1. (2 marks) A coin is biased to land heads with probability $1/10$, it is flipped 200 times consecutively. Use Markov’s inequality to give an upper bound on the probability that it lands heads at least 120 times.
   
   A. $6/10$
   B. $3/6$
   C. $1/6$
   D. none of these

2. (2 marks) The mean age of new professors at IIT is 40 with a standard deviation of 6. Between which two age limit must 75% of the professors lie? (You must use one of inequalities taught covered in the lectures.)
   
   A. $[28, 52]$
   B. $[30, 50]$
   C. $[34, 46]$
   D. none of these

3. (2 marks) Consider a biased coin with probability $p = 1/3$ of landing heads. Suppose the coin is flipped $n$ times. Use the Chernoff bound to determine the smallest value for $n$ so that the probability that more than half of the coin flips come out heads is less than 0.001.
   
   A. 9
   B. 249
   C. 99
   D. 499

4. (2 marks) If the covariance between two random variables $X$ and $Y$ is zero then
   
   A. $X$ and $Y$ are independent
   B. Knowing the value of $X$ provides no information about the value of $Y$
   C. $E(X) = E(Y) = 0$
   D. none of the above
5. (2 marks) A company claims to produce ball bearings with mean weight of 6 grams and standard deviation of 1 gram. If we take a random sample of size 1000, what is the probability of the mean weight of the sample to be ≤ 5.9?
   A. 0.1
   B. 0.59
   C. 0.0008
   D. none of these

6. (2 marks) You take a random sample from some population and form a 96% confidence interval for the population mean, μ. Which quantity is guaranteed to be in the interval you form?
   A. μ
   B. 0
   C. 0.96
   D. sample mean \( \bar{x} \)

7. (2 marks) Consider a random variable X whose moments are defined by \( E[X^n] = n! \). Then, \( M(t) = \)
   A. 1/(1-t)
   B. \( t/(1-t) \)
   C. \( t/(1-t!) \)
   D. none of these

8. (6 marks) Consider the random graph \( G(n, p) \) on \( n \) vertices, where the probability of an edge between any two vertices in the graph is \( p \). Now, consider the random graph \( G(n, 1/2) \), Then:
   HINT: \( \frac{n-1}{2} \approx n/2 \), and do use one of the bounds.
   A. Almost all random graphs have minimum degree \( d = (\frac{n}{2} - \sqrt{n \ln n}) \).
   B. Almost all nodes have degree concentrated in the range \( (\frac{n}{2} - \sqrt{3n/2 \ln n}, \frac{n}{2} + \sqrt{3n/2 \ln n}) \).
   C. Almost all random graphs (assume connected) have diameter ≥ 2.
   D. All of the above