Math 2414

Calculus II

Lab Exercise # 1

Name ____________ Date _______________

Section # _________ Semester ___________

Attach the computer printouts to this sheet.

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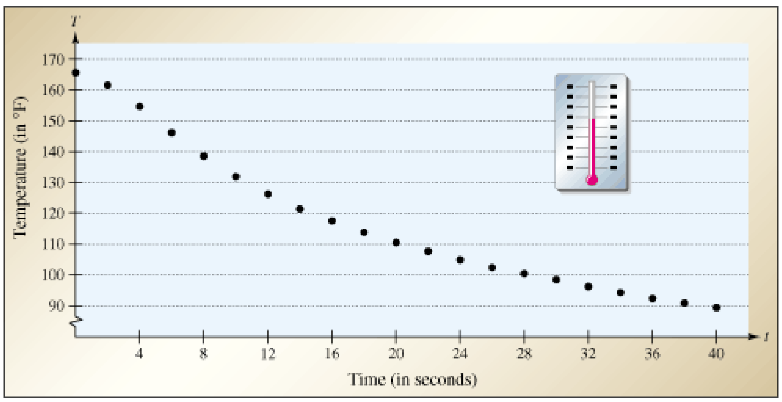
1) What type of equation would model this data.
2) Give a reasonable explanation.
3) What would the derivative look like. You should graph it.
4) Start with the following differential equation. $\frac{dy}{dt} = k(y - 69.55)$. To Solve for c use the fact that when t=0, y= 165.58. To solve for k use t (20) where y = 110. Put your answer in the form y = .

Plastics and Cooling

What do Corvette fenders, panty hose, and garbage bags have in common? They are all made of plastic. The Greek word *plastikos*, meaning “able to be shaped,” was modified to name the most versatile family of materials ever created. Plastic was created when Leo Hendrik Baekeland attempted to create a shellac by combining phenol and formaldehyde. The experiment “failed” in that it did not result in shellac, but it did form the first completely synthetic plastic resin. Since Bakelite was introduced in 1909, the plastics industry has steadily expanded to the point where today, plastics are used in nearly every aspect of our daily lives.

Several methods are used to shape plastic products, one of the most common being to pour hot, syrupy *plastic resin* into a mold or cast. Plastic resin is produced in very small pieces that are easy to heat to a liquid state. The temperature of the molten resin is over 300°F. The mold is then cooled in a chiller system that is kept at 58°F before the part is ejected from the mold. To minimize the cost, it helps to eject the parts quickly, allowing the mold to be reused as soon as possible. Yet ejecting the part when it is too hot can cause warping or punctures. The rate at which objects cool is therefore of great interest.

To illustrate the rate of cooling, the *Texas Instruments Calculator-Based Laboratory (CBL) System* was used to measure the temperature of a cup of water over a 40-second period. The room temperature was measured at 69.55°F, and the water temperature at time $t = 0$ was measured at 165.58°F. The results are shown in the following scatter plot.



QUESTIONS

1. Describe the pattern of the temperature points over time. Does the *rate* at which the temperature changes seem to increase, decrease, or remain constant?

2. Imagine a curve running through the data points. How would you expect the curve to behave as the value of t increases? Would you expect the curve to intersect the line $T = 69.55$? Explain your reasoning.

3. Would the derivative of a function modeling the data points be increasing, decreasing, or constant? Explain your reasoning.

4. The data in the scatter plot can be modeled using a function of the form

   $$T = a \cdot b^t + c.$$

   Find values of a, b, and c that produce a reasonable model.

The concepts presented here will be explored further in this chapter. For an extension of this application, select the Calculus Lab button.

Calculus Lab