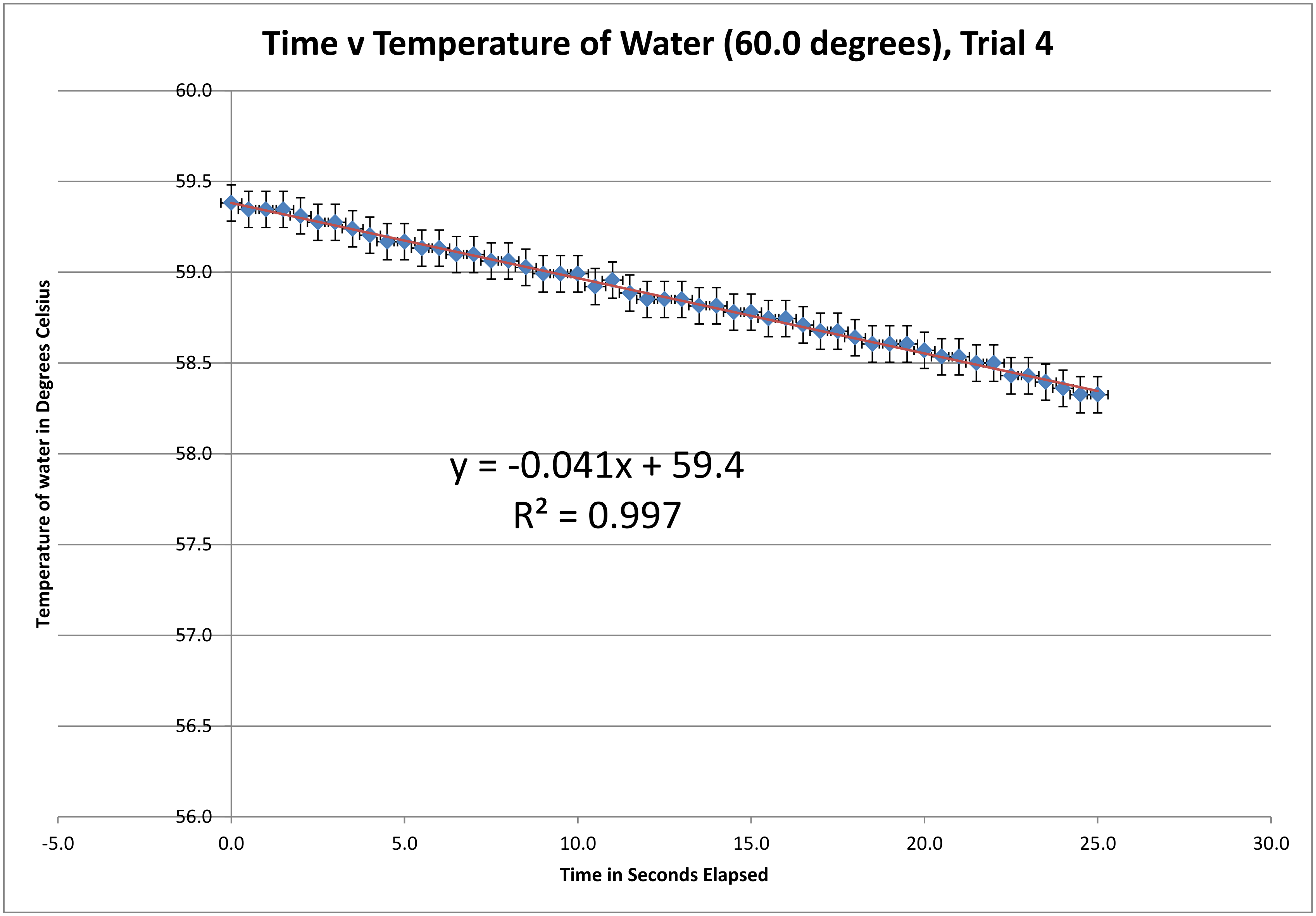
Cooling of Water with Initial Temp of 60.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	59.8	59.9	60.0	59.4	60.0
0.5	59.8	59.9	60.0	59.3	60.0
1.0	59.8	59.9	60.0	59.3	60.0
1.5	59.8	59.9	60.0	59.3	60.0
2.0	59.8	59.9	59.9	59.3	60.0
2.5	59.8	59.9	59.9	59.3	59.9
3.0	59.7	59.8	59.9	59.3	59.9
3.5	59.7	59.8	59.8	59.2	59.9
4.0	59.7	59.8	59.8	59.2	59.8
4.5	59.7	59.8	59.8	59.2	59.8
5.0	59.7	59.8	59.8	59.2	59.8
5.5	59.7	59.8	59.8	59.1	59.8
6.0	59.6	59.8	59.7	59.1	59.8
6.5	59.6	59.7	59.7	59.1	59.8
7.0	59.6	59.7	59.7	59.1	59.7
7.5	59.6	59.7	59.7	59.1	59.7
8.0	59.6	59.7	59.6	59.1	59.7
8.5	59.6	59.7	59.6	59.0	59.7
9.0	59.5	59.7	59.6	59.0	59.7
9.5	59.5	59.7	59.5	59.0	59.7
10.0	59.5	59.6	59.5	59.0	59.6
10.5	59.5	59.6	59.5	58.9	59.6
11.0	59.5	59.6	59.5	59.0	59.6
11.5	59.5	59.6	59.5	58.9	59.6
12.0	59.4	59.6	59.4	58.9	59.5
12.5	59.4	59.5	59.4	58.9	59.5
13.0	59.4	59.5	59.4	58.9	59.5
13.5	59.3	59.5	59.3	58.8	59.5
14.0	59.4	59.5	59.3	58.8	59.5
14.5	59.3	59.5	59.3	58.8	59.5
15.0	59.3	59.4	59.3	58.8	59.5

