1) Show that 2 is a primitive root modulo 11.

A number is a primitive root modulo a prime p if its multiplicative order modulo p is $\varphi(p) = p-1$. Here p is 11, so we need to check that the order of 2 mod 11 is 10.

Let us compute successive power of 2 mod 11:

$2^1 \equiv 2$, $2^2 \equiv 4$, $2^3 \equiv 8$, $2^4 \equiv 5$, $2^5 \equiv 10$, $2^6 \equiv 9$, $2^8 \equiv 14 \equiv 3$, $2^9 = 6$
$2^{10} \equiv 12 \equiv 1$. (mod 11)

No smaller positive exponent gives 1 modulo 11 so the order of 2 is 10 $= \varphi(11)$. Hence 2 is a primitive root modulo 2.

2) How many incongruent primitive roots does 14 have?

Soln: If primitive roots exist modulo n, their number equal $\varphi(\varphi(n))$.
First compute $\varphi(14)$. Since $14 = 2 \cdot 7$, $\varphi(14) = \varphi(2) \cdot \varphi(7) = 1 \cdot 6 = 6$.
Thus the primitive root if it exists, is $\varphi(\varphi(6)) = 2$.
(Primitive roots do exist where p is an odd prime number). So the formula applies.
The units modulo 14 are $\{1, 3, 5, 9, 11, 13\}$. A element is primitive if it has 6. Checking for 3: $3^1 = 3$, $3^2 \equiv 9$, $3^3 \equiv 13$, $3^4 \equiv 11$, $3^5 \equiv 5$. $3^6 \equiv 1$ (mod 14)
So 3 has order 6. It's inverse 5 (since $3 \cdot 5 \equiv 1$) is the other root. So the two incongruent pritive roots modulo 14 are 3 and 5.