# Approach

The approach below gives a guideline in how to solve the problems presented during this course. Correctly applying this approach will lead to a good understanding of the concepts presented in this course.

### Analysis

1 Explain the problem: which physical phenomena are important in this problem?

2 Make a sketch of the problem

3 Give the known variables (with the appropriate units!)

### Approach

1 Explain the assumptions you make to solve the problem

2 Show the solution method for solving the problem

### Elaboration

1 Show the calculation steps and explain the equations you use

2 Give references if values are found online or in tables

### Evaluation

1 Check the units of your solution

2 Is the answer realistic/expected?

3 Did you answer all the questions asked?

4 Iterate if this is required

# Assignment 3

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.

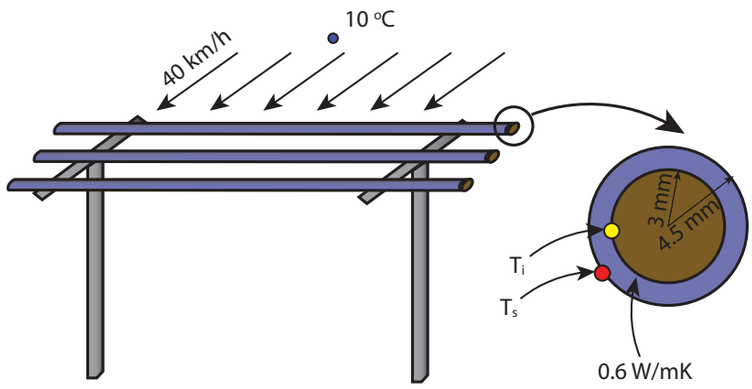


Figure 8: Transmission lines subjected to convection

a) Determine the Reynolds number. Clearly state on the assumptions that are made.

b) 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?

c) What will happen to the flow if the flow temperature increases? Assume $T_s$ to remain constant.

d) Determine the interface temperature $T_i$

e) Provide a sketch of the temperature profile in radial direction of The transmission line.
**Note:** Also include the temperature profile outside the transmission line.

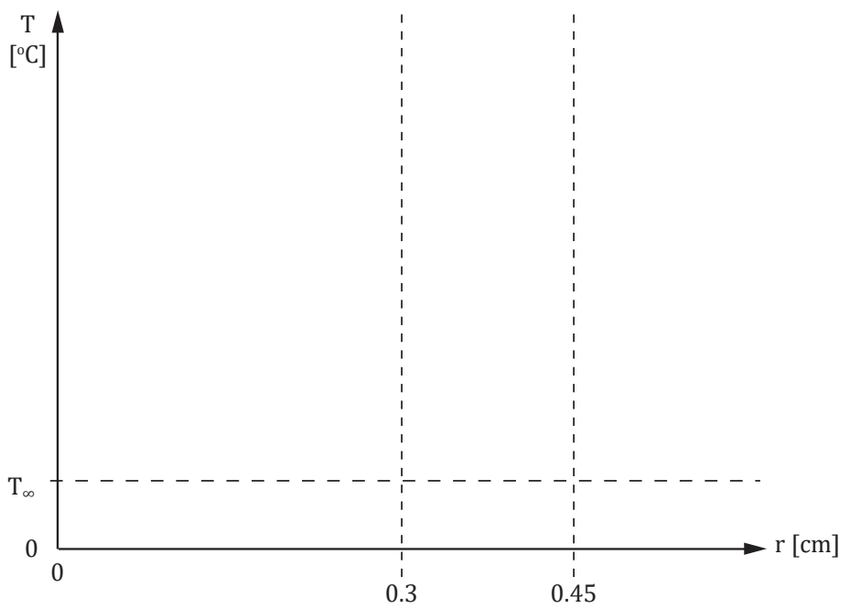


Figure 9: Transmission lines subjected to convection

| 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 |

Table 2: Air properties at 1 atm pressure