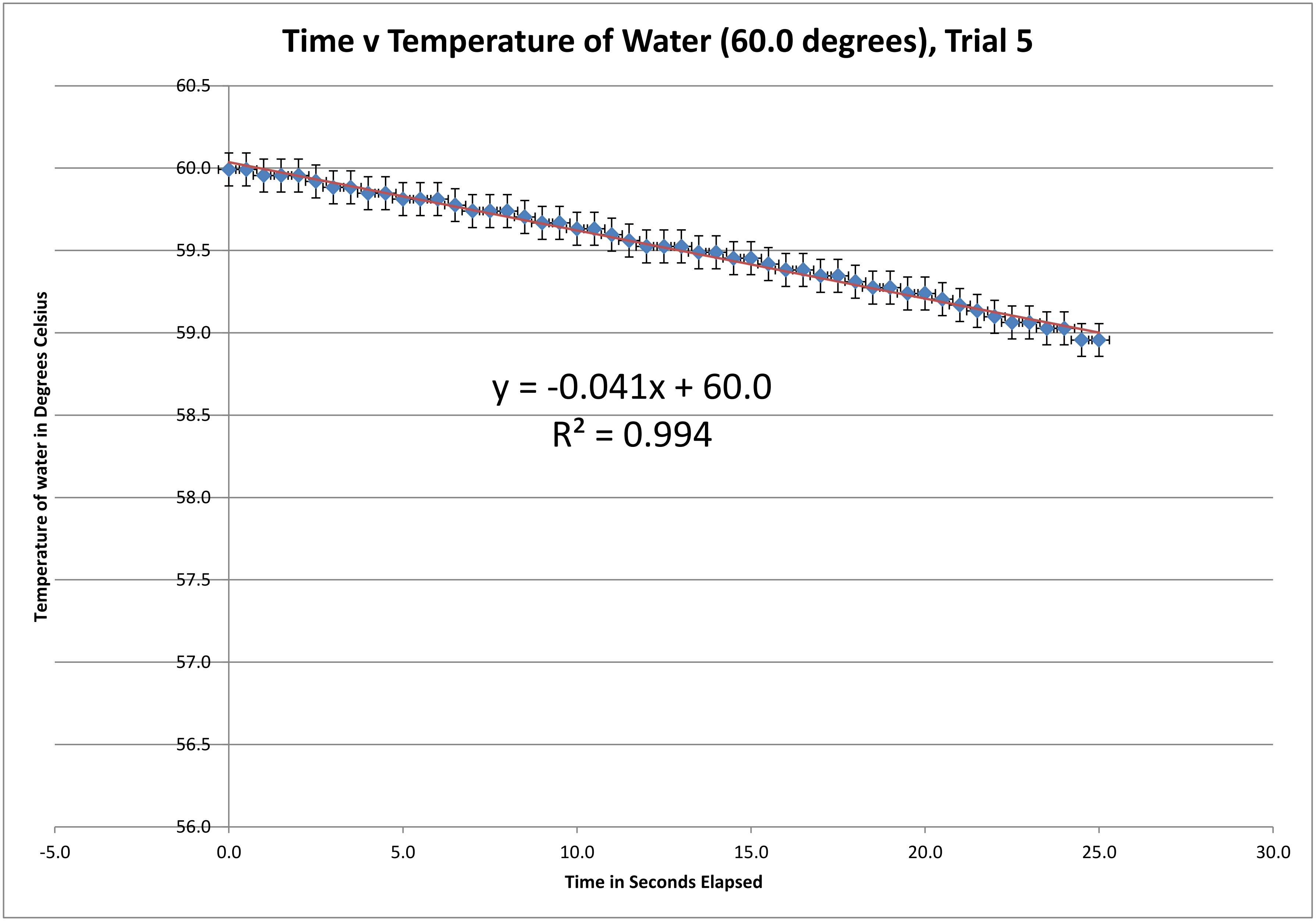
Cooling of Water with Initial Temp of 60.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
15.5	59.3	59.4	59.3	58.7	59.4
16.0	59.3	59.4	59.2	58.7	59.4
16.5	59.2	59.4	59.2	58.7	59.4
17.0	59.2	59.3	59.2	58.7	59.3
17.5	59.2	59.3	59.2	58.7	59.3
18.0	59.2	59.3	59.1	58.6	59.3
18.5	59.2	59.3	59.1	58.6	59.3
19.0	59.2	59.3	59.1	58.6	59.3
19.5	59.1	59.3	59.1	58.6	59.2
20.0	59.1	59.2	59.1	58.6	59.2
20.5	59.1	59.3	59.0	58.5	59.2
21.0	59.1	59.2	59.0	58.5	59.2
21.5	59.1	59.2	59.0	58.5	59.1
22.0	59.1	59.2	59.0	58.5	59.1
22.5	59.0	59.2	58.9	58.4	59.1
23.0	59.0	59.1	58.9	58.4	59.1
23.5	59.0	59.1	58.9	58.4	59.0
24.0	59.0	59.1	58.9	58.4	59.0
24.5	59.0	59.1	58.8	58.3	59.0
25.0	58.9	59.1	58.8	58.3	59.0


Time v Temperature of Water (60.0 degrees), Trial 1
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
y = -0.037x + 59.9
R² = 0.997


Time v Temperature of Water (60.0 degrees), Trial 2
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
y = -0.035x + 60.0
R² = 0.995


Time v Temperature of Water (60.0 degrees), Trial 3
y = -0.049x + 60.0
R² = 0.998
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0

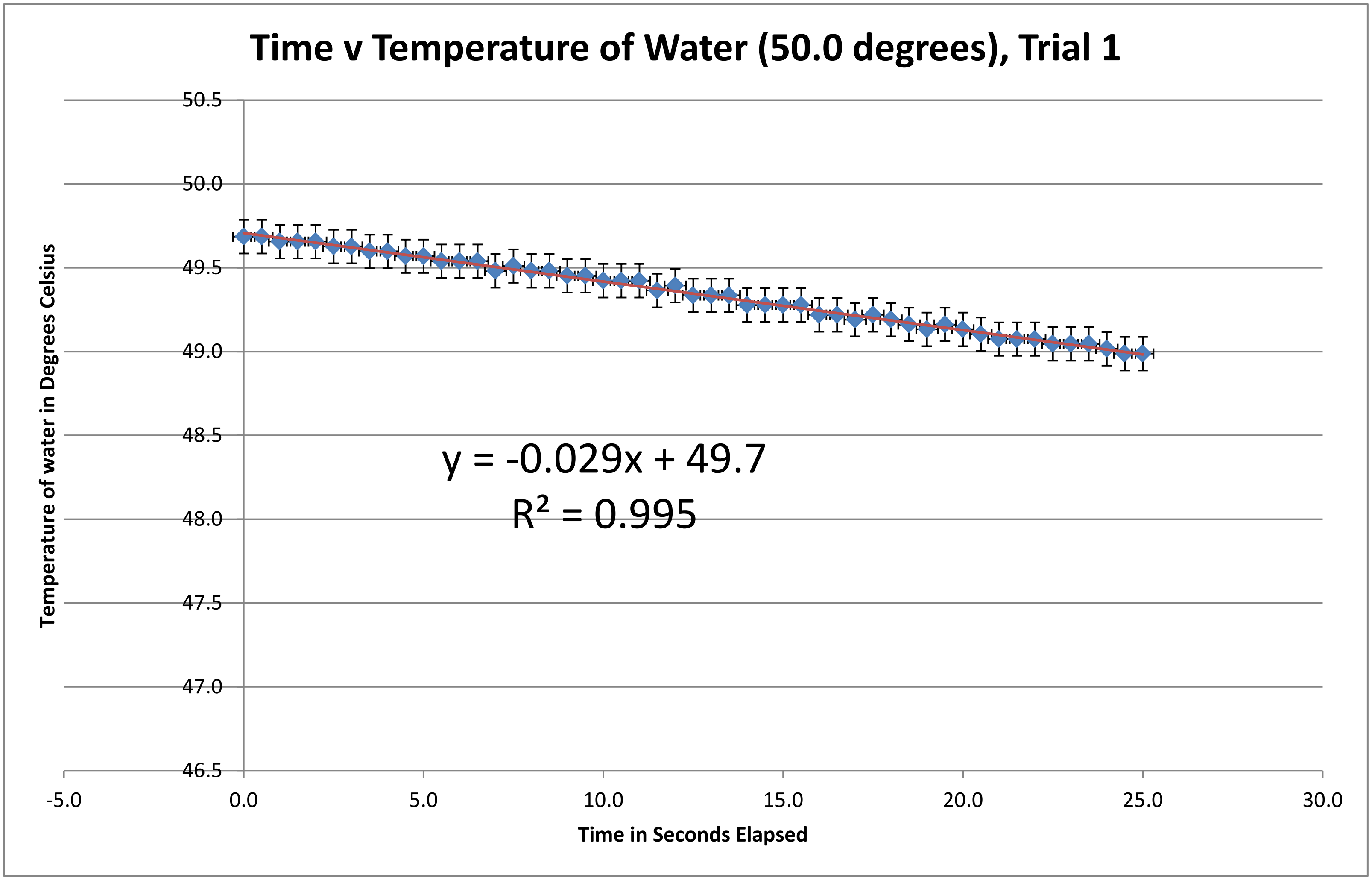

Time v Temperature of Water (60.0 degrees), Trial 4
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
y = -0.041x + 59.4
R² = 0.997

