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ISIM Fall 2018

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Coffee Lab

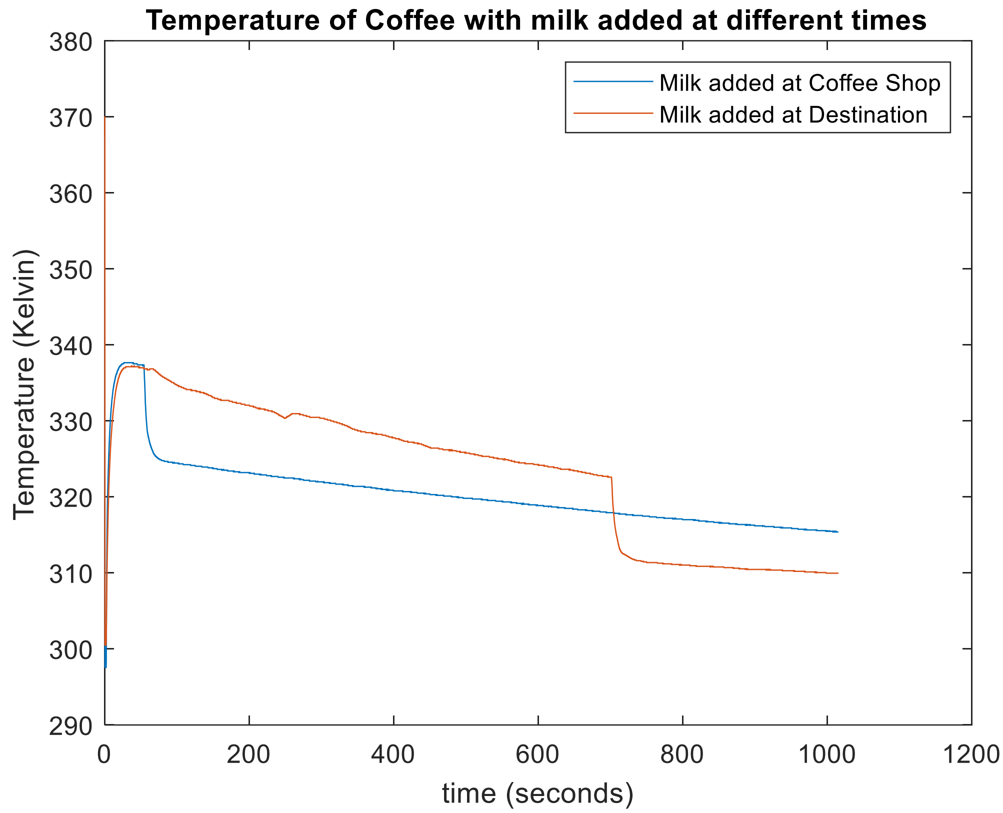


Figure 1: The figure above shows the relation between the temperatures of a cup of coffee as affected by adding milk at different times.

The results were found by measured the temperature of two cups of water. The first cup was used to simulate the milk being added at the coffee shop, while a second was used to simulate milk being added at the destination. The cups started off with 146mL and 134 mL, respectively. The milk was simulated by adding 40 mL of ice water.

The temperature was measured with the use of a thermistor set up as the second resistor in a voltage divider setup. The voltage drop across the thermistor was then converted into a measurement of temperature with the use of the following equations:

$$T = \frac{1}{\frac{1}{298} + \frac{\ln\left(R/_{1000}\right)}{3528}}$$

$$R = \frac{1000 \times V_{out}}{V_{in} - V_{out}}$$

The plot was obtained by using these two equations which are derived on the attached page.

In response the original prompt, it would appear that it is a much better idea to add milk to one's coffee while at the coffee shop as it will result in hotter coffee when one reaches their place of work.

