

Physics 262: Exam 3
100 points

1. (30 points) An electron is accelerated through a voltage V . By analyzing the diffraction pattern from a well known crystal lattice, the wavelength is found to be $\lambda = 0.1$ nm.
 - (a) (10 points) What is the speed of the particle compared to c ?
 - (b) (10 points) What is the voltage V ?
 - (c) (10 points) The electron is incident on a tin target. What is the lowest wavelength x-ray that can be produced?

2. (30 points) A 100 eV photon scatters from an electron that is at rest.
 - (a) (10 points) What is the photon's momentum before interacting with the electron? Give your result in SI units (eV is not an SI unit.)
 - (b) (10 points) If the photon scatters at $\theta = \pi$, what is the momentum after scattering? Find the expression, but do not evaluate.
 - (c) (10 points) What is the momentum of the electron after the scattering event? Find the expression, but do not evaluate.

3. (20 points) Consider the Franck-Hertz experiment. Sketch the experimental setup. If the gas in the tube has a first excited state of 3 eV, plot the observed current versus accelerating voltage.

4. (10 points) A laser on the surface of the earth produces light with wavelength λ . If this light is detected far from the earth (and far from any other massive object) will the light have a longer or shorter wavelength? Explain your answer using at least one equation.

5. (10 points) Which modern physics experiment do you find the most interesting? Sketch the experimental setup and explain that experiment's significance.