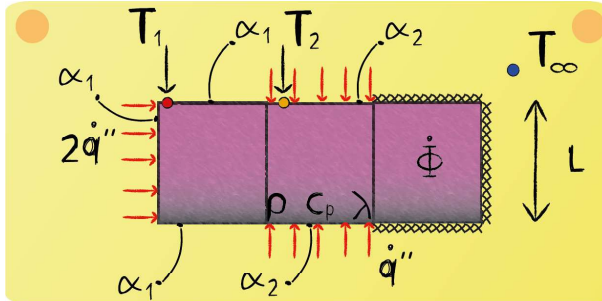


Lecture 13 - Question 10



The left cube is subjected to a constant heat flux entering, but is losing heat from its free surfaces because of convection. All the free surfaces of the cube in the middle are subjected to a constant heat flux entering, as well as heat leaving due to convection. The right cube is fully adiabatic, except for the surface touching the middle cube, and is losing heat because of a sink. Develop an energy balance to determine the rate of heat being extracted by the sink per unit volume. Assume the temperature to be homogeneous, the heat transfer to be steady-state and neglect radiation.

Energy Balance:

$$\dot{Q}_{in} - \dot{\Phi} = 0$$



Heat Fluxes:

$$\dot{Q}_{in} = 6\dot{q}''L^2 - L^2 (5\alpha_1 (T_1 - T_\infty) + 4\alpha_2 (T_2 - T_\infty))$$

$$\dot{\Phi} = \dot{\Phi}''' L^3$$