Show all work clearly and in order. Circle or box your final answer but points will be awarded based on a correct solution. A solution should always justify the steps taken and explain the assumptions needed to reach a final answer (e.g. how do you know you are not dividing by zero in the last step?).

For this quiz, assume $X \sim Binomial(n, p)$

**Q1** Note that $\mathbb{E}[X] = n \cdot p$ and $\mathbb{E}[X^2 - X] = n(n-1)p^2$. What is $Var[X]$?

(A) $np$

(B) $n(n - p - 1)p$

(C) $n(n - 1)p$

(D) $n(1 - p)p$

(E) $n^2p^2(1 - p)$

**Q2** Find the approximate sampling distribution of $\bar{X}$ using the Central Limit Theorem.

**Q3** Construct a 95% confidence interval for $\bar{X}$. Let $\Phi$ denote the CDF of the standard normal distribution. Recall $\Phi(-1.96) = 2.5\%$ and $\Phi(1.96) = 97.5\%$.

**Q4** True or False. The margin of error increases as $n \to \infty$.