EMSE314--Fall 2003--Homework 4--Name: Changrong Li
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Problem 1— "DOS for a 2D electron gas"

The density of states g for 2D electron is defined as the number of states per unit area per unit energy, i.e. $g = \frac{1}{a^2}\frac{dS}{dE'} = \frac{1}{a^2}\frac{4\pi a^2 m_e}{h^2} = \frac{4\pi m_e}{h^2}$

Problem 2— "Diamond and Tin"

In our case, tin is a metal because its band gap $E_g \leq 0$.

Grey tin (Alpha-Sn, diamond strucutre) has $E_g = 0$. It is definitely a metal. However, white tin (beta-Sn, tetragonal) has a band gap about 0.08eV, which makes it a semiconductor at low temperature.

Problem 3—"Bohr model of the Hydrogen atom"

- The total energy of an electron occupying the n-th orbit is the sum of kinetic energy and potential energy. It turns out that $E_{total}^n = \frac{mv_n^2}{2} - \frac{4\pi\varepsilon_0 e^2}{r_n} = -\frac{mv_n^2}{2}$. We can find $E_{total}^n \neq \frac{mv_n^2}{2}$
- The binding energy is a kind of energy required to separate particles from a molecule or atom or nucleus. It has a positive value. In other words, $E_n = -E_{total}^n$.
- Note that the radius is very small, which is equivalent to about 1/10,000 of the wavelength of blue visible light. The energy is also low. However, the velocity is high!

Problem 4—"Fermi energy and electron concentration"

Remember to take into account the different valencies.