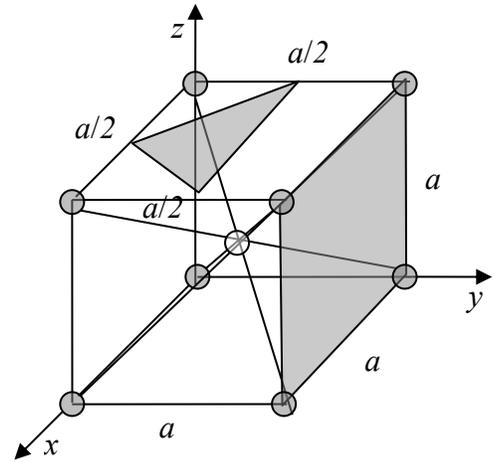


**ELEC 315 - Assignment 1**  
**Winter 2025-26 Term 1**

**Due: Sept. 19, 2025**

1. The unit cell of CsCl crystal is BCC as shown in the figure (Cs<sup>+</sup>: dark spheres, Cl<sup>-</sup>: light sphere).

- What are the Miller's indices for the two planes shown by shaded areas in the figure.
- The ionic radii of Cs<sup>+</sup> and Cl<sup>-</sup> are 1.67 and 1.81 Å, respectively (1 Å = 0.1 nm). Find  $a$  (the side of the unit cell), if atoms are assumed to be hard spheres that are closely-packed, such that the closest spheres are pressed against each other. How many Cs<sup>+</sup> and Cl<sup>-</sup> are present in each unit cell? What is the packing density or the fraction of the unit cell volume filled with atoms (considering the volume of atoms as the volume within the hard spheres with above radii)?
- Knowing that the atomic weights of Cs<sup>+</sup> and Cl<sup>-</sup> are 133 and 35.5, respectively, calculate the density (g/cm<sup>3</sup>) of CsCl in crystalline form. (Hint: Avogadro's number  $N_A = 6.02 \times 10^{23}$  is the number of atoms in one mole (weight of 1 mole = atomic weight in grams).
- In contrast to CsCl, NaCl crystal has a different unit cell. Draw the schematic of the unit cell of NaCl crystal. Find  $a$  for NaCl if the ionic radius of Na<sup>+</sup> is 1.02 Å.



2. Considering what you have learned in class for crystal structures and unit cells, research and explain the difference in density of aluminum, magnesium and titanium. Which one is the lightest material? Comment on the applications and considerations for use of these metals for manufacturing structures for automobile and bike parts.

3. A simple vacuum tube system for photoelectric experiment is shown. The electrode under light illumination is made of Platinum with a work function of 5.25 eV.

- Draw the direction of the photocurrent and the positive and negative poles for voltage  $V$  that is required for reducing the photocurrent to zero.
- We use light sources with wavelengths 190, 220, 300, 400, and 500 nm to study photoelectric effect. What are frequency (Hz) and energy (eV) of photons for each light source? Plot the voltage  $V$  required for reducing the photocurrent to zero as a function of the frequency of the light source.
- If a Lithium electrode with work function of 2.9 eV is used, what are the values of voltage  $V$  for reducing the photocurrent to zero.