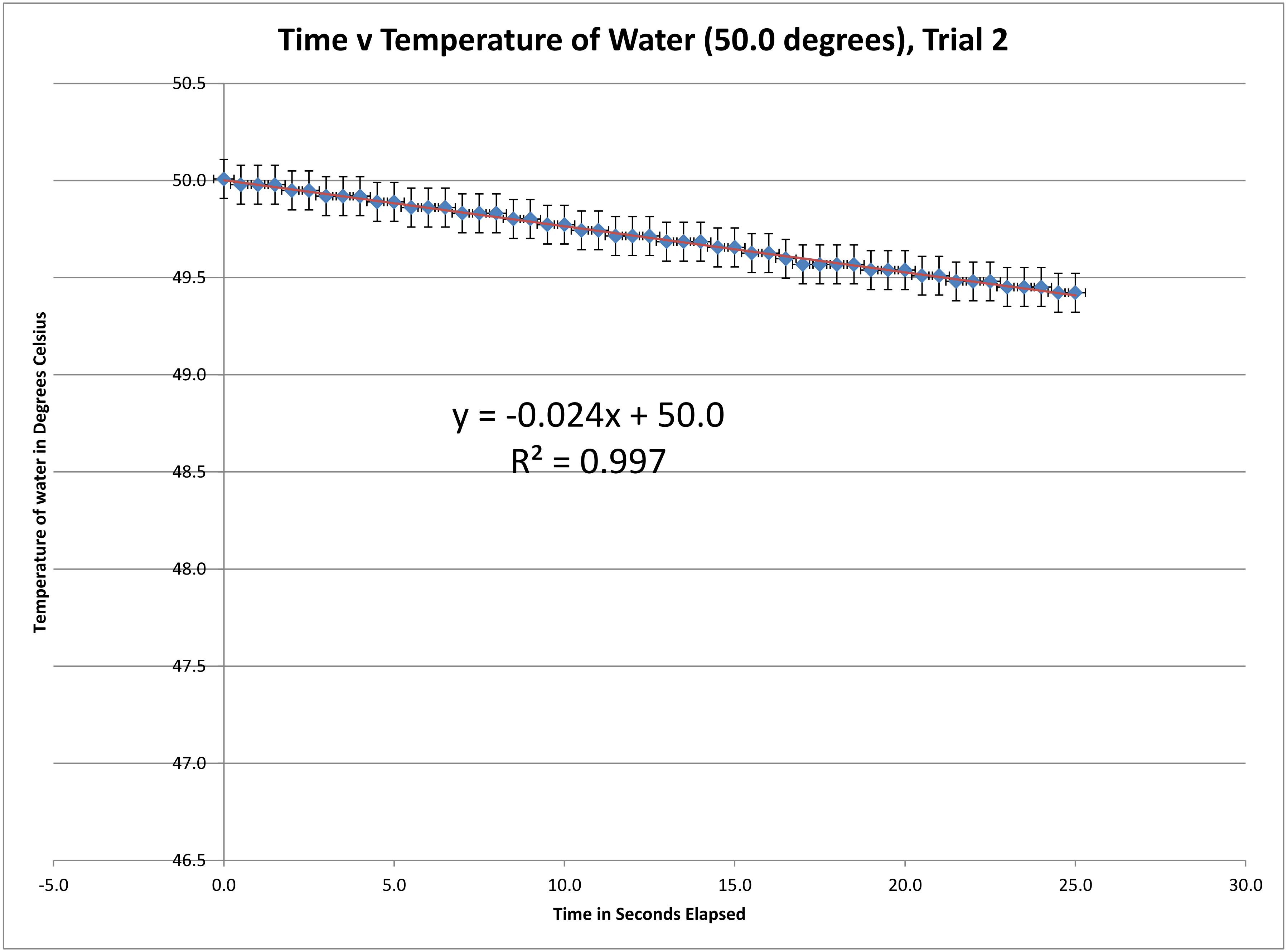

Time v Temperature of Water (60.0 degrees), Trial 5
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
60.5
60.0
59.5
59.0
58.5
58.0
57.5
57.0
56.5
56.0
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
y = -0.041x + 60.0
R² = 0.994

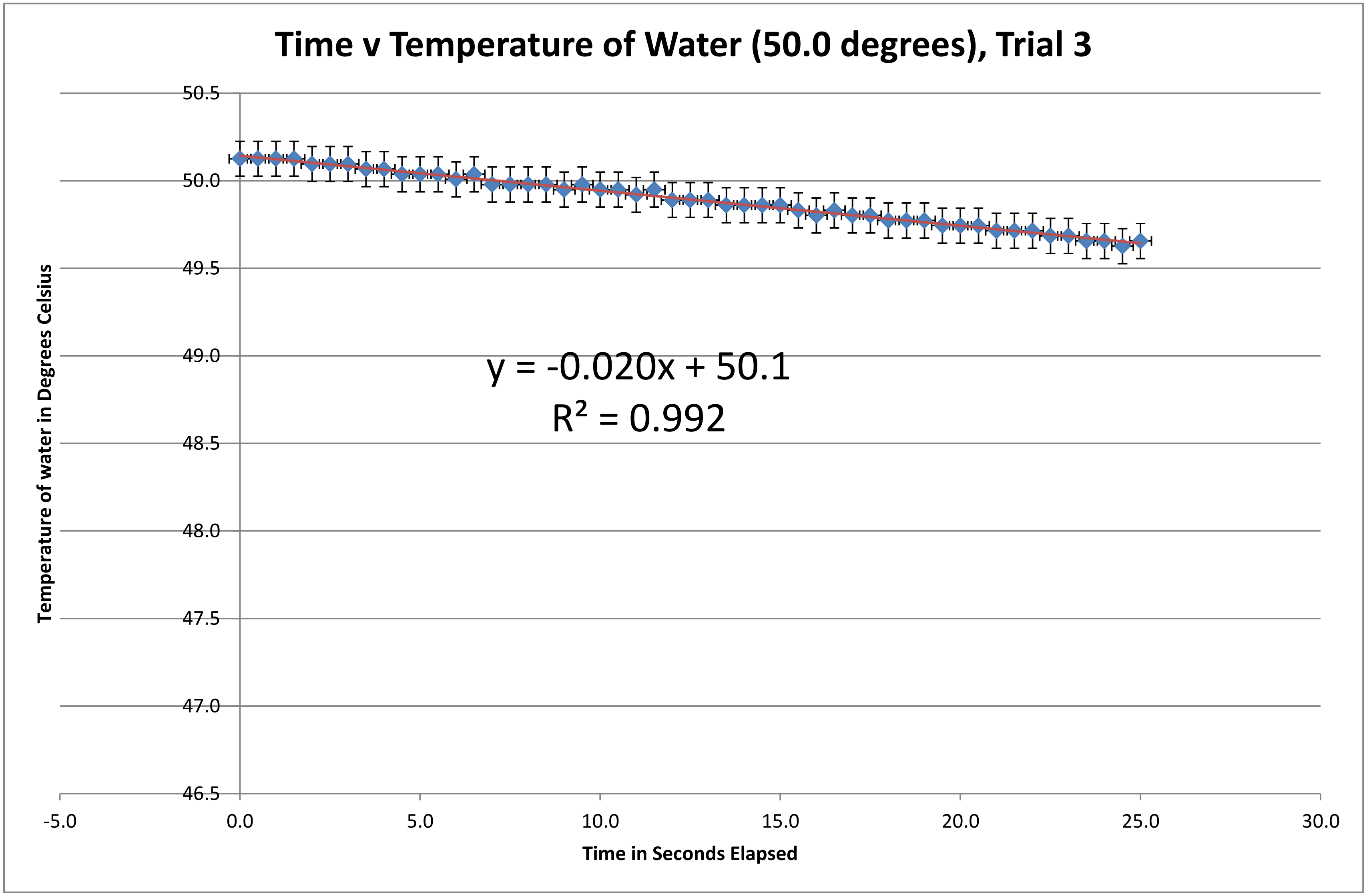
Appendix IV: 50 degrees Celsius Data:

