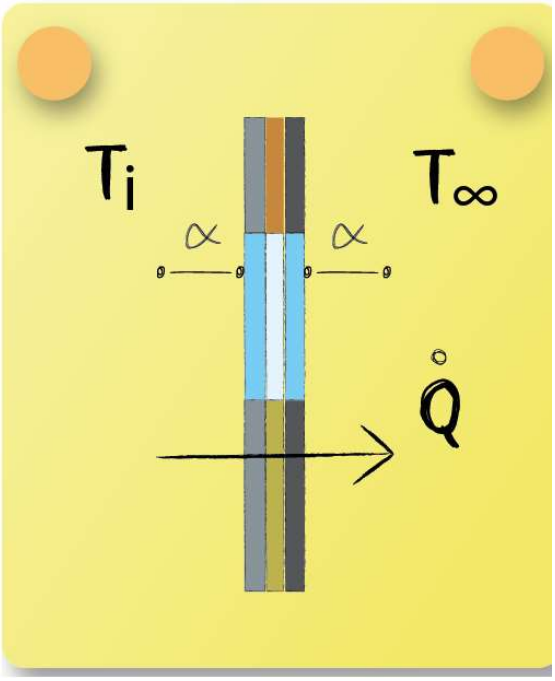
Lecture 7 - Question 1



A cross section of the wall of a train cabin can be seen in the figure. The wall consists out of a part that exists out of three layers and double insulation glass. The double glass has stagnant argon gas in between. The constant indoor and outdoor temperatures are T_i and T_∞. Assume one-dimensional steady-state heat transfer. When determining the rate of heat transfer, which network of resistors is correct for the situation described. Note that no simplifications have been made by simplifying series or parallel networks.

No parallel connected resistors.
From the figure it can be seen that the cross sectional area per layer remains constant, which is the height multiplied by the length of the cabin.
As there is only a temperature gradient in horizontal direction, one-dimensional heat transfer can be assumed.
The material properties of a train wall will not change over time.
The temperatures of the surrounding fluids remain constant, implying that the temperature gradient will not change. Since this is the driving force when it comes to heat transfer, steady-state heat transfer can be assumed.
The resistor network will exist out of parallel connected resistors. This because the serial chains of -aluminium (light grey)-foam (brown)-plastic (dark grey)- and -glass (blue)-argon (white)-glass(blue)- will be connected parallel.