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Dedekind Cotangent Sums

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Let a, a_1, \dots, a_d be positive integers, m_1, \dots, m_d nonnegative integers, and z_1, \dots, z_d complex numbers. We study expressions of the form

$$\sum_{k \bmod a} \prod_{j=1, \dots, d} \cot^{(m_j)} \pi \left(\frac{k a_j}{a} + z_j \right).$$

Here the sum is taken over all $k \bmod a$ for which the summand is not singular. These **Dedekind cotangent sums** generalize and unify various arithmetic sums introduced by Dedekind, Rademacher, Apostol, Carlitz, Zagier, Berndt, Meyer, Sczech, and Dieter. Generalized Dedekind sums appear in various areas such as analytic and algebraic number theory, topology, algebraic and combinatorial geometry, and algorithmic complexity. We prove reciprocity laws, Petersson-Knopp identities, and computability statements for the Dedekind cotangent sums.

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