**P502** **Problem set # 3** **Due: Oct 25, 14:30**

**Problem 1. (15 points)** *"AF magnons in 2D"*

a) Show that while the ferromagnetic state is an exact eigenstate of the Heissenberg Hamiltonian, this is not true for the antiferromagnetic state.

b) Following the discussion on p. 61-62 of Kittel handout work out the zero-point sublattice magnetization for an *antiferromagnet* on a 2D square lattice. Assume zero applied field and ignore magnon interaction terms. *Hint:* To get the final numerical answer you must evaluate the $k$-space integral numerically using Maple, Mathematica, Wolfram Alpha, MatLab or a similar package. Alternately, you can use the long-wavelength approximation for $\omega_k$ and evaluate the integral analytically using the Debye-type approach (but this leads to a less accurate result).

c) Now discuss the temperature dependence of sublattice magnetization in the same setup. What does your result imply for the stability of AF order in low-dimensional solids?