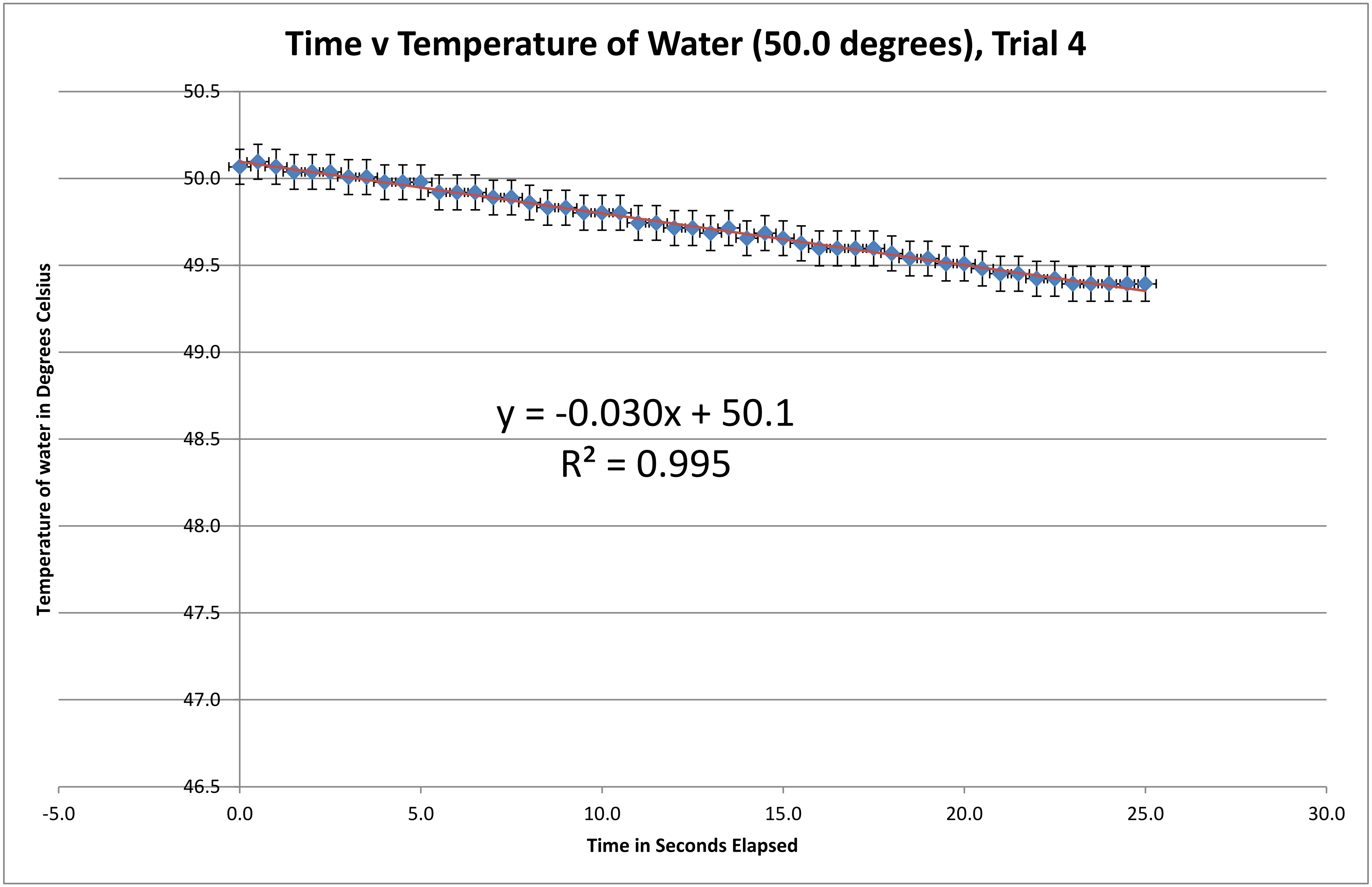
Cooling of Water with Initial Temp of 50.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	49.7	50.0	50.1	50.1	50.3
0.5	49.7	50.0	50.1	50.1	50.3
1.0	49.7	50.0	50.1	50.1	50.3
1.5	49.7	50.0	50.1	50.0	50.3
2.0	49.7	49.9	50.1	50.0	50.3
2.5	49.6	49.9	50.1	50.0	50.3
3.0	49.6	49.9	50.1	50.0	50.3
3.5	49.6	49.9	50.1	50.0	50.3
4.0	49.6	49.9	50.1	50.0	50.3
4.5	49.6	49.9	50.0	50.0	50.3
5.0	49.6	49.9	50.0	50.0	50.3
5.5	49.5	49.9	50.0	49.9	50.3
6.0	49.5	49.9	50.0	49.9	50.3
6.5	49.5	49.9	50.0	49.9	50.3
7.0	49.5	49.8	50.0	49.9	50.2
7.5	49.5	49.8	50.0	49.9	50.3
8.0	49.5	49.8	50.0	49.9	50.3
8.5	49.5	49.8	50.0	49.8	50.3
9.0	49.5	49.8	49.9	49.8	50.3
9.5	49.5	49.8	50.0	49.8	50.3
10.0	49.4	49.8	49.9	49.8	50.3
10.5	49.4	49.7	49.9	49.8	50.3
11.0	49.4	49.7	49.9	49.7	50.3
11.5	49.4	49.7	49.9	49.7	50.3
12.0	49.4	49.7	49.9	49.7	50.3
12.5	49.3	49.7	49.9	49.7	50.3
13.0	49.3	49.7	49.9	49.7	50.3
13.5	49.3	49.7	49.9	49.7	50.3
14.0	49.3	49.7	49.9	49.7	50.2
14.5	49.3	49.7	49.9	49.7	50.2
15.0	49.3	49.7	49.9	49.7	50.2

