W03

A aluminum conductor transmission line carries an electric current of 100 A, and has a resistance of 0.004 ohm per meter length. A transverse wind flow is passing the lines at a velocity of 40 km/h.

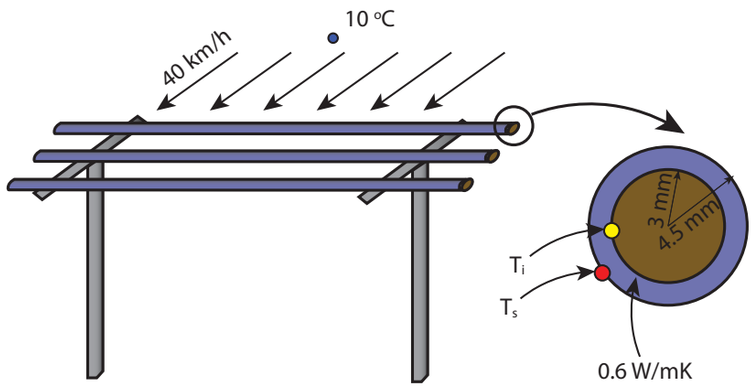

Figure 3: Transmission lines subjected to convection

1. Determine the Reynolds number. Clearly state on the assumptions that are made.
2. Determine the surface temperature T_s. Evaluate whether the assumptions made in question a) were correct. What can be done to increase the quality of the results?
3. What will happen to the flow if the flow temperature increases? Assume T_s to remain constant.
4. Determine the interface temperature T_i
5. Provide a sketch of the temperature profile in radial direction of The transmission line.
   Note: Also include the temperature profile outside the transmission line.

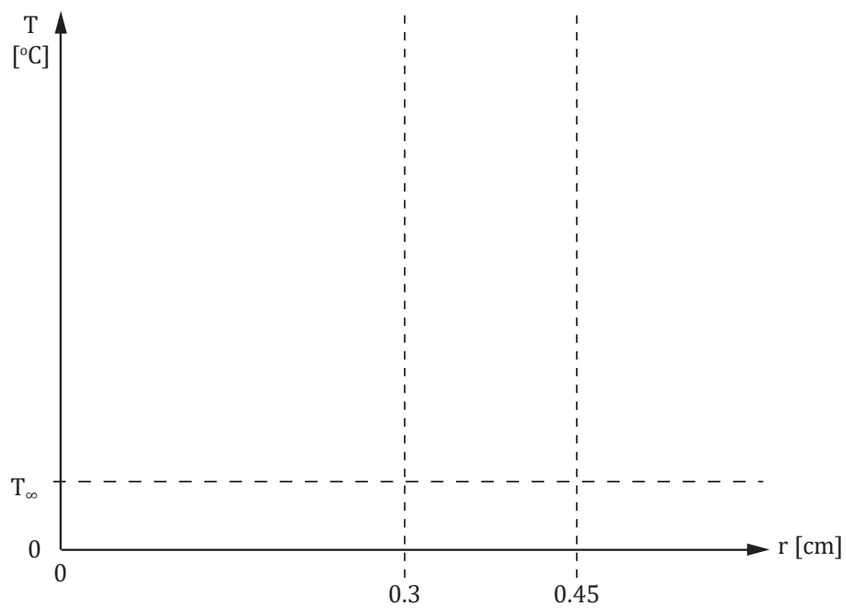

Figure 4: Transmission lines subjected to convection

Table 1: Air properties at 1 atm pressure

Temperature °C	Density kg/m^3	Specific heat J/kgK	Thermal conductivity W/m·K	Thermal diffusivity m^2/s	Dynamic viscosity kg/m·s	Kinematic viscosity m^2/s	Prandtl number
0	1.292	1006	0.02364	$1.818{\cdot}10^{-5}$	$1.729{\cdot}10^{-5}$	$1.338{\cdot}10^{-5}$	0.7362
10	1.246	1006	0.02439	$1.944{\cdot}10^{-5}$	$1.778{\cdot}10^{-5}$	$1.426{\cdot}10^{-5}$	0.7336
20	1.204	1007	0.02514	$2.074{\cdot}10^{-5}$	$1.825{\cdot}10^{-5}$	$1.516{\cdot}10^{-5}$	0.7309
30	1.164	1007	0.02588	$2.208{\cdot}10^{-5}$	$1.872{\cdot}10^{-5}$	$1.608{\cdot}10^{-5}$	0.7282
40	1.127	1007	0.02662	$2.346{\cdot}10^{-5}$	$1.918{\cdot}10^{-5}$	$1.702{\cdot}10^{-5}$	0.7255