Épreuve de section européenne

Dolbear's law

Here are two articles about a curious relationship between crickets chirping and temperature : the first one was published in the New York Times, (Questions and Answers column) and the second one is taken from Wikipedia.

1. **Question.** Is it true that "the hotter the night, the louder the crickets" ?
   Answer. "Not on an individual basis," said Louis N. Sorkin, an entomologist at the American Museum of Natural History, "but if it's hot and there is less overall noise at that time, then the cricket chirping[1] may seem louder."
   There is another likely explanation for the saying, Mr. Sorkin said. Day or night, "there will certainly be more males chirping at the same time because of higher temperatures, and if they sing in unison, then the overall sound will be louder." Cricket metabolism and chirping speed vary with ambient temperature, with the chirps coming faster at higher temperatures.
   The frequency varies from 4 to 5 a second to more than 200 ; it also varies from species to species. One, the snowy tree cricket, is so reliable that a formula called Dolbear's Law (after A. E. Dolbear, who reported his studies in 1897), provides a temperature gauge : count the number of chirps in 13 or 15 seconds and add 40 for the temperature in Fahrenheit. It does not work with the house cricket or field cricket, and it is hard to tell by sound alone which insect you are hearing, Mr. Sorkin said.

   The New York Times, "Science Times", August 25, 2008, by C. Clairborne Ray.

2. Dolbear's Law states the relationship between the air temperature and the rate at which Snowy Tree Crickets chirp. It was formulated by Amos Dolbear and published in 1897 in an article called The Cricket as a Thermometer. Dolbear expressed the relationship as the following formula which provides a way to estimate the temperature T_F in degrees Fahrenheit from the number of chirps per minute N : $T_F = 50 + \frac{(N-40)}{4}$. Note that we can speed up counting by simplifying the formula and counting the number of chirps produced in 15 seconds (N') : $T_F = 40 + N'$. Reformulated to give the temperature in degrees Celsius, it is : $T_C = 10 + \frac{(N-40)}{7}$. These formulae are expressed in terms of integers in order to make them easier to remember – they are not intended to be exact.

   Wikipedia : http ://en.wikipedia.org

Questions

1. Use the Wikipedia formula to calculate the temperature (in degrees Fahrenheit) when the number of chirps is 60 per minute. How many chirps per minute might you expect to hear when the temperature is 70°řF ?
2. Prove that the two formulae for T_F given by the Wikipedia website are equivalent. Which time interval (13 or 15 seconds) proposed by the Q & A column is needed to be consistent with Wikipedia's formulae ?
3. Assuming that the Wikipedia's formula for T_C is correct, find a way to translate directly T_C into T_F and vice versa.
4. The real translation from T_C to T_F is : $T_F = 1.8T_C + 32$. Check your answer to question 3. How do you explain the difference ?

1. Chirping is the noise crickets make by rubbing their wings together.