Problem Sheet 6

1. Consider an epitaxial sheet of graphene on a $1\,\mu$ thick SiO_2 sheet, charged with a gate voltage 150 V and in a field in the range 8-12 T, measured at 1 K. What would be the (approximate) cyclotron resonance frequency? If the mobility is $10^4\,\mathrm{cm}^2/\mathrm{V\,sec}$, would one expect to see well-defined quantum Hall plateaux in this region? If so, to which steps would it correspond?

2. Consider two layers of high-mobility graphene separated by a thin insulating layer, so that the two honeycomb lattices lie on top of one another and the interlayer $A-A$ ($B-B$) tunneling matrix element is 1 eV (neglect any other tunneling between layers). What do you expect to be the pattern of the (low-temperature) quantum Hall plateaux in a perpendicular field of (a) 1 T (b) 20 T? Do you expect the effect to be visible at room temperature?

3. (very open-ended): Consider the possibility that the static "ripples" observed in graphene are due to the electrostatic repulsion of the charge carriers. For a suspended sheet whose electrostatic interactions with the support can be neglected (except in so far as they give rise to the charging) give an order-of-magnitude estimate of the maximum deviation angle θ of the surface which could be produced by this effect on a length scale of 50 Å.

   (Note: You will need to go to *quadratic* order in θ and look up various experimental numbers.)

Solutions to be put in 598PTD homework box (2nd floor Loomis) by 9 a.m. on Mon. 30 Nov.