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Analytically Evaluating Sums in Quantum and Statistical Physics Using Integral Transforms JOHN VASTOLA, University of Central Florida — Evaluating sums analytically is a problem that is easy to pose and to give approximate solutions to, but that is difficult to exactly solve in general. Many results that are known are byproducts of Fourier analysis, which requires guessing that a series corresponds to a function. A more systematic method of evaluating sums using integral transforms is proposed which can reproduce many results obtained using other techniques. In particular, representing polynomials as Laplace transforms gives some nontrivial exact results. Some applications of the method are demonstrated, and extensions of the method using integral representations of frequently appearing functions are suggested. One useful representation of the gamma function is supplied, and used to provide both well-known and more obscure results. Interestingly, the application of this integral representation to evaluating sums suggests the introduction of a novel integral transform, which itself can be used to evaluate sums. Some of the transform's properties are given, and its usefulness in other areas (like solving differential equations) is touched upon. Some physical problems involving the partition functions of statistical mechanics, and some infinite sums appearing in quantum mechanics, are considered.

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