1. (18 points) Let $K$ be an $n$-bit integer. We are given a function $g : \{1, 2, \ldots, K\} \rightarrow \{0, 1\}$ by a black box: we can feed an integer $x$ ($1 \leq x \leq K$) to the black box and it produces the value $g(x)$.

Suppose $g(1) = 0$ and $g(K) = 1$. Find a value $y$ such that $g(y) = 0$ and $g(y + 1) = 1$ ($1 \leq y \leq K - 1$). Use as few queries to the black box as possible. State the number of queries made in terms of $n$. Describe your algorithm in elegant pseudocode.
2. (5 points) Recall that a Boolean function in \( n \) Boolean variables is a function \( f : \{0, 1\}^n \rightarrow \{0, 1\} \). Count the Boolean functions in \( n \) Boolean variables. Your answer should be a simple closed-form expression. Do not prove.

3. (17 points) Define the complexity class NP. Your answer should begin with the words “The language \( L \subseteq \Sigma^* \) belongs to NP if”; the rest of the answer should be a formula, no English words (except for logical connectives like “AND” and “OR”). Watch your quantifiers.