Problem 1

The work function for cesium is 1.9ev.

(a) Determine the threshold frequency and the threshold wavelength of the photoelectric effect of cesium.

(b) If one wants to obtain a photoelectron with energy of 1.5ev, what wavelength of light is required?

Problem 2

What minimum kinetic energy must an electron have in order to allow an inelastic collision between the electron and a lithium ion Li^{2+} in its ground state to take place?

Problem 3

(a) In the case of thermal equilibrium, the distribution of the atoms in different energy states is given by the Boltzmann distribution, namely, the number of atoms in an excited state with energy of E_n is

$$N_n = N_1 \frac{g_n}{g_1} e^{-(E_n - E_1)/kT},$$

where N_1 is the number of atoms in the state with energy E_1, k is the Boltzmann constant, and g_n and g_1 are the statistical weights (determined by how many different ways one can put the electrons in each of the two states with energies E_n and E_1) of the corresponding states. For hydrogen atoms at a pressure of 1 atm and a temperature of 20°C, how large must the container be to let one atom be in the first excited state? Take the statistical weights of the hydrogen atoms in the ground state and in the first excited state to be $g_1 = 2$ and $g_2 = 8$, respectively. Remember from thermodynamics $PV = \gamma RT$ where γ = number of atoms present/Avogadro's number $= N/N_A$.

(b) Let electrons collide with hydrogen gas at room temperature. In order to observe the H_α line, what is the minimum kinetic energy of the electrons?

Problem 4

For which hydrogenlike ion is the difference in wavelength between the principle line the Balmer series and the principle line of Lyman series 1337 angstrom?

Problem 5

Assume a hydrogen atom in its ground state absorbed a 12.75ev photon.

(a) After absorption, in which excited state will it be?

(b) Show in and energy diagram the possible transitions from that excited state. What is the shortest wavelength among the transitions?