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 5

A thermos flask is used to keep drinks hot. The flask has two walls separated by vacuum, to minimize the heat transfer. Initially, the fluid has a temperature of 90 ^oC. It can be assumed that body 1 has the same homogeneous temperature as the fluid. Furthermore body 1 has opaque properties, where body 2 can be considered to act as a black body at 10 ^oC.

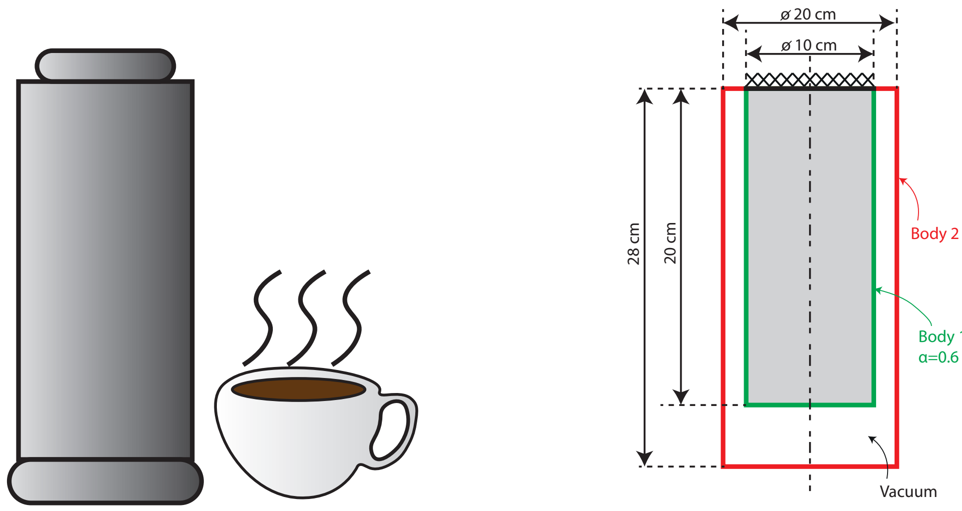

Figure 14: Thermos flask containing a hot fluid

a) Determine the view factor $F_{2i \rightarrow 1o}$.
(The subscripts 2i and 1o indicate the inner side of body 2 and outer side of body 1 respectively).

b) Give values for the emissivity ϵ, transmissivity τ and reflectivity ρ of bodies 1 and 2.

c) Determine the surface brightness of the outer-side of body 1.
Hint: Surface brightness = sum of the rates of heat transfer emitted, reflected, and transmitted.

d) Compute the **net** rate of heat transfer by radiation from the outer-side body 1 to the inner-side of body 2 at the given temperatures.

e) Based on the answer found in question d), how long will it take the fluid (c_p=1008 J/kgK, ρ = 1000 kg/m^3) to cool down 1 ^{o}C?

f) Reflect on your given answer in question e). Is it realistic ? If not, what is the implication for the time needed to heat up the soda by one degree if the assumption is not valid?