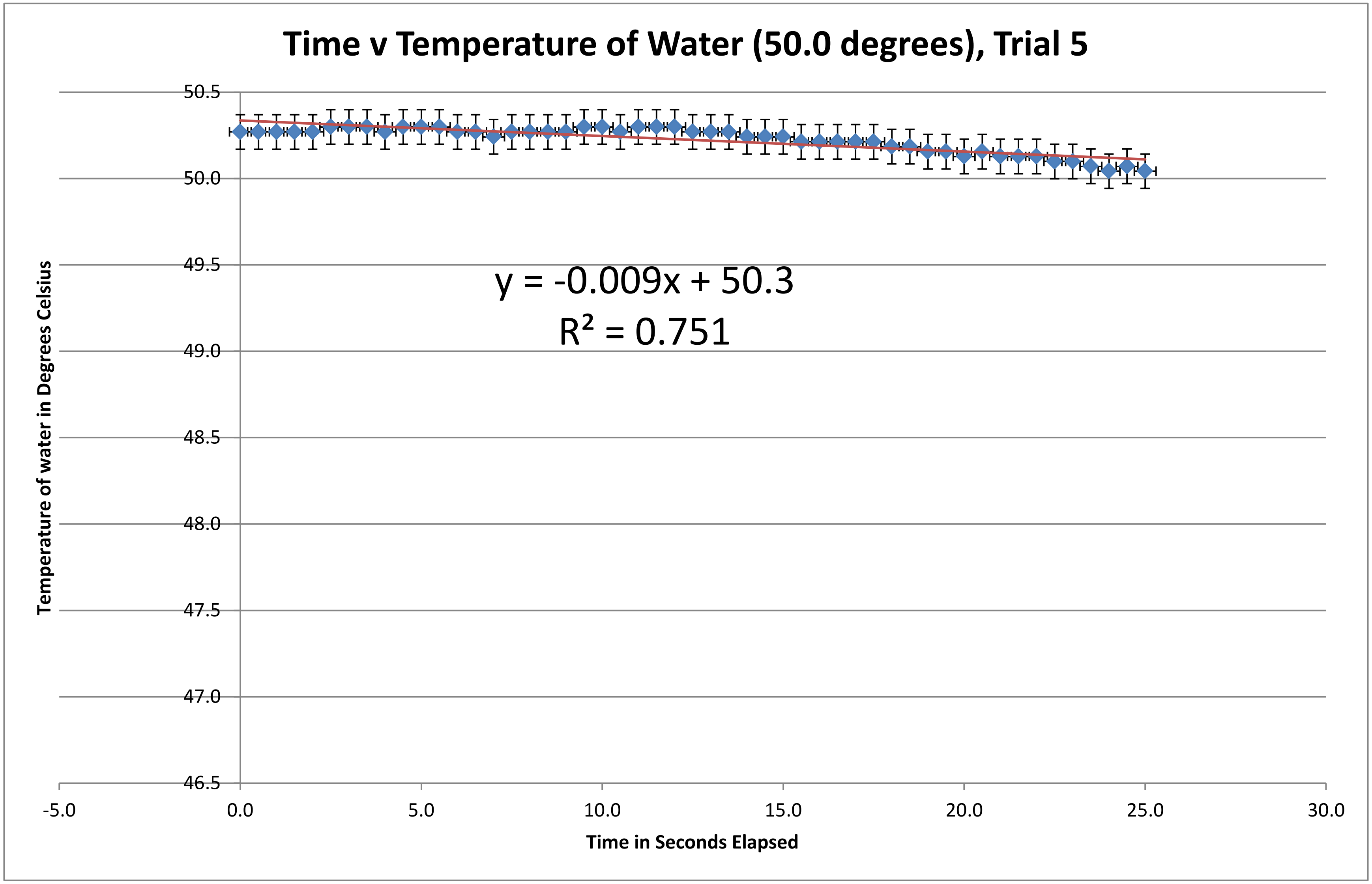
Cooling of Water with Initial Temp of 50.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
15.5	49.3	49.6	49.8	49.6	50.2
16.0	49.2	49.6	49.8	49.6	50.2
16.5	49.2	49.6	49.8	49.6	50.2
17.0	49.2	49.6	49.8	49.6	50.2
17.5	49.2	49.6	49.8	49.6	50.2
18.0	49.2	49.6	49.8	49.6	50.2
18.5	49.2	49.6	49.8	49.5	50.2
19.0	49.1	49.5	49.8	49.5	50.2
19.5	49.2	49.5	49.7	49.5	50.2
20.0	49.1	49.5	49.7	49.5	50.1
20.5	49.1	49.5	49.7	49.5	50.2
21.0	49.1	49.5	49.7	49.5	50.1
21.5	49.1	49.5	49.7	49.5	50.1
22.0	49.1	49.5	49.7	49.4	50.1
22.5	49.0	49.5	49.7	49.4	50.1
23.0	49.0	49.5	49.7	49.4	50.1
23.5	49.0	49.5	49.7	49.4	50.1
24.0	49.0	49.5	49.7	49.4	50.0
24.5	49.0	49.4	49.6	49.4	50.1
25.0	49.0	49.4	49.7	49.4	50.0


Time v Temperature of Water (50.0 degrees), Trial 1
Temperature of water in Degrees Celsius
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed
y = -0.029x + 49.7
R² = 0.995


Time v Temperature of Water (50.0 degrees), Trial 2
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
Temperature of water in Degrees Celsius
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed
y = -0.024x + 50.0
R² = 0.997


Time v Temperature of Water (50.0 degrees), Trial 3
y = -0.020x + 50.1
R² = 0.992
Temperature of water in Degrees Celsius
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

