**Murder Mystery Project**

**Newton’s Law Of Cooling – use this to determine when the murder occurred and potentially verify an alibi!**

This law applies in a situation where you have a definite starting point and ending point, and you want to gradually shift from one to the other. For example, if room temperature is 70°, and I take a pie out of a 400° oven, then the pie’s temperature will gradually shift from 400° to 70°, but once it reaches 70°, it’s not going to get any cooler!

The formula for Newton’s Law of Cooling is $y=a+be^{rx}$. In other words, it’s just the continuously compounded model, plus a constant.

a = room temperature.

b = the amount of cooling that occurs. This is the difference between your starting point and your ending point. If heating is done instead of cooling, for example, if you took a chicken out of the freezer to thaw, then b will be negative.

r = the rate at which the object loses heat—this will depend on the type of object, as well as on how insulated its container is. To solve for r, you need to know one intermediate piece of data—somewhere between the starting point and the ending point.

x = the amount of time that’s elapsed.

y = the temperature at the end of x units of time.

Example) A hard boiled egg with a temperature of 98oC was put under cold water with a temperature of 18oC to cool down before being peeled and eaten. After 3 minutes, the egg has a temperature of 66oC.

1. Write a formula for the temperature of the egg, x, after it has been running under the water for x minutes.
2. What will the temperature of the egg be after 8 minutes under the water?
3. When will the temperature of the egg be 22oC?

**Half Life Formula – you may need to use this to verify someone’s story!**

This law applies to radioactive substances that decay over time. For example, Carbon-14 has a half life of 5,730 years. Therefore, this substance has a radioactive isotope present and at any given tiem will undergo spontaneous disintegration during the succeeding 5,730 years. For example, if a sample begins with 50 grams of Carbon-14, after 5,730 years there will be 25 grams left of the Carbon-14 in that sample.

The formual for Half Life is $y=a\left(\frac{1}{2}\right)^{\frac{t}{h}}$.

 a = the original amount of the substance

 h = half life of the substance

 t = time that has passed

 y = amount that is present after t units of time have passed

Example) A painting is being sold at an acution that is said to be by Vermeer (who lived from 1632 – 1675). In order to verify the painting, scientiest test the amount of Carbon-14 (which has a half life of 5,730 years) that is left in the painting. Upon testing, the scientiest finds that the painting has 99.56% of its Carbon-14 remaining. Is this painting real or is it a fake?