1. Let $C$ and $D$ be two points, not diametrically opposite, on a circle $C_1$ with center $M$. Let $H$ be a point on minor arc $CD$. The tangent to $C_1$ at $H$ intersects the circumcircle of $CMD$ at points $A$ and $B$. Prove that $CD$ bisects $MH$ iff $\angle AMB = \frac{\pi}{2}$.

2. Suppose that $A$ is a set of positive integers less than $N$ and that no two distinct elements of $A$ sum to a perfect square. That is, if $a_1, a_2 \in A$ and $a_1 \neq a_2$ then $|a_1 + a_2|$ is not a square of an integer. Prove that the maximum number of elements in $A$ is at least $\left\lfloor \frac{11}{12}N \right\rfloor$.

3. Find the minimum number of colors necessary to color the integers from 1 to 2007 such that if distinct integers $a$, $b$, and $c$ are the same color, then $a \nmid b$ or $b \nmid c$. 