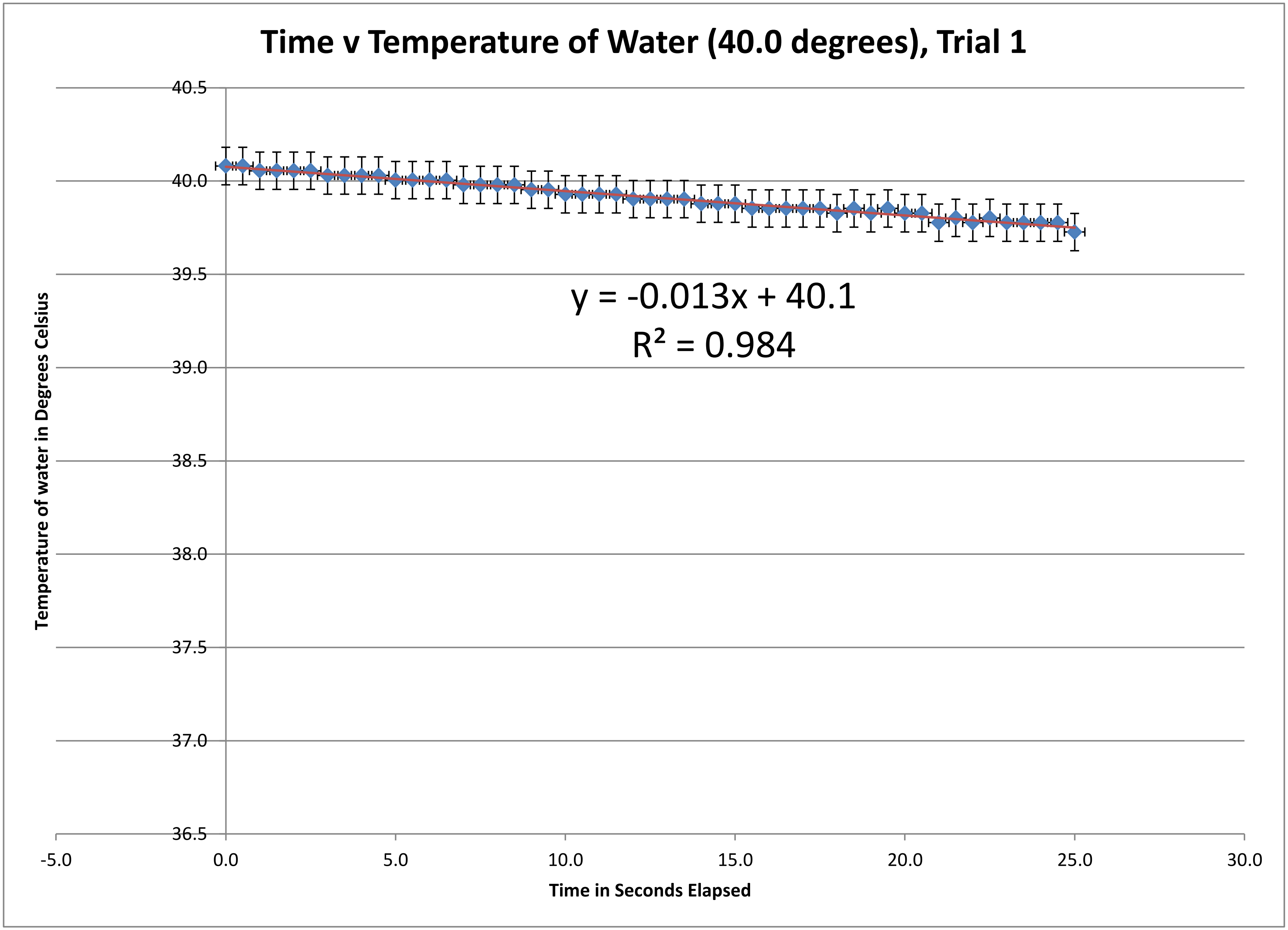

Time v Temperature of Water (50.0 degrees), Trial 4
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
y = -0.030x + 50.1
R² = 0.995

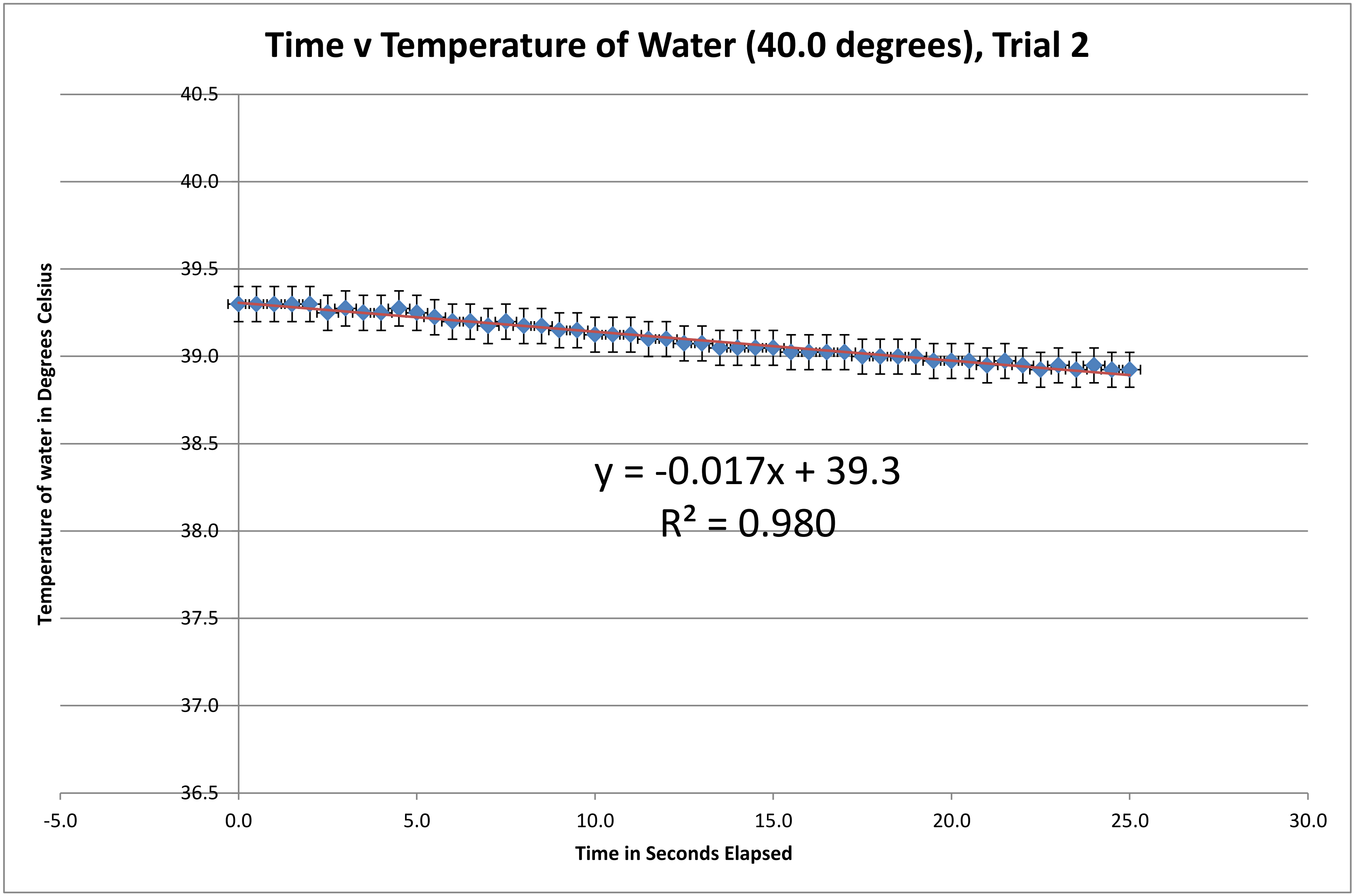

Time v Temperature of Water (50.0 degrees), Trial 5
y = -0.009x + 50.3
R² = 0.751
Temperature of water in Degrees Celsius
50.5
50.0
49.5
49.0
48.5
48.0
47.5
47.0
46.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed

