Pledge: I (we) have not received unauthorized aid on this assignment. I (we) understand the answers that I (we) have submitted. The answers submitted have not been directly copied from another source, but instead are written in my (our) own words.

1. [20 points] For each relation below, explain why the relation does or does not satisfy each of the properties reflexive, symmetric, antisymmetric, and transitive.
   
   (a) “isBrotherOf” on the set of people.
   (b) “isFatherOf” on the set of people.
   (c) The relation $R = \{(x, y) \mid x^2 + y^2 = 1\}$ for real numbers $x$ and $y$.
   (d) The relation $R = \{(x, y) \mid x^2 = y^2\}$ for real numbers $x$ and $y$.
   (e) The relation $R = \{(x, y) \mid x \mod y = 0\}$ for $x, y \in \{1, 2, 3, 4\}$.

2. [10 points] Show that big-Theta notation ($\Theta$) defines an equivalence relation on the set of functions.

3. [20 points]
   
   (a) Present an adversary argument as a lower bounds proof to show that $n - 1$ comparisons are necessary to find the maximum of $n$ values in the worst case.
   
   (b) Present an adversary argument as a lower bounds proof to show that $n$ comparisons are necessary in the worst case when searching for an element with value $X$ (if one exists) from among $n$ elements.