Prove the following statements. Use any method you like, but follow directions.

1. Given an integer a, then $a^2 + 4a + 7$ is odd if and only if a is even.

2. There exists a set X such that $\mathbb{N} \in X$ and $N \subseteq X$.

3. Suppose $x, y \in \mathbb{R}$. Then $(x+y)^2 = x^2 + y^2$ if and only if $x = 0$ or $y = 0$.

4. Suppose $a, b, c \in \mathbb{N}$. Use the proposition we proved in class to show that if $a \mid bc$ and $\gcd(a, b) = 1$, then $a \mid c$.