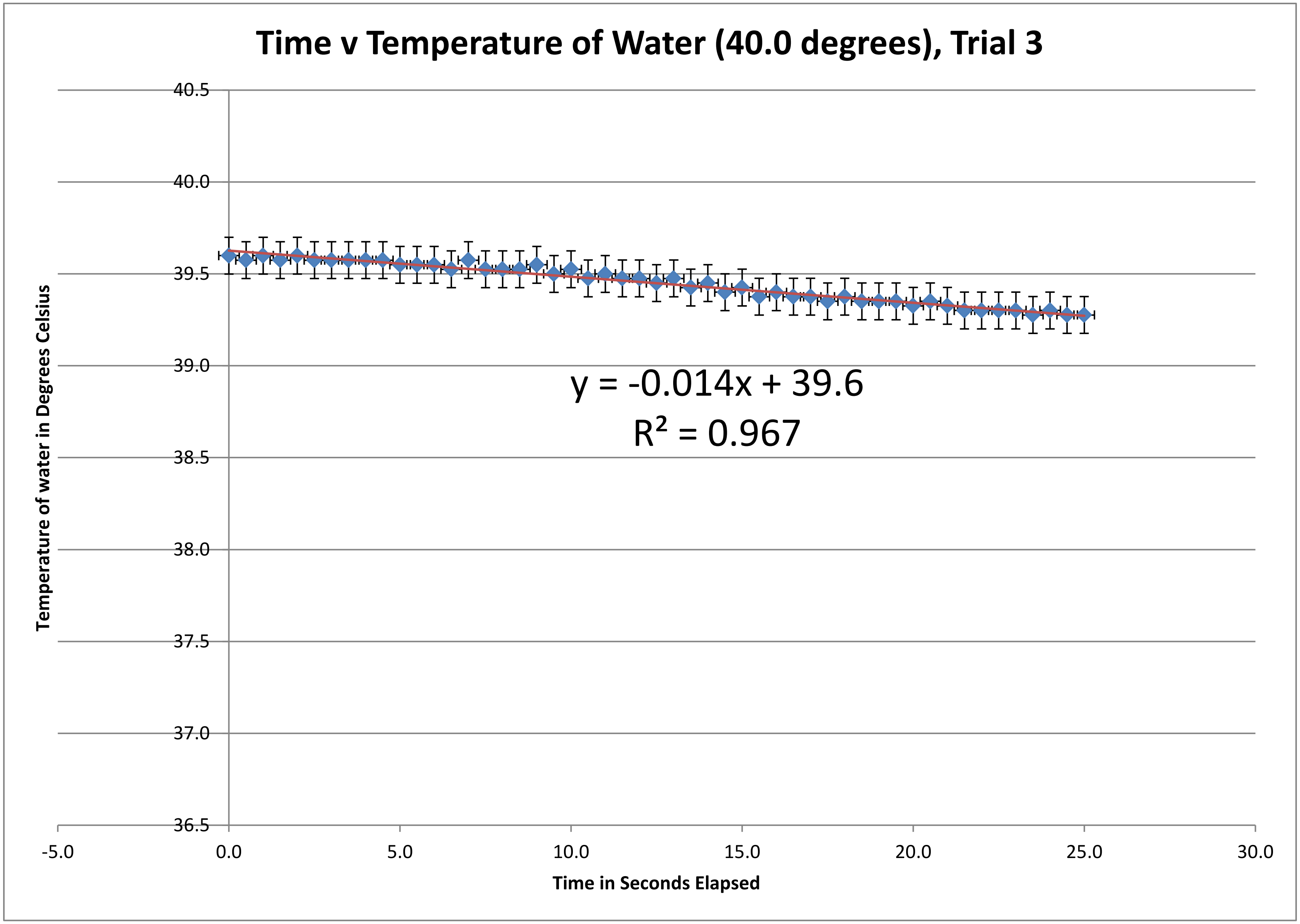
Appendix V: 40 degrees Celsius Data:

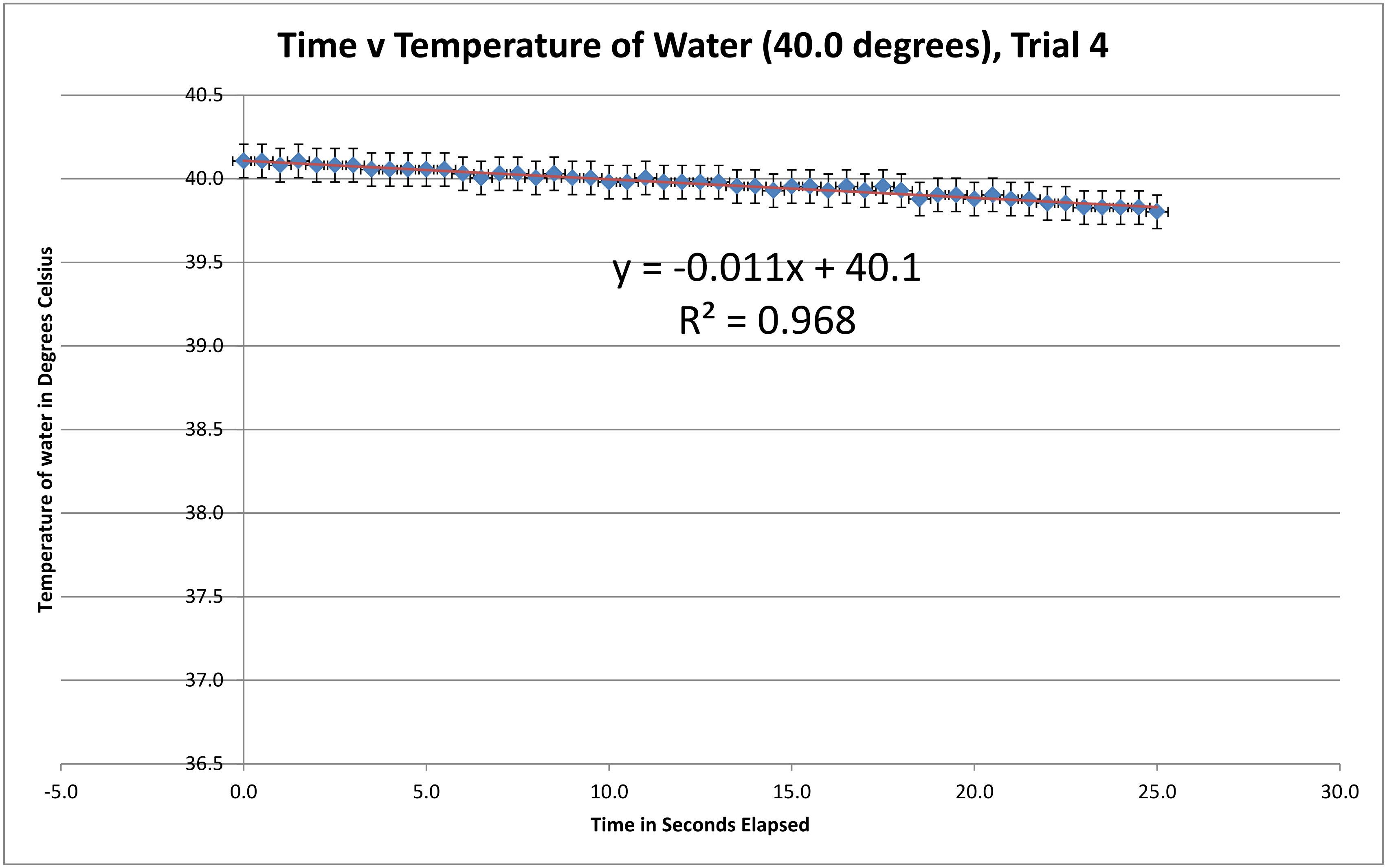
Cooling of Water with Initial Temp of 40.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
0.0	40.1	39.3	39.6	40.1	39.7
0.5	40.1	39.3	39.6	40.1	39.7
1.0	40.1	39.3	39.6	40.1	39.7
1.5	40.1	39.3	39.6	40.1	39.7
2.0	40.1	39.3	39.6	40.1	39.8
2.5	40.1	39.2	39.6	40.1	39.7
3.0	40.0	39.3	39.6	40.1	39.8
3.5	40.0	39.2	39.6	40.1	39.7
4.0	40.0	39.2	39.6	40.1	39.8
4.5	40.0	39.3	39.6	40.1	39.8
5.0	40.0	39.2	39.5	40.1	39.7
5.5	40.0	39.2	39.5	40.1	39.7
6.0	40.0	39.2	39.5	40.0	39.8
6.5	40.0	39.2	39.5	40.0	39.8
7.0	40.0	39.2	39.6	40.0	39.8
7.5	40.0	39.2	39.5	40.0	39.8
8.0	40.0	39.2	39.5	40.0	39.8
8.5	40.0	39.2	39.5	40.0	39.7
9.0	40.0	39.1	39.5	40.0	39.7
9.5	40.0	39.1	39.5	40.0	39.7
10.0	39.9	39.1	39.5	40.0	39.7
10.5	39.9	39.1	39.5	40.0	39.7
11.0	39.9	39.1	39.5	40.0	39.7
11.5	39.9	39.1	39.5	40.0	39.7
12.0	39.9	39.1	39.5	40.0	39.7
12.5	39.9	39.1	39.4	40.0	39.7
13.0	39.9	39.1	39.5	40.0	39.7
13.5	39.9	39.0	39.4	40.0	39.7
14.0	39.9	39.0	39.4	40.0	39.7
14.5	39.9	39.0	39.4	39.9	39.7
15.0	39.9	39.0	39.4	40.0	39.7

