

Homework 1: due on Sep. 5th

1. Based on Planck formula derive the Stefan-Boltzman law (the total energy density $\rho = \sigma T^4$ and the expression of σ) and the Rayleigh-Jeans formula of radiation.
2. Derive Compton formula: $\lambda_f - \lambda_i = \frac{h}{m_e c} (1 - \cos \theta)$ by using both energy and momentum conservation.
3. Using Bohr-Sommerfeld quantization condition ($\oint p_x dx = nh$) to find the energy levels of a one-dimensional harmonic oscillator with its potential energy ($V(x) = \frac{1}{2} m \omega^2 x^2$).
4. (optional) Using the statistical mechanics and Planck hypothesis derive Planck formula: $\rho(\nu) = \frac{8\pi kT}{c^3} \frac{\nu^3}{e^{\frac{h\nu}{kT}} - 1}$.