Condensed Matter Physics: Workshop 2

Summary: The material in this workshop will show how you can use an x-ray diffraction pattern to identify the lattice type and the lattice parameter of a crystalline material. It requires knowledge of crystal structures, Miller indices, Bragg scattering, Bragg's Law and structure factor calculations. This was covered in lectures 3 and 4.

An x-ray diffraction measurement is performed on a powdered sample. There are five peaks observed. The 2θ values are:

Peak	2θ (degrees)
1	38.11
2	44.29
3	64.43
4	77.38
5	81.53

The x-ray wavelength from the Cu $K\alpha$ line is $\lambda = 0.15418$ nm.

a. In small groups discuss each of the terms:
    i.   Miller Indices.
    ii. Bragg scattering and Bragg's Law.
    iii. Structure Factor.

b. Determine the N value for each observed peak (where $N = h^2 + k^2 + l^2$).

c. Determine the lattice parameter a (you may assume a cubic structure). Hence confirm if the material is aluminium ($a = 0.405$ nm) or silver ($a = 0.409$ nm).

d. Using structure factor calculations and the N values obtained in (b) above show that the lattice of this material has a face centred cubic structure.