2) For all $n > 0$, $5^n - 1$ is divisible by 4

1. For a basis, let $n = 1$. Then

$$5^1 - 1 = 4,$$

and clearly $4 \mid 4$.

2. Assume that $5^n - 1$ is is divisible by 4 for $n = k$, $k \in N$, Then by this assumption,

$$4 \mid (5^k - 1) \Rightarrow 5^k - 1 = 4m, \ m \in Z$$

(This notationally means than $5^k - 1$ is an integer multiple of 4.)

3. Let $n = k + 1$. Then

$$\begin{aligned} 5^{k+1} - 1 &= 5^k \cdot 5 - 1 \\ &= 5^k (4 + 1) - 1 \\ &= 4 \cdot 5^k + 5^k - 1 \\ &= 4 \cdot 5^k + 4m \\ &= 4 (5^k + m). \end{aligned}$$

Since $4 \mid 4(5^k + m)$, we may conclude, by the axiom of induction, that the property holds for all $n \in N$.