1. Evaluate via residues
\[ \int_{0}^{\infty} \frac{x^{a-1}}{1 + x} \, dx \]
where \( 0 < a < 1 \).

2. Suppose that \( \Omega \) is a domain in \( \mathbb{C} \), \( f_k \) is a sequence of analytic functions on \( \Omega \), \( f_k \to f \) uniformly on compact subsets of \( \Omega \), and \( f \) has a zero of order \( N \) at \( z_0 \in \Omega \). Show that there exists \( \rho > 0 \) such that for \( k \) sufficiently large, \( f_k \) has exactly \( N \) zeros counting multiplicities on \( |z - z_0| < \rho \).

3. a) Let \( f \) and \( g \) be \( 1-1 \) analytic mappings from a domain \( \Omega \subset \mathbb{C} \) onto the unit open disc \( \Delta \subset \mathbb{C} \). Suppose that for some point \( z_0 \in \Omega \), \( f(z_0) = g(z_0) = 0 \). What is the relation between \( f \) and \( g \)?

b) Let \( f \) be a \( 1-1 \) analytic map of the unit disc \( \Delta \) onto the unit square with centre 0, satisfying \( f(0) = 0 \). Show that \( f(iz) = if(z) \).