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Part 1: Solving the equation thermistor equation,

$$R = R_o e^{\beta\left(\frac{1}{T}-\frac{1}{T_o}\right)},$$

for R_o and β.

Original Equation:

$$R = R_o e^{\beta\left(\frac{1}{T}-\frac{1}{T_o}\right)}$$

Table of Values:

$R_1(\Omega)$	$R_2(\Omega)$	$T_1(K)$	$T_2(K)$	$T_o(K)$	$\beta(K)$	$R_o(\Omega)$
$29.95 * 10^3$	854	273.15	373.15	298.15	3601	9915

Using initial conditions of T_1, R_1 solve the equation for R_o:

$$R_1 = R_o e^{\beta\left(\frac{1}{T_1}-\frac{1}{T_o}\right)}$$

Rearrange to find:

$$R_o = \frac{R_1}{e^{\beta\left(\frac{1}{T_1}-\frac{1}{T_o}\right)}}$$

Rewrite equation for second conditions T_2, R_2:

$$R_2 = R_o e^{\beta\left(\frac{1}{T_2}-\frac{1}{T_o}\right)}$$

Substitute R_o with the first equation:

$$R_2 = \frac{R_1 e^{\beta\left(\frac{1}{T_2}-\frac{1}{T_o}\right)}}{e^{\beta\left(\frac{1}{T_1}-\frac{1}{T_o}\right)}}$$

Simplify:

$$R_2 = \frac{R_1 e^{\beta\left(\frac{1}{T_2}\right)} e^{-\beta\left(\frac{1}{T_0}\right)}}{e^{\beta\left(\frac{1}{T_1}\right)} e^{-\beta\left(\frac{1}{T_0}\right)}}$$

$$\frac{R_2}{R_1} = \frac{e^{\beta\left(\frac{1}{T_2}\right)}}{e^{\beta\left(\frac{1}{T_1}\right)}}$$

$$\ln\left(\frac{R_2}{R_1}\right) = \ln\left(\frac{e^{\beta\left(\frac{1}{T_2}\right)}}{e^{\beta\left(\frac{1}{T_1}\right)}}\right)$$

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$$\ln\left(\frac{R_2}{R_1}\right) = ln\left(e^{\beta\left(\frac{1}{T_2}\right)}\right) - ln\left(e^{\beta\left(\frac{1}{T_1}\right)}\right)$$

$$\ln\left(\frac{R_2}{R_1}\right) = \beta\left(\frac{1}{T_2} - \frac{1}{T_1}\right)$$

Final equation for β:

$$\beta = \frac{\ln\left(\frac{R_2}{R_1}\right)}{\left(\frac{1}{T_2} - \frac{1}{T_1}\right)}$$

Now that β is known the equation for R_o, can be solved for a value:

$$R_o = \frac{R_1}{e^{\beta\left(\frac{1}{T_1} - \frac{1}{T_o}\right)}}$$

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Part 2: Statistics of Ice Bath

Table of Ice Bath Data (Measurements are in mV):

15.35	27.17	28.56	28.54	28.03	28.05	27.67	29.39	30.26	27.86

Temperature of ice bath is approximately 273K.

0mV corresponds to 0 °C.

By reading the chart given by the amplifiers manufacturer the actual temperatures measured by the thermocouple can be approximated by a linear interpolation.

The measured temperatures of the ice bath, in Celsius, was found to be:

1.251℃	2.459℃	2.601℃	2.599℃	2.547℃	2.549℃	2.510℃	2.685℃	2.774℃	2.529℃

With a resolution of only $\pm.1$℃ the maximum decimal places that could be accurately measured are 2.

The mean of the sample, $\bar{x}$, can be calculated by the equation:

$$\bar{x} = \frac{\sum_{i=1}^{n} x_i}{n}$$

Where n is the number of samples taken and is equal to 10.

$$\bar{x} = 2.4503℃$$

The standard deviation of the data, σ, is calculated with the equation:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n}[x_i - \bar{x}]^2}{n-1}}$$

$$\sigma = 0.4309℃$$

Determine t value from table

$$t_{v,P} = t_{9,95} = 2.262$$

Determine standard deviation of the mean:

$$s_x = \frac{\sigma}{\sqrt{N}} = 0.1363$$

Determine population mean:

$$x' = \bar{x} \pm t_{v,P} s_x = 2.7585℃, 2.1420℃$$

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Final Values for Time Constants (τ) and Deviation of the Best Fit Lines (S_{yx}):

	Bare Wire Boil to Ice	Bare Wire Ice to Boil	Embedded Stainless Boil to Ice	Embedded Stainless Boil to Ice	Embedded Aluminum Boil to Ice	Embedded Aluminum Ice to Boil
Tau: 5 Standard Deviations and Gamma Method (s)	0.199	0.084	7.830	5.170	2.560	6.210
Tau: Max Slope and Gamma Method (s)	0.191	0.058	7.480	5.010	2.460	6.550
Tau: 5 Standard Deviations and .632 Method (s)	0.745	0.300	11.600	7.790	4.750	3.360
Tau: Max Slope and .632 Method (s)	0.046	0.052	10.400	6.090	4.290	2.970
Syx: 5 Standard Deviations and Gamma Method (°C)	19.400	15.200	7.570	7.790	7.680	9.580
Syx: Max Slope and Gamma Method (°C)	5.570	0.564	4.610	2.460	5.850	9.620
Syx: 5 Standard Deviations and .632 Method (°C)	14.100	8.900	6.710	7.790	4.050	4.040
Syx: Max Slope and .632 Method (°C)	0.432	0.352	1.310	0.659	2.420	1.090