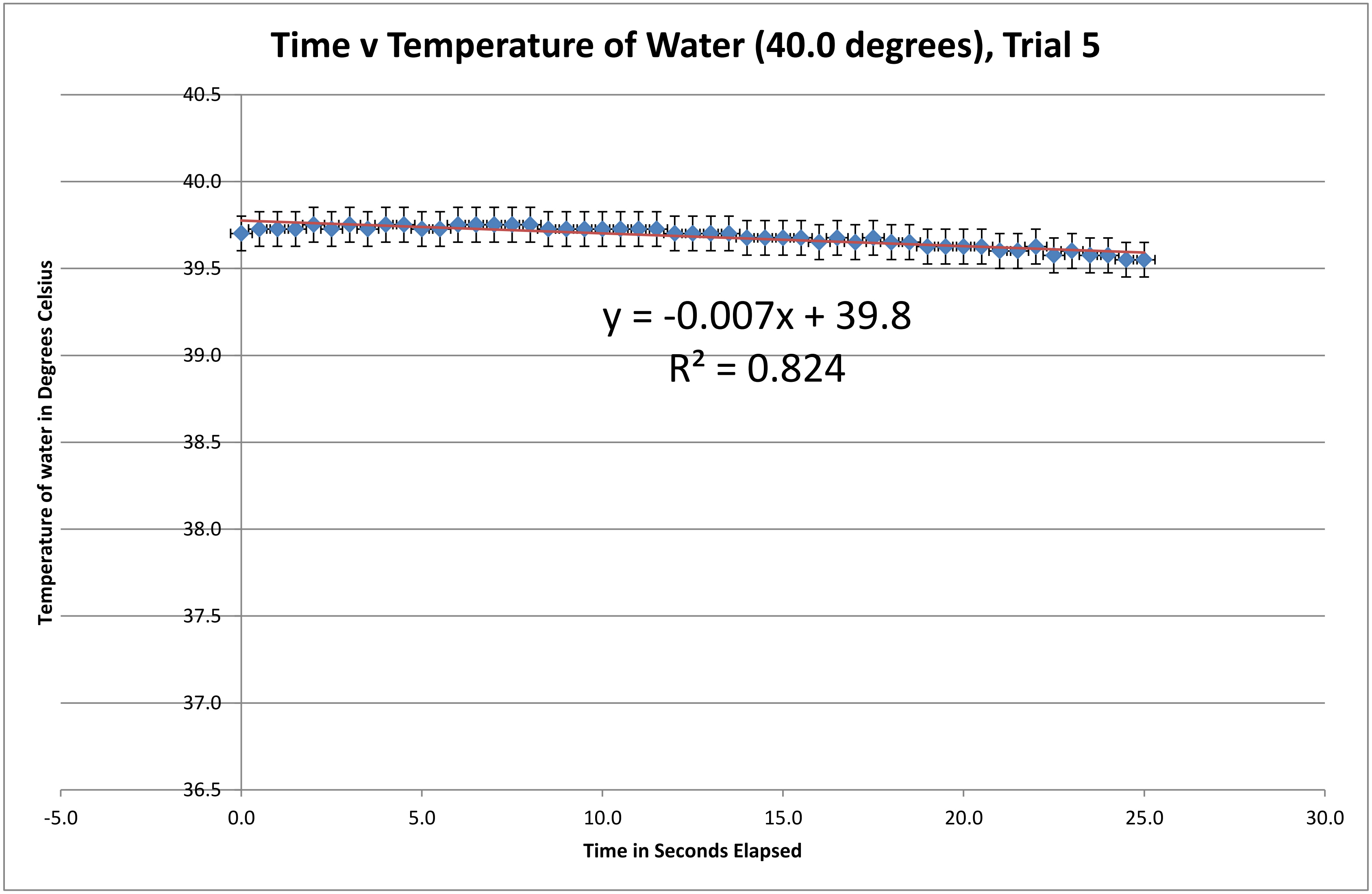
Cooling of Water with Initial Temp of 40.0 degrees Celsius					
	Temperature (±0.1 degrees Celsius)				
Time Elapsed (±0.3 s)	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5
15.5	39.9	39.0	39.4	40.0	39.7
16.0	39.9	39.0	39.4	39.9	39.7
16.5	39.9	39.0	39.4	40.0	39.7
17.0	39.9	39.0	39.4	39.9	39.7
17.5	39.9	39.0	39.4	40.0	39.7
18.0	39.8	39.0	39.4	39.9	39.7
18.5	39.9	39.0	39.4	39.9	39.7
19.0	39.8	39.0	39.4	39.9	39.6
19.5	39.9	39.0	39.4	39.9	39.6
20.0	39.8	39.0	39.3	39.9	39.6
20.5	39.8	39.0	39.4	39.9	39.6
21.0	39.8	38.9	39.3	39.9	39.6
21.5	39.8	39.0	39.3	39.9	39.6
22.0	39.8	38.9	39.3	39.9	39.6
22.5	39.8	38.9	39.3	39.9	39.6
23.0	39.8	38.9	39.3	39.8	39.6
23.5	39.8	38.9	39.3	39.8	39.6
24.0	39.8	38.9	39.3	39.8	39.6
24.5	39.8	38.9	39.3	39.8	39.6
25.0	39.7	38.9	39.3	39.8	39.6


Time v Temperature of Water (40.0 degrees), Trial 1
y = -0.013x + 40.1
R² = 0.984
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0


Time v Temperature of Water (40.0 degrees), Trial 2
Temperature of water in Degrees Celsius
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed
y = -0.017x + 39.3
R² = 0.980


Time v Temperature of Water (40.0 degrees), Trial 3
Temperature of water in Degrees Celsius
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Time in Seconds Elapsed
y = -0.014x + 39.6
R² = 0.967


Time v Temperature of Water (40.0 degrees), Trial 4
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
y = -0.011x + 40.1
R² = 0.968


Time v Temperature of Water (40.0 degrees), Trial 5
Temperature of water in Degrees Celsius
Time in Seconds Elapsed
40.5
40.0
39.5
39.0
38.5
38.0
37.5
37.0
36.5
-5.0
0.0
5.0
10.0
15.0
20.0
25.0
30.0
y = -0.007x + 39.8
R² = 0.824

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