PHYS421 - Michaelmas Term 2010
Sheet 2 (total mark = 20)

THIS SHEET MUST BE ATTACHED TO YOUR ANSWERS — please insert your name at the top of this page and ensure your work is clearly legible. Do not submit your work in folders or plastic sleeves. Your answers should be placed in the appropriate IN-BOX in the Physics Foyer not later than 12:00 on Tuesday 9 November 2010. Work handed in after the above time and before the seminar on Thursday 12pm will be subject to a 10% reduction. Work handed in later than this will not count towards your continuous assessment.

I declare that this submission is my own work. I have not submitted it in substantially the same form towards the award of a degree or other qualification. It has not been written or composed by any other person and all sources have been appropriately referenced or acknowledged.

Signed:

1. [4] State the Curie law for paramagnetic susceptibility of a solid of atoms each carrying magnetic moment equal to the Bohr magneton, explaining meaning of all parameters/quantities used in its formulation. Compare that with the contribution towards paramagnetic susceptibility from magnetic moments of nuclei.

2. [3] Write down the formula describing Pauli susceptibility of due to the electron spin in a metal, explaining meaning of all parameters/quantities used in it.

3. [3] Describe the origin of the intra-atomic exchange energy and Hund's rules in application to spins of atoms. Use Hund's rules to determine the magnetic moment of one atom of manganese, Mn.

4. [4] Write down the Heisenberg Hamiltonian for the inter-atomic exchange in a solid. Describe ferro- and antiferromagnetic ordering of atomic spins in a one-dimensional chain of atoms.

5. [6] Following notes, use self-consistent mean field theory to describe magnetization dependence on temperature, $M(T)$ near the critical temperature, T_c of a ferromagnetic transition. Write down the formula which relates the Curie temperature, T_c to the inter-atomic exchange constant in a ferromagnetic material and explain meaning of all parameters which appear in it.