# Spin excitations and thermodynamics of the Heisenberg model on the layered honeycomb lattice

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We present the spin-rotation-invariant Green-function theory for the dynamic spin susceptibility in the spin-1/2 antiferromagnetic Heisenberg model on a stacked honeycomb lattice for various interlayer couplings. Employing a generalized mean-field approximation for arbitrary temperatures, the thermodynamic quantities (two-spin correlation functions, internal energy, magnetic susceptibility, staggered magnetization, Néel temperature, correlation length) and the spin-excitation spectrum are calculated by solving a coupled system of self-consistency equations for the correlation functions. Our results are in good agreement with numerical computations for finite clusters and with available experimental data. The spin-wave excitation spectrum, the sublattice magnetization, and transition temperatures are also calculated for the pseudo-spin-1/2 Kitaev - Heisenberg model in the random phase approximation for four ordered phases observed in the model: antiferomagnetic, stripe, ferromagnetic, and zigzag phases. The Néel temperature and temperature dependence of the sublattice magnetization are compared with the experimental data on $Na_2IrO_3$.