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

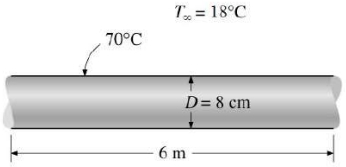
Evaluation

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

Lecture 4

4.1 Cooling of a hot water pipe

A 6-m-long section of a horizontal hot water pipe with a diameter of 8.0 cm passes through the basement of the Oosthorst. The temperature in the basement is 18 °C and the complete outer surface of the pipe is 70 °C. Determine the rate of heat loss from the pipe by convection.



4.2 Convection of heat from a coffee machine

When the can of a coffee machine is removed and the machine is still switched on, the heater plate just heats the air above. Consider a 16-cm-diameter circular heating plate in a surrounding which is at 20 °C. It is measured that the heater plate consumes 90 W of electricity. Assuming that 52.4% of this power is emitted by thermal radiation and the other part by natural convection, find the equilibrium temperature of the heater plate surface. Hint: some plastic and soldered parts directly around the heater plate have a melting point around 250 °C. The manufacturer guarantees that this temperature will not be exceeded.

4.3 Heat convection parameters

List all fluid and flow parameters influencing the heat transfer coefficient h, directly or indirectly, for forced as well as for natural convection. Explain how they affect the heat transfer coefficient.

4.4 Light bulb temperature

Consider a 25 W lightbulb with a light-efficiency of 10 %. The lightbulb has a diameter of 8.0 cm, and an outside temperature of 25 °C. When assuming all heat is lost due to natural convection, determine the surface temperature of the lightbulb.