1. Let $n$ be a positive integer. Prove that the polynomial
\[ f(x) = \sum_{i=0}^{n} \frac{x^i}{i!} \]
has $n$ distinct complex zeroes $z_1, \cdots, z_n$, and they satisfy
\[ \sum_{i=1}^{n} z_i^{-j} = 0 \quad \text{for} \quad 2 \leq j \leq n. \]

2. Let $C$ denote the positively oriented circle $|z| = 2$. Evaluate the integral
\[ \int_{C} \sqrt{z^2 - 1} \, dz \]
where the branch of the square root is chosen so that $\sqrt{2^2 - 1} > 0$.

3. Let $\Omega$ be the region whose boundaries are the rays $\text{Arg}(z) = \pm \frac{\pi}{4}$ and the branch of the hyperbola $x^2 - y^2 = 1$ lying in the half-plane $\text{Re}(z) > 0$. Find a conformal map of $\Omega$ onto the unit disk.