Problem 1. Show that if n is odd and $3 \nmid n$ then $n^2 \equiv 1 \pmod{24}$.

Problem 2. Show that the product of three consecutive integers is divisible by 504 if the middle one is a cube.

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Problem 3. Show that if p is prime, then $\binom{2p}{p} \equiv 2 \pmod{p}$.

Problem 4. Show that if n is a positive integer with $n \geq 2$, then n does not divide $2^n - 1$.