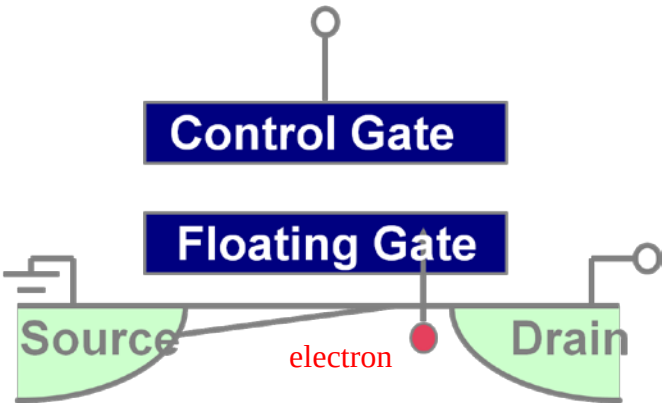
2015 Qualifying Exam Questions

Prof. H.-S. Philip Wong

You got some extra money from working as a course grader. A new phone is on the market with 128 GB of storage. You got yourself one of these new phones and started loading it up with songs and videos. Say you transferred all the data from your old 16 GB phone (which was practically loaded to full capacity) and bought some new songs to fill the storage up to 64BG. And you did this all over wi-fi.

Assume you can measure the weight of the phone to infinitesimally small values. If you measure the weight of the phone before and after you load in the data and the new songs.
1. Would there be any difference in the weight? Please explain your reasoning.

2. Now down to the chip level. If you can somehow weigh the data storage chip separately from the phone, would you observe any difference in the weight of the data storage chip when the phone was brand new vs when the phone had 64GB data loaded on it?



3. Now, on to the device. Data in the phone are stored in Flash memories. Flash memory has a floating gate (consider it a metal) and a control gate (consider it like the gate of a MOSFET) with oxides in between them. Draw the Id vs Vgs curve of the transistor (show above) for the case before and after electrons are stored in the floating gate.
4. If the threshold voltage difference between the case of having electrons and having no electron in the floating gate is 1 V, what is the total amount of charge stored in the floating gate?
5. I have not given you all the information you need to calculate this total amount of charge. You need to ask me for the necessary device information. You need to be judicious and not just ask for everything.
6. Show how you arrive at your answer. Accurate numerical answer is not required. Just the method to get to the solution.