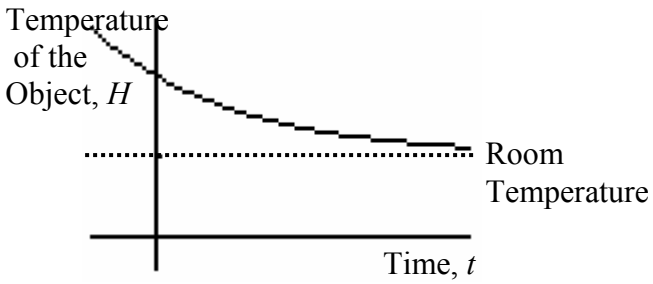
WR 8: Dead Body Simulation Due 11-13-06 Name_____

Sir Isaac Newton did more than give us the Laws of Motion, but the Law of Cooling as well.

Newton's Law of Cooling:

The closer an object gets to room temperature, the slower it cools.



If room temperature remains constant, coroners can use Newton's Law of Cooling to estimate the time of death. We will investigate what kind of mathematical equation obeys this law by collecting the temperature of a heated probe as it cools to room temperature.

Group # _____

Names in Group _____

1. Use the CBL2 and a temperature probe to collect the room temperature.
   Report with appropriate units: _____

2. Set up the CBL2 so that it collects data for a temperature run for a few minutes.
   DO NOT start the data collection yet. First, immerse the temperature probe in a cup of hot water for a minute. When the probe is nice and hot, remove it from the cup. Then start collecting data. Exit the Datamate APP.

3. In the Y= Editor enter the room temperature in Y2. (Y1 is reserved for something else.)

   Change your viewing window so that Ymin = 0. Press GRAPH.
   Recopy the graph screen of your *(time, temperature)* data from your graphing calculator along with the line showing room temperature:

(1) 4. Explain how this graph obeys Newton's Law of Cooling.

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_____

_____

5. Write an equation in Y1 which models the *(time, temperature)* data using

(1) a. A *Guess and Check* strategy:
Report one of your best guesses here: _____

(1) b. An *analytical* method (solving an equation using two points through which it passes):
Report your analytical solution here: _____
Show work below:
Two points used: (_____, _____) (_____, _____)

(1) 6. Can you use the regression features of the calculator to find an equation which models the data? If so, explain how. Compare the calculator's model with the ones you created in Question 5.

Using the catalogue feature, set Diagnositic On to get values for r^2 and r.
Report all of the digits of YOUR values of *a, b,* and *r* (for comparison later).

a = _____
b = _____
r = _____

7. In the previous question, you might have made a list containing the difference between the cooling data and the room temperature. If you haven't, do so in list L3.
Make list L4 to be the *natural logarithm* of list L3.
Plot L1 and L4 and use ZoomStat for the window.

(1) Recopy your screen.

Perform a linear regression on L1 and L4.
Compare *r* for the linear regression with the one for the exponential regression. Déjà vu?
Report all of the digits of YOUR values of *a, b,* and *r*.

a = _____
b = _____
r = _____

Calculate e^(*a*) and e^(*b*) of the line and report them below. Get *a* and *b* through **VARS 5:Statistics EQ**.
Report all of the digits of your calculations here.

$e^{\wedge}(a)$ = _____
$e^{\wedge}(b)$ = _____

(1) Compare with values in the previous question. What do you observe?

8. NCIS Director Jenny Shepard hosts a dinner party and needs a fine Amontillado for her guests. She opens the wine cellar (kept at a constant 55°F) only to find Jack the Butler sprawled on the floor, attacked by the dreaded Black Orphan Spider.

(1) (Much deadlier than its cousin, the Black Widow, this arachnid kills its victim instantly on the first bite.) Jenny pounds the spider into oblivion. Despite the wine cellar's temperature, the body is still warm! Fortunately, one of her guests has a rectal thermometer, a graphing calculator, and knows about Newton's Law of Cooling.

- At 8 p.m. the body is 85.2°F.
- One hour later (after dinner) the temperature of the body (still in the cooler), has cooled to 79.1°F.
- The temperature H of the (dead) body obeys the law $H = ab^t + c$, t in hours, H in °F.
- Assume Jack's body temperature was 98.6°F at the time of death.

(1) a. Construct an equation of H in terms of t. Check with a grapher.

(2) b. When did the black arachnid attack Jack for a snack?
Solve algebraically (using logs) and graphically.