1. Let $A, B, C$ be three sets such that $|A| = 14$, $|B| = 6$, $|C| = 7$, $|A \cup B \cup C| = 20$ and $|A \cap B| = 7$. Compute $|A \cap C|$ and $|B \cap C|$. (Hint: use the Principle of Inclusion-Exclusion for $A \cup B$ and $C$).

2. Find the number of integers $n$ such that $1 \leq n \leq 2010$ and $n$ is relatively prime to 2010.

3. 50 points are scattered inside a square with a side of 1 meter. Prove that some set of 3 of these points can be covered by a square with side length equal to 20 centimeters.

4. Prove that there exists a power of 3 that ends with the three digits 001. (Hint: consider numbers of the form $3^n - 1$, $n$ is a positive integer and use the Pigeonhole Principle together with the fact that 3 and 100 are relatively prime).

5. A group of 100 people want to choose a board consisting of president, secretary and 3 other officers. In how many ways can this be done?

6. If a die is tossed twice, find the probability that the sum of the numbers appearing is not divisible by 3.

7. How many permutations of the word CHATTAHOOCHEE are there if
   a. There are no restrictions?
   b. The word must start in an H and end also in an H?
   c. The two C’s are adjacent?
   d. The two E’s are not adjacent?

8. Thirty one people in section L3 forgot to write their names on their midterm exams. In how many ways can their exams be returned so that
   a. No one receives his or her exam?
   b. Exactly 1 person receives his or her own exams?
   c. Exactly 2 people receive their own exams?
   d. At most three people receive their own exams?

9. Find the coefficient of $x^7$ in the binomial extension of $(x^3 - \frac{1}{x^4})^{28}$