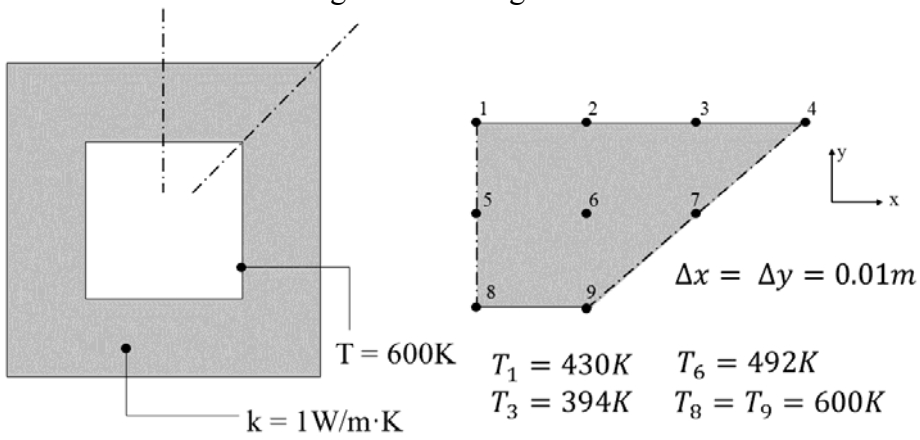
MIE 313 TA Application Question:

Provide a detailed solution for this question, and indicate in a different colour how you would allocate marks to this question (if it was on a quiz or exam).

Consider the following square channel. The inner surface of the channel is at a uniform temperature of 600K, and the outer surface is exposed to convection with a fluid at 300K and a convection coefficient of 50W/m^2·K. Assume steady state conditions. Taking advantage of symmetry in the channel, heat transfer is to be modeled using the 2-dimensional grid shown in the figure below. Some nodal temperatures have been measured and are given in the figure.



a) State all assumptions.
b) Derive the finite-difference equations for nodes 2, 4, and 7.
c) Determine the temperatures: T_2, T_4, and T_7, in K.
d) Calculate the heat loss per unit length from the channel.