Physics 4243/5243
Problem Set #2
Due Wednesday January 28th

Problem 1:

Recall your answers to problem set #1 to figure out what's going on with this graph.

For a single walled 10,10 nanotube (SWNT) the lowest energy phonon modes have dispersion relationships which are linear (two degenerate transverse modes (v=9km/s), a twist mode (v=15km/s) and another mode with v=18km/s).) In contrast graphene (which is like an unrolled nanotube) has three acoustic modes (LA with v=24km/s, TA with 18km/s and a out of plane mode (ZA) with $\omega=\delta k^2$ with $\delta \sim 6\times10^{-7} m^2/s$.)
Use this information to explain the behavior of the specific heats of these materials as shown in the figure below. Use full sentences and explain your reasoning.

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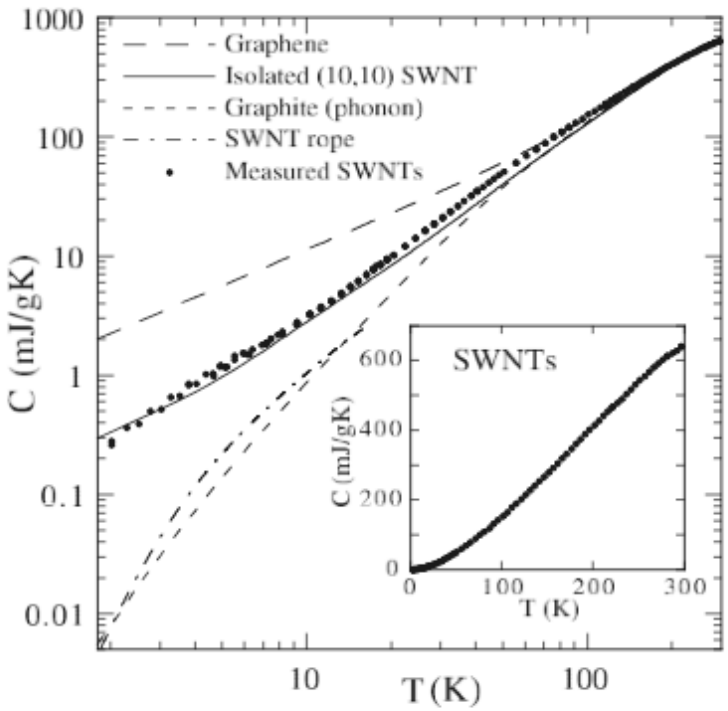
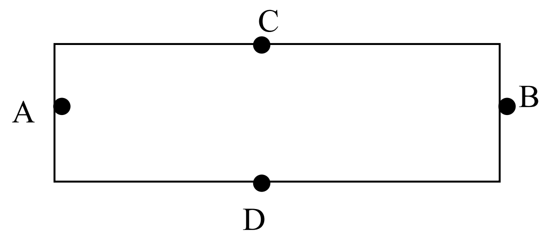


Fig. 3. Measured specific heat of SWNTs, compared to predictions for the specific heat of isolated (10,10) tubes, SWNT ropes, a graphene layer and graphite [11]

Problem 2:

A 7.5cm long and 2cm wide copper sample with thickness 2400A has 100mA flowing from A to B. Voltage readings are taken at points C and D as a function of applied magnetic field.



Magnetic field (kG)	**Voltage (mV)**
0	.002
1.3	.0143
1.9	.0175
3.0	.028
3.3	.0315
4.5	.0425
4.8	.0425
5.9	.056
6.3	.0575
7.1	.064
7.5	.068
8.0	.072

a) Calculate the Hall coefficient

b) In MKS units where I is in amps, B in webers/m^2 and e in coloumbs, R_h=-1/ne where n is the volume density of conduction electrons. Make a determination of Avogadro's number from this data (which I took 20+ years ago as an undergrad in our junior lab equivalent). Moral of the story: it's worthwhile to keep your old notes if you are going to be a professor.

Problem 3:

Simon textbook problem 3.2

Problem 4

Simon Textbook problem 3.3 (don't do part c)