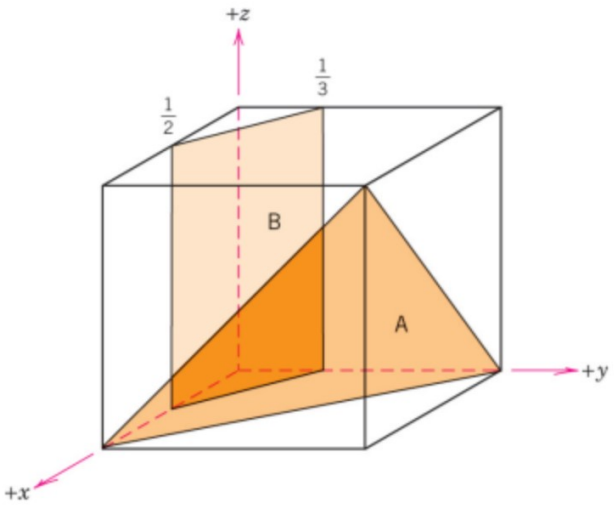
1. a) Determine the indices for the planes shown in the unit cell below. Indicate the origin used.



(b) Sketch a unit cell below and draw the (101) and (021) planes.

2. Copper has an atomic radius of 0.128 nm, an FCC crystal structure, and an atomic weight of 63.5 g/mol. Compute its theoretical density and compare with the measured density (8.94 g/cm^3).

3. The metal niobium (Nb) has a BCC crystal structure. If the angle of diffraction for the (211) set of planes occurs at 75.99° (first-order reflection) when monochromatic x-radiation having a wavelength of 0.1659 nm is used, compute the following:
    a. The interplanar spacing for this set of planes
    b. The atomic radius for the Nb atom

4. Bragg's law for x-ray diffraction is given as $n\lambda = 2d \sin\theta$. Show how this relationship is derived, using two parallel planes of atoms (with interplanar spacing d), such that the extra path length for parallel x-ray beams (wavelength λ) is equal to a multiple (n) of λ, to cause constructive interference.

5. Calculate the number of vacancies per cubic meter in gold (Au) at 900°C. The energy for vacancy formation is 0.98 eV/atom. Furthermore, the density and atomic weight for Au are 18.63 g/cm3 (at 900°C) and 196.9 g/mol, respectively.