**Key for grading Newton’s Law of Cooling Lab**

**10 pts** – Graph with title, axes labeled (Temperature in oC, time in s) attempted smooth curve through points. reject connect the dots type graph. Take off 5 pts for each missing thing.

**5 pts** – 4 calculations of k – typically something like k = -ln(T/To)/t so it will look **like -ln(25.7/82.5)/100**. They must show at least one. Note that in this case, the 100 is the time, 25.7 is the temperature at that time, and the 82.5 is the original temperature. The 82.5 is used in all four calculations of k. k is **typically about .01, so if it is** significantly different from this, put the numbers in a calculator and check them yourself, and make them re-do it is they are wrong. Show your calculation.

**5 pts** – Question A – They must say something like 1. heat flows faster when there is a big difference in temperature, and 2. **at the beginning there is a big difference, so the heat flows quickly**, and at the end when the difference is small, the heat flows more slowly. They must mention the notion that the difference in temperature between the beaker and the ice water is what matters – but be flexible in accepting answers that imply this. Reject answers that say “Because it is an exponential decay” as that really is the question – we are asking them why it is an exponential decay.

**5 pts** – Question B – The answer is that the heat would flow more slowly, so **the temperature would drop more slowly**. The value of k would decrease. They must get the first part of this answer, but if they say that k will increase, just add a “NOT” before the increase. Put a smiley face in too.

**5 pts** – Question C – **The answer is to put the cream in right away.** They will think that the important thing is the temperature difference between the cream and the coffee, but the important thing is that it is the difference between the coffee and the room. Putting the cream in first makes it cooler (and closer in temperature to the room), so it then loses less heat while you are on the phone. They need to explain why to get the 5 points. If they guess wrong, simply write “**Don’t wait – Why??**” on their paper.

**10 pts** – Question D – **5 pts** for concluding. They must cite data – most likely the values for k – did they stay constant or not, but accept other citations of data that support the hypothesis that it is an exponential decay.  **5 pts** for any mention of sources of error, or modifications they might make to the experiment to make it better. They do not need to have both to get the second 5 points.