**Practice Question 2: Modeling a Non-periodic Context**

2. The temperature of Shania’s butternut squash soup when it is first removed from the stove $(t=0)$ is 185˚ Fahrenheit. Ten minutes later $(t=10)$, Shania uses a thermometer to determine that the temperature of the soup has cooled to 130˚ Fahrenheit.

 The temperature of Shania’s bowl of soup can be modeled by the function $S$ given by

$S\left(t\right)=ab^{t}+72$, where $S(t)$ is the temperature of the soup, in degrees Fahrenheit (˚F), and $t$ is the number of minutes since the soup was removed from the stove.

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| (A) | (i) | Use the given data to write two equations that can be used to find the values for constants $a$ and $b$ in the expression for $S(t)$. |
| (ii) | Find the values of $a$ and $b$ as decimal approximations. |
| (B) | (i) | Use the given data to find the average rate of change of the temperature of the soup, in degrees Fahrenheit per minute, from $t=0$ to $t=10$. Express your answer as a decimal approximation. Show the computations that lead to your answer. |
| (ii) | Use the average rate of change found in (i) to estimate the temperature of the soup when $t=8$. Show the work that leads to your answer. |
|  | (iii) | The average rate of change calculated in part (i) can be used to estimate the temperature of the soup at time $t$ for values of $t$ between $t=0$ and $t=10$. Will the values estimated using the average rate of change be strictly greater than, strictly less than, or sometimes greater and sometimes less than the values predicted by the model, $S$, for $0\leq t\leq 10$? Explain why this is the case.  |
| (C) | According to the model, the temperature of the soup will always exceed a certain temperature, $M$, which corresponds to the temperature of the room in which the soup is cooling. In other words, $S\left(t\right)>M$ for all $t$. However, Shania finishes her soup by the time the soup’s temperature has cooled to 10˚ Fahrenheit above the room temperature, $M$. Explain how this information could be used to determine an appropriate domain for $S$ based on the context. |