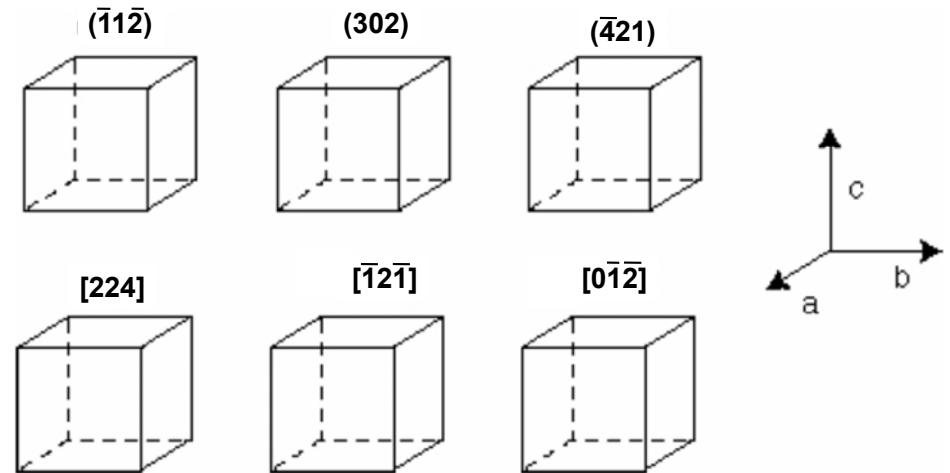# MATE 318

Spring 2025

Homework 1

Due: March 11th, 2025

Group submission (up to 3 students per group) is allowed.

Question 1

Draw the three planes and three directions given below.

$(\bar{1}1\bar{2})$ (302) $(\bar{4}21)$

$[224]$ $[\bar{1}2\bar{1}]$ $[0\bar{1}\bar{2}]$

Question 2

Find the Miller indices of a plane that makes intercepts on a, b, c axes equal to 3 nm, 4 nm and 2 nm in a tetragonal crystal with the c/a ratio of 1.5

Question 3

The figure below is the reciprocal lattice of a cubic system with a lattice parameter of 4 Angstroms.
a) Use this figure and find the angle between (140) and (310) planes
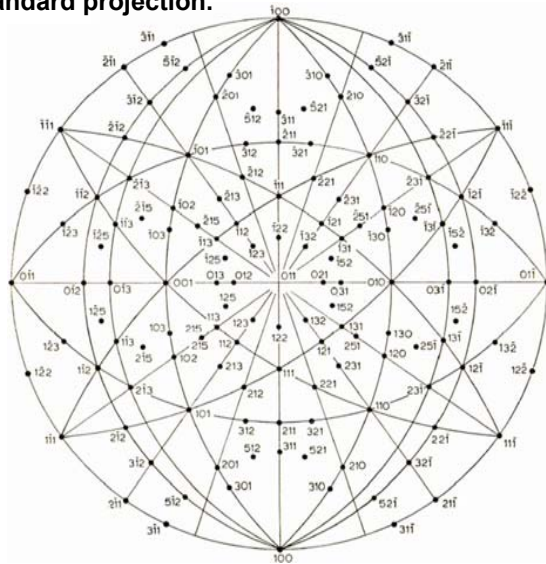b) Verify your result in a) through analytical solution.
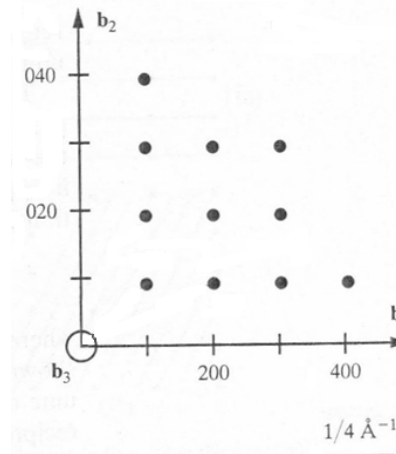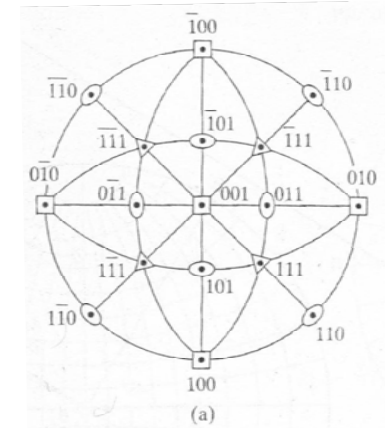
Question 4

For a cubic system:
a) Find an axis (direction) which is parallel to both (110) and (100).
b) Suggest three more planes which are parallel to the same axis in (a). Show them in (011) standard projection.

Question 5

Using the standard (001) stereographic projection for a CUBIC crystal shown below as a starting point, show the positions of the (-1 0 0), (-1 0 1), (1 0 1) and (1 0 0) poles for a TETRAGONAL crystal, with $c = 1.59\ a$. (HINT: Think about how the projected poles move as the crystal distorts from cubic to tetragonal.)

(a)

Question 6

The air absorption of X-rays can cause troubles, especially with longer wavelength X-rays.

a) Calculate the transmission factor (I_x/I_o) of Mo K_α x-rays (0.071 nm) by one meter of air,
b) How far should Mo K_α travel to have I_x/I_o of 1/10000?

Assume that air has chemical composition of 75.4% N_2, 23.2% O_2 and 1.4% Ar by weight with a density of 1.29×10^{-3} g/cm^3.