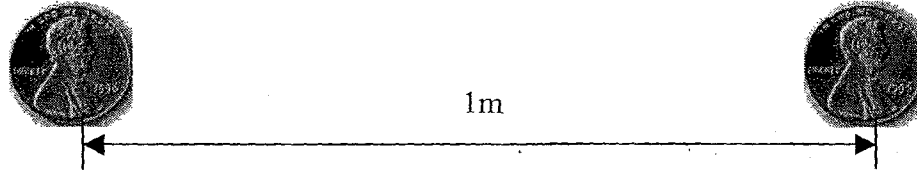


1. We know that the magnitudes of the negative charge of an electron and the positive charge of a proton are equal. Suppose, however, that these magnitudes differ from each other by 0.0001%. With what force would two copper cents placed 1m apart then act on each other? Is this force larger or smaller than the force of gravity acting on a cent at the surface of the Earth?

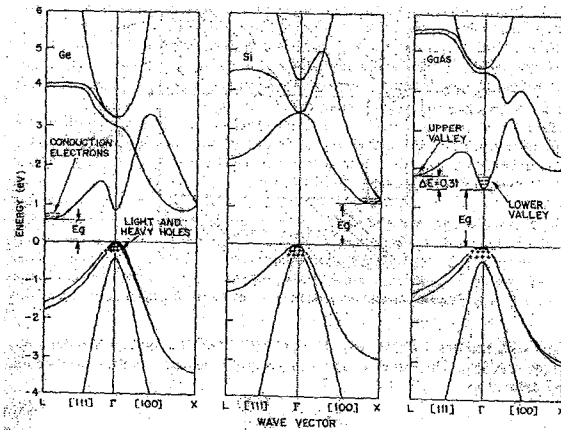


Hints:

- Give order of magnitude answers.
- You may assume that a cent is made of copper only, and has the mass of 2.5g.
- You can use the attached periodic table of elements.
- Some useful constants: the dielectric constant of vacuum is $\epsilon_0 = 8.85 \cdot 10^{-12} \text{ F/m}$, the charge of an electron is $e = -1.6 \cdot 10^{-19} \text{ C}$, and the mass of a proton is $m_p = 1.67 \cdot 10^{-27} \text{ kg}$.

2. When studying semiconductors, we plot their energy band diagrams, as shown in the figure on the right for Ge, Si and GaAs.

Explain what these diagrams mean and how they are calculated. How would the states (wavefunctions) of electrons differ at various points of these band diagrams? What about the probability distributions of electrons throughout such materials?



3. Why is ice slippery?

