

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°C . 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°C .

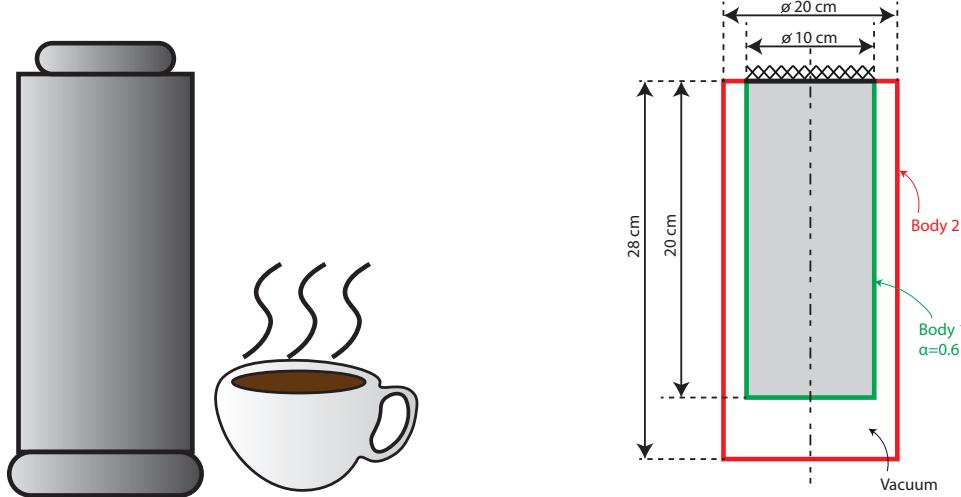


Figure 14: Thermos flask containing a hot fluid

- 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).
- Give values for the emissivity ϵ , transmissivity τ and reflectivity ρ of bodies 1 and 2.
- 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.
- 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.
- Based on the answer found in question d), how long will it take the fluid ($c_p=1008 \text{ J/kgK}$) to cool down 1°C ?
- 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?