(1) (a) Divide $3^{10203}$ by 101. What is the remainder?
(b) Find a primitive root modulo 97.

(2) Prove or provide a counterexample for each.
(a) $\gcd(n, \varphi(n)) > 1$.
(b) If $d|m$, then $\varphi(d)|\varphi(m)$.
(c) If the same primes divide $m$ and $n$, then $n\varphi(m) = m\varphi(n)$.

(3) (Page 108, problem 26) Let $p \equiv 3 \pmod{4}$ be prime. Show that $x^2 \equiv -1 \pmod{p}$ has no solutions. (Hint: Suppose $x$ exists. Raise both sides to some power and find a contradiction.)