BONUS QUESTIONS

For credit on a bonus question turn in a written sheet with your name, course number, ID, and the solution - including your explanation. Deadline is April 11.

1. Determine the next number in the sequence: 7 8 5 3 9 8 1 6 3 3 9 7 4

   The next three tricks, which were done in class, all have to do with arithmetic in base n, for some n (a different n for each trick).

2. A magic trick done this semester asked someone to pick a number between 100 and 999 (not a palindromic number that reads the same forwards and backwards), then reverse the digits and subtract the smaller of the two numbers from the larger. Then turn to this page in The Complete Sherlock Holmes book, then take the last digit of the page and count down that many lines. Finally, give the first two words of the line. From this the magician is able to recite the entire sentence containing those two words. Give a full (mathematical) explanation of how this can be done, and also which number base is being used.

3. Another magic trick this semester had someone pick three integers between 0 and 10, then add them and put the sum in a circle. Next take 12 times the first number, add the second, multiply by 10, and finally add the number originally put in the circle. The answer is told to the magician, who then is able to say what all three original numbers were. Give a full (mathematical) explanation of how this can be done, and also which number base is being used.

4. Still another magic trick done this semester had someone choose a number from 1 to 127, then look at a bunch of cards with numbers on them and say which cards had their number. The magician then told what the number is. Here are the numbers on each card, explain the trick and the number base that is being used.
   First card   1,3,5,7,9,11,....,123,125,127 (all odd numbers from 1 to 127)
   Second card   2,3,6,7,10,11,14,15,18,19,22,23,26,27,30,31,34,35,38,39,42, 43,46,47,50,51,54,55,58,59, 62,63,66,67,70,71,74,75,78,79,82,83,86,87, 90,91,94,95,98,99,102,103,106,107,110,111,114,115,118,119,122, 123,126, 127
   Third card   4-7,12-15,20-23,28-31,36-39,44-47,52-55,60-63,68-71,76-79, 84-87,92-95,100-103,108-111, 116-119,124-127
   Fourth card   8-15,24-31,40-47,56-63,72-79,88-95,104-111,120-127
   Fifth card   16-31,48-63,80-95,112-127
   Sixth card   32-63,96-127
   Seventh card   64-127

5. One hundred wine tasters meet in a hotel in southern France for a convention. The owner of the hotel wants to see how good they are, so all 100 are seated at a table and blindfolded. The owner tells them "each of you has four glasses of wine in front of you, an 1890 Chardonnay, a 1900 Burgundy, a 1911 Chablis, and a 1932 Riesling. Your task is to identify them by tasting them."

   The results were as follows. No-one got all four wrong, i.e. every taster got at least one correct. The number that got exactly one correct was 50, and the number that got exactly two correct 25. The number that got all four correct was half the difference between 50 and twice the number that got exactly three correct.

   Question: how many got exactly three correct? [Given on a scholarship examination for Oxford Univ.]

6. Calgary and Banff are 100 km distant. A train leaves Calgary towards Banff at 60 km/hr, and another train departs Banff at exactly the same time, headed towards Calgary at 40 km/hr. There is also a fly which can fly at 150 km/hr. It leaves the front tip of the Calgary train at the moment the train departs, flies to the tip of the train that had departed Banff, then flies back to the Calgary train, then back to the Banff train, etc., until it is crushed when the two trains unfortunately crash (the railroad controller had a hangover and had fallen asleep on the job).

   Question : what was the total distance the fly travelled?