

## CSI: RHS

Group Members: \_\_\_\_\_  
 \_\_\_\_\_  
 \_\_\_\_\_

You have just discovered a murder victim. You (somewhat illegally) decide to take it upon yourself to solve this crime.

Newton's Law of Cooling states that the rate of cooling of an object is proportional to the temperature difference between the object and its surroundings. By taking temperature readings of the object and the room (the "environment"), you are able to determine the time of the murder.

Things you need to know:

Time the body was found: \_\_\_\_\_  
 Temperature of the body at that time: \_\_\_\_\_  
 Surrounding Temperature: \_\_\_\_\_  
 Temperature of the body 30 minutes later: \_\_\_\_\_  
 (Remember the corpse gets colder as time elapses)  
 Assume normal body temperature to be 98.6°.



$$T(t) = T_E + (T_O - T_E)e^{-kt}$$

(This formula is used twice when solving these problems; follow the example from in class)

Project Requirements:

- You need to come up with a list of 4 suspects. Each has his/her own alibi that accounts for certain times of the day. Every suspect has some unaccounted time of the day in their alibi. Of course each suspect's unaccounted time should be different. Each suspect must have at least 3 different details in his/her alibi.

ex. Suspect 1: \_\_\_\_\_

Alibi detail 1: at school from 9:00 – 2:00

Alibi detail 2: seen at Starbucks 2:15 – 3:45

Alibi detail 3: home studying from 5:30 until bed time

Unaccounted time: **2:00 – 2:15 and 3:45 – 5:30**

- You will be presenting your project to your classmates on **Thursday, October 11<sup>th</sup>**.
- Each presentation must include some type of visual aids, such as power point, video, "evidence folder," etc. Be creative! (No posters please). All props must be school appropriate!!
- You will EACH turn in your project packet with the information listed in on page 1 (temperatures, times, etc.).
- You will use Newton's Law of Cooling to determine the time of death, thus solving your case. You must show all work from the formula, and you must include the name of the culprit.
- You must present your math in your presentation then reveal the name of the perpetrator
- You may not use any of the same combinations of numbers used in the examples. Do not use the alibi details given in our example. Your numbers must be unique from all of the other groups so I will give you the details from the crime scene.

This project will count as a QUIZ GRADE! Please follow all directions and deadlines. YOUR ENTIRE PROJECT MUST BE SCHOOL APPROPRIATE. If it is not, it will be sent to administration. Please ask questions. Please impress us with your creativity. Remember, it's a quiz grade! The project may be done with a group, however, **every person must turn in the page with your calculations.**

### Newton's Law of Cooling Example Question

**Solve the problem, showing all work! For your answer, I would like to know how many minutes prior to midnight the murder occurred, and then please give the approximate time of the murder.**

**You will need to solve the equation twice. First, use temperatures and time references you know (temperature at midnight and temperature later) in order to find  $k$ . Then, use that value of  $k$  and other temperatures (beginning temperature and temperature at midnight) to find  $t$ , time.**

Newton's Law of Cooling states that an object with temperature  $T_o$  in an environment with temperature  $T_E$  will have temperature  $T(t)$  after  $t$  minutes according to the following equation:

$$T(t) = T_E + (T_o - T_E)e^{-kt}.$$

A coroner arrives at the scene of a murder at 12:00 a.m. and immediately determines the temperature of the victim to be 93.6° F. Twenty minutes later, the temperature has fallen to 92.8° F. If the temperature of the room is 72° F, when was the murder committed? (Assume the victim's temperature at time of death was normal body temperature, 98.6° F.)

$k =$  \_\_\_\_\_

$t =$  \_\_\_\_\_

The murder occurred \_\_\_\_\_ minutes prior to midnight, which was approximately \_\_\_\_\_ a.m./p.m.

**For your project, please fill in the information provided, and use the facts to solve the mystery.**

Project name(s): \_\_\_\_\_

Brief description: \_\_\_\_\_

Time the body was found: \_\_\_\_\_

Surrounding Temperature: \_\_\_\_\_

Temperature of the body at that time:  
\_\_\_\_\_

Temperature of the body 30 minutes  
later: \_\_\_\_\_

4 suspects (include in visual & presentation)

- Details, motive, alibis, and unaccounted time

Work shown to determine time of death:

$k =$  \_\_\_\_\_

$t =$  \_\_\_\_\_

Therefore, the crime occurred at \_\_\_\_\_ (time),  
so the criminal was \_\_\_\_\_!

**Grading Rubric**

**Your project counts as a quiz grade. Your grade will be determined by the sum of the points given below:**

- \_\_\_\_\_ /40      Work (math)  
Math is correct, all work shown, suspect identified, turned in on correct due date
- \_\_\_\_\_ /28      Suspects (7 points each)  
Suspect identified, 3 details per suspect (1 point each),  
unaccounted time correct (2 points), visual for the suspect (2 pts)
- Suspects: 1 \_\_\_\_\_ 2 \_\_\_\_\_ 3 \_\_\_\_\_ 4 \_\_\_\_\_

- \_\_\_\_\_ /32      Presentations  
Some type of visual provided, clear presentation, all introductory information included (time body found, temperature, room temperature, later body temperature), prepared on due date

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**EXTRA CREDIT!**

- \_\_\_\_\_ /5      WOW factor  
Project was exceptionally creative, time obviously spent, went above and beyond

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- \_\_\_\_\_ /100      Total = Quiz Grade