1. **Diffraction powder analysis**

   Specimens of three different monatomic cubic crystals are analyzed using the powder method and peaks are found in the x-ray spectra at the following angles. One of the crystals is fcc, one is bcc and one has the diamond structure. Note that angle between the scattered $\vec{k'}$ and incident wavevector $\vec{k}$ is given in the table.

A	B	C
44.2^o	$28.8\ ^o$	42.8^o
49.2	41.0	73.2
72.0	50.8	89.0
87.3	59.6	115.0

   (a) Identify the crystal structure of A,B and C.

   (b) If the wavelength of the incident X-ray beam is 1.54 Å, what is the length of the side of the conventional cube in each case ?

   (c) If the diamond structure were replaced by a cubic zinc sulfide structure with a cubic unit cell of the same side, at what angles would the first four lines in the pattern now occur?

2. **Powder Diffraction of *hcp* and *fcc* crystals**
   Cobalt has two forms: $\alpha-$Co, with *hcp* structure (in-plane atomic spacing of a=2.51 Å and β-Co, with *fcc* structure (lattice spacing of a_{cubic}=3.55 Å). Note that for a has different meanings in α and β structures. Assume that the *hcp* structure has the ideal c/a ratio. Calculate and compare the angles (2θ) of the first five X-ray diffraction peaks assuming Cu Kα radiation where $\lambda = 1.54$Å is used.

3. **Effect of Cubic-Tetragonal Transition on powder x-ray pattern**

   CuV_2S_4 is a material that is cubic at 300 K but undergoes a transformation from a cubic to a tetragonal bravais lattice at 90 K . For T just above 90 K the cubic lattice parameter a=9.788 Å. Just below the transition temperature a=9.793 Å and c=9.775 Å. Determine the diffraction angles θ of the (100), (110), (111), (200) and (120) peaks in the cubic powder xray diffraction pattern and the splitting of these peaks in the tetragonal phase. Assume $\lambda = 1.54$ Å.