Year 2013/14 - Number 1

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Question 1. Define a binary property $p(x, y)$ over natural numbers that satisfies both the requisites:

1. $\forall x \in \mathbb{N}.\exists y \in \mathbb{N}.p(x, y)$ and
2. *it is false that* $\forall y \in \mathbb{N}.\exists x \in \mathbb{N}.p(x, y)$

Provide a definition for p, and a proof for the above claims.

Answer 2. We define $p(x, y) = \{(x, y) \in \mathbb{N} | x + y > 50 \wedge x < y\}$. Clearly, $\forall x \in \mathbb{N}.\exists y \in \mathbb{N}$ such that $x < y$ (for example $y = x + 1$). We choose a number $y \in \{z \in \mathbb{N} | z > x\}$ such that $x + y > 50$ (for example $y = x + 51$). We prove the rightness of the second point with a *Reductio ad Absurdum*. Let y be a number less than 50, for example $y = 2$. In this case, $\nexists x \in \mathbb{N}$ such that $x < y \wedge x + y > 50$.

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