1. Classify the singularities at 0:

   \( a) \exp\left(\frac{\sin z}{z}\right), \quad b) \sum_{n=0}^{\infty} n(z - 1)^n, \quad \cos\left(\frac{1}{e^{z} - 1}\right). \)

2. Evaluate the integrals

   \( a) \int_C \sin\frac{1}{z}dz, \quad b) \int_C \sin^2\frac{1}{z}dz, \)

   where \( C \) is the circle \( |z| = 2. \)

3. Describe the full preimage of the segment \([-2, 2]\) under \( \cos z \). Make a picture.

4. Find a conformal map of the upper half-plane, from which the vertical ray \([i, \infty)\) is removed, onto the upper half-plane.

5. Let \( f \) be a meromorphic function in the unit disc \( D \) having only one simple pole at \( z_0 \in D, \quad z_0 \neq 0. \) Let \( f(z) = a_0 + a_1z + a_2z^2 + \ldots \) in a neighborhood of 0. Prove the equality

   \( z_0 = \lim_{n \to \infty} \frac{a_n}{a_{n+1}}. \)

6. Let \( f \) be a holomorphic function in the unit disc \( D. \)

   a) Prove that if \( f \) is injective in \( D \) then \( f'(z) \neq 0 \) for all \( z \in D. \)

   b) Show that the converse is not true: there is a holomorphic function \( f \) in \( D \) whose derivative has no zeros in \( D \) but \( f \) is not injective in \( D. \)