2. We should use the Euclidean Algorthm to do this problem. In particular, this will tell us that $24 * 89 - 35 * 61 = 1$. In other words, $-35 * 61 \equiv 1$ (mod 89), so the inverse is $-35 \equiv 54$.

3. If $x^2 \equiv 1$ (mod p), then $p|(x^2 - 1)$. This implies (why?) that $p|(x-1)$ or $p|(x+1)$. In other words, wither $x \equiv 1$ or $x \equiv -1$ (mod p).

5. Fermat's Little Theorem tells us that $a^{p-1} \equiv 1$ (mod p). But $a^{p-1} = (a^k)^2$, so this tells us that $(a^k)^2 \equiv 1$. The result follows from Problem 3 above.

6. There are plenty of counterexamples.

9. Let $d = (a, b)$. By definition, $d|b$ and therefore d is a common divisor of (a, b) and b. But d is the greatest divisor of itself, and therefor it must be the GREATEST common divisor of (a, b) and b.

10. Lots of counterexamples