Please be succinct, trying to give a proof sketch rather than gory details.

1. Suppose a gambler enters a casino with $k$ dollars, and proceeds to make a sequence of fair bets (i.e., win $1$ or lose $1$ with equal probability). What is the chance that he goes broke before he doubles his money? What is the chance that he increases his money to $1.5k$ without going broke first? What is the chance that he increases his money to $3k$ before he goes broke? (Rough asymptotic expressions are OK if needed.)

2. Calculate the expected size of the largest clique in a random graph $G(n, 1/2)$. Try to use any of the concentration inequalities from the lecture for this problem and report your results.

3. Suppose we take $n$ points $x_1, x_2, \ldots, x_n$ in the square of unit length in $\mathbb{R}^2$. The length of edge $\{x_i, x_j\}$ is the Euclidean distance between $x_i, x_j$.

   (a) Show that there is constant $c$ independent of $n$ such that the optimum traveling salesman tour of the points has length no more than $c\sqrt{n}$.

   (b) Show that there is a constant $c'$ such that the sum of squares of edge lengths in the optimum salesman tour is no more than $c'$.

   (c) Use these facts to derive a concentration bound for the length of the optimum salesman tour when $x_1, x_2, \ldots, x_n$ are randomly chosen in the unit square.