Prove by mathematical induction that (assuming $x \neq 1$):

$$
\sum_{i=j}^{n} x^i = \frac{x^{n+1} - x^j}{x - 1}
$$

Base case $n = j$: LHS = RHS = $x^j$. Inductive step:

$$
\text{LHS} = \sum_{i=j}^{n} x^i = \sum_{i=j}^{n-1} x^i + x^n
$$

$$
= \frac{x^n - x^j}{x - 1} + x^n
$$

by IH

$$
= \frac{x^n - x^j + (x - 1)x^n}{x - 1}
$$

$$
= \frac{x^{n+1} - x^j}{x - 1} = \text{RHS}
$$