

Student name :

Mark :

Initials: VF

Lancaster University

Department of Physics

PHYS421 - Michaelmas Term 2010 Sheet 5 (total mark = 10)

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 16:00 on Tuesday 19 January 2011. 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] Write down the formula describing the transmission of an electron through a double-barrier structure and use it to describe the resonance tunneling phenomenon.
2. (a) [4] Describe the origin of the Coulomb blockade of resonance tunneling and its manifestation in the transport characteristics of a circuit which contains a quantum dot contacted by two conducting leads. (b) [2] A metallic nanocluster with radius 20 nm is used as a quantum dot in a single-electron transistor. Estimate at what temperatures one would be able to observe the Coulomb blockage of tunneling through this metallic nanocluster.