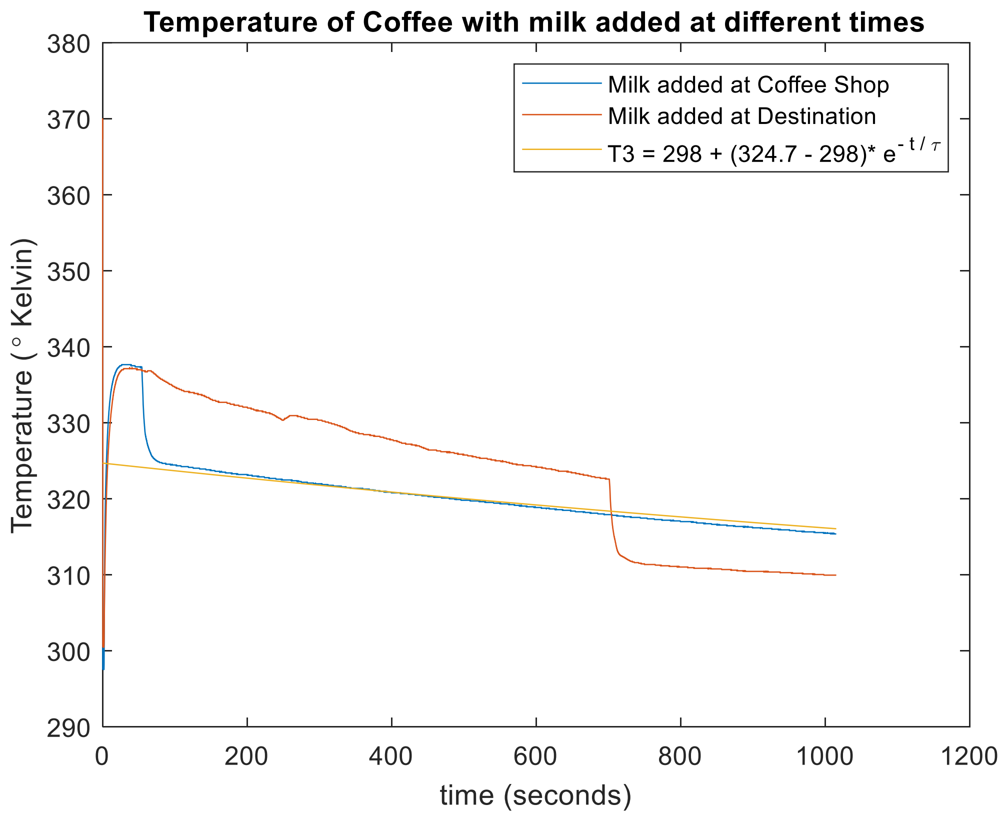


Figure 2: This figure shows an exponential decay curve (T3) fitted to the temperature curve of milk added at the coffee shop. The value of τ was found to be approximately 2600.

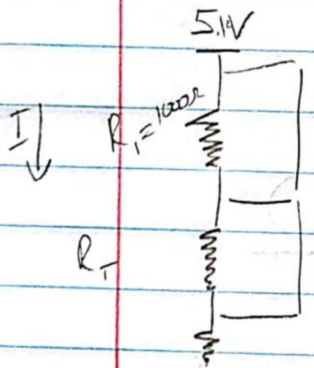
Thermistor

$R = 1000\Omega\, e^{-3528(1/298 - 1/T)}$

$\ln\left(\frac{R_T}{1000\Omega}\right) = -3528\left(1/298 - 1/T\right)$

$1/298 + \frac{\ln(R_T/1000\Omega)}{3528} = 1/T$

$T = 1/\left(1/298 + \ln(R_T/1000\Omega)/3528\right)$



$\Delta V_1 = 5.19 - \Delta V_2$ $\qquad I = \frac{\Delta V_1}{R_1}$

$\Delta V_2 = \Delta V_2$ $\qquad I = \frac{\Delta V_2}{R_T}$

$\frac{5.19 - \Delta V_2}{1000\Omega} = \frac{\Delta V_2}{R_T}$

$R_T = \frac{\Delta V_2 \cdot 1000\Omega}{5.19 - \Delta V_2}$

$T = 1/\left(1/298 + \ln(R_T/1000\Omega)/3528\right)$

$R_T = (\Delta V_2 \cdot 1000)/(5.19 - \Delta V_2$