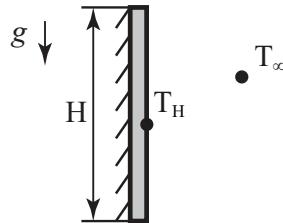
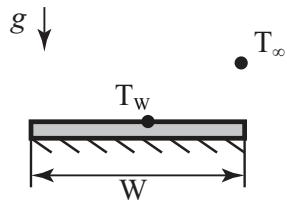


Exercise III.13 (Horizontal and vertical wall ★★):

Two heat-emitting surfaces (case 1: H height, case 2: W width) with the respective wall temperatures T_H and T_W are given. The quiescent environment has a temperature T_∞ .



(a) Case 1



(b) Case 2

Given parameters:

- Prandtl Number: $\text{Pr} = 1$
- Value range for laminar boundary layer: $1 \cdot 10^5 < \text{Gr}_L \text{Pr} < 1 \cdot 10^6$
- Geometrical ratio: $W = 2 \cdot H$
- Length of both plates: L
- Temperatures: $T_H = 2 \cdot T_W = 4 \cdot T_\infty$

Hint:

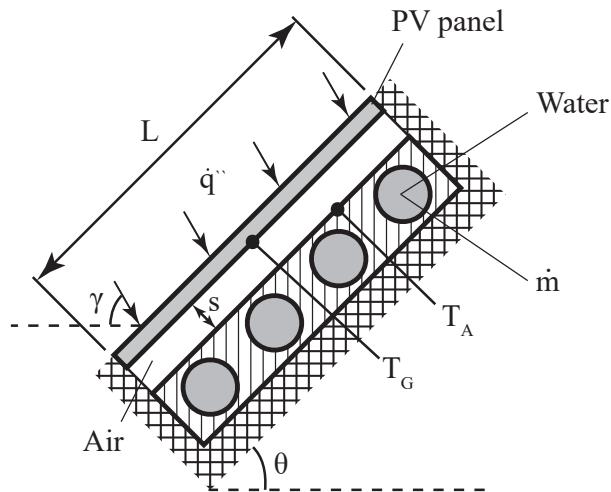
- The difference in average fluid properties between both cases is negligible.
- $L \gg W$

Tasks:

- a) Determine the ratio of the convective losses from the surfaces.

Exercise III.14 (PV-T Panel ★★):

PV-T panels, generating thermal and electrical power, are frequently inclined towards the sun to enhance their efficiency. The tilt angle, denoted as θ , plays a crucial role in determining the effectiveness of the solar panel. Radiation is incident upon a PV-T collector at an angle γ , and it possesses a constant heat density represented by \dot{q}'' . Within the tube collectors, water flows in, entering at a temperature T_{in} , and exits at a temperature T_{out} .

**Given parameters:**

- Collector height: $L = 0.8 \text{ m}$
- Collector width: $W = 3 \text{ m}$
- Space between absorber plate and glass cover: $s = 2 \text{ cm}$
- Heat flux density: $\dot{q}'' = 1000 \text{ W/m}^2$
- Heat flux angle: $\gamma = 60^\circ$
- Glass cover temperature: $T_G = 40 \text{ }^\circ\text{C}$
- Absorber plate temperature: $T_A = 100 \text{ }^\circ\text{C}$
- Air average density: $\rho = 1.05 \text{ kg/m}^3$
- Air average thermal conductivity: $\lambda = 0.029 \text{ W/mK}$
- Air average kinematic viscosity: $\nu = 1.9 \cdot 10^{-5} \text{ m}^2/\text{s}$
- Air average Prandtl number: $\text{Pr} = 0.71$
- Water inlet temperature: $T_{\text{in}} = 10 \text{ }^\circ\text{C}$
- Water mass flow rate: $\dot{m} = 0.01 \text{ kg/s}$
- Water average specific heat capacity: $c_p = 4.2 \text{ kJ/kgK}$
- Water outlet temperature:

$$T_{\text{out}} = T_{\text{in}} (2 + 2 \cdot \sin(2\gamma - \theta))$$

Hints:

- All incident radiation is absorbed by the collector.
- The back side of the absorber is heavily insulated.
- The process can be assumed to be steady-state.

Tasks:

- Determine the overall efficiency of the PV-T panel for $\theta = 0^\circ$.
- Reason what you expect to be the optimal tilt angle for the PV-T panel to have the highest generation of useful energy.
- Draw the temperature profile for the domain $0 \leq x \leq \infty$.

