

# Physics 244, Modern Physics

## Final Exam Review Problems

*Not to be handed in*

The exam will cover: the entire course! About 4 problems will focus on topics covered since the last exam. The remaining 4 will cover earlier topics.

### Review Problems/Questions:

These are not meant to cover everything, but just to remind you of some topics we have studied...

1. Compute the de Broglie wavelength of a conduction electron at the Fermi energy in copper. Estimate the Fermi energy for copper from first principles (density, atomic weight of copper, etc.)
2. What is the magnitude of the drift velocity of electrons in a typical copper wire of radius 0.815 mm carrying a current of 1 A?
3. Find  $\sigma_x = \Delta x$  and  $\sigma_p = \Delta p$  for the ground state wave function of a one-dimensional infinite square well. Is your result consistent with the uncertainty principle?
4. Repeat the previous problem for the ground state of the harmonic oscillator.
5. At what value of  $r$  is  $\psi^*\psi$  a maximum for the ground state of the hydrogen atom? What is the probability of finding the electron in this state at  $r > a_0$ ? What is  $\langle r \rangle$  for this state?
6. The microwave spectrum of CO has lines at 0.86 mm, 1.29 mm, and 2.59 mm. Compute the photon energies and carefully sketch the corresponding energy-level diagram. What molecular motion produces these lines?

“Never express yourself more clearly than you are able to think.”  
– Niels Bohr

