Problem 1 (10 points):

Lattice vectors are given as

$\mathbf{a} = \frac{a}{2}\mathbf{x}_0 - \frac{\sqrt{3}a}{2}\mathbf{y}_0$; $\mathbf{b} = \frac{a}{2}\mathbf{x}_0 + \frac{\sqrt{3}a}{2}\mathbf{y}_0$; $\mathrm{c} = c\mathbf{z}_0$, where $\mathbf{x}_0$, $\mathbf{y}_0$ a $\mathbf{z}_0$ are vectors of orthonormal base and *a*, *b* are given lattice constants.

a) Find which type of Brawais lattice it is.
b) Find *a*, *b* and c and all of angles between them.
c) Draw the unit cell, find all the axis of symmetry with some *n*-fold symmetry, where $n > 1$ and find *n* to every axis.
d) Calculate the volume of the given cell.
e) Find vectors of the unit cell of the reciprocal lattice.
f) Calculate the volume of the unit cell of the reciprocal lattice.

Problem 2 (10 points):

Find the heating capacity for constant pressure C_p, express it as a function of entropy *S* and some of variables *p*, *V* and *T*.

Question 1 (5 points):

Which basic models for heating capacity of solid matter (calculated from ions) exists? Which are their assumptions? Express mean energy of one degree of freedom for each. What relationship has this quantity to the total inner energy?

Question 2 (5 points):

Derive Laue diffraction conditions. Explain the geometry and explain, on which possible lines/planes can go to the diffraction.

Question 3 (5 points):

What are quasicrystals? How are defined? What is the difference between them and crystals? Which are some of their unit cells?

Question 4 (5 points):

Find all of possible unit cell categories according their rotation symmetry for two dimensional space. How much of them exist and which symmetry they have?