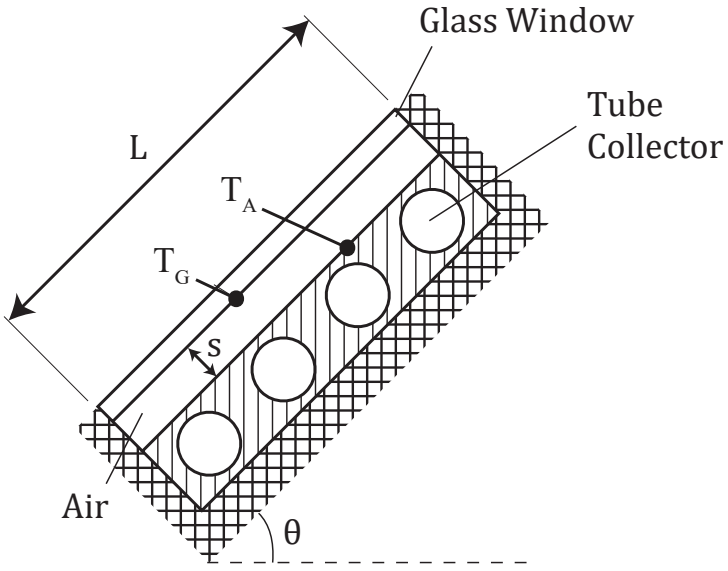
1.12 Solar collector ★

Often are solar collectors tilted up toward the sun, in order to obtain a greater efficiency. The tilt angle θ affects the rate of heat loss.

a) Determine the rate of heat loss for $\theta = 0^o$.

b) Determine the rate of heat loss for $\theta = 90^o$.



Hints:

- Radiation can be neglected.
- The back side of the absorber is heavily insulated.
- The inside glass temperature T_G remains the same in both scenarios.

Given parameters:

Solar Collector properties:

- Collector height: $L = 0.8$ m
- Collector width: $w = 3$ m
- Space between absorber plate and glass cover: $s = 2$ cm
- Glass cover temperature: $T_G = 40$ °C
- Absorber plate temperature: $T_A = 80$ °C

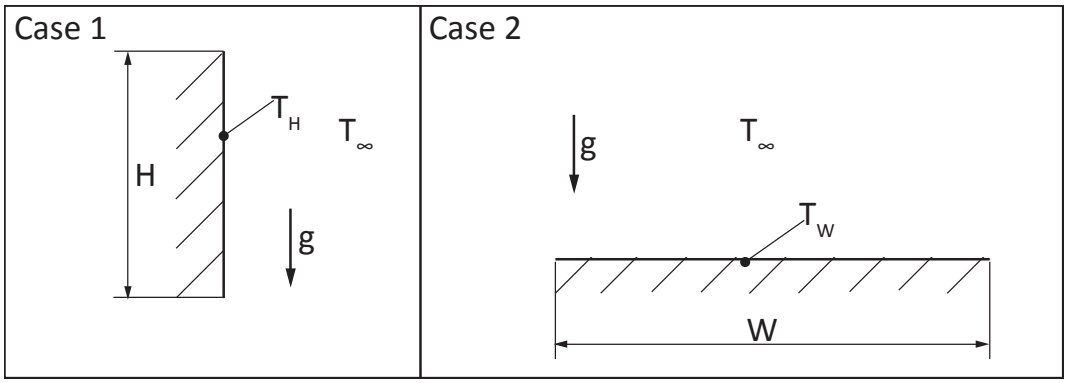
Average air properties inside the collector:

- Density: $\rho = 1.045$ kg/m^3
- Thermal conductivity: $\lambda = 0.0286$ W/mK
- Kinematic viscosity: $\nu = 1.9305 \cdot 10^{-5}$ m^2/s
- Prandtl number: Pr = 0.7103

1.13 Horizontal & 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_1.

a) Determine the ratio of the two heat transfer coefficients α_H and α_H of the surfaces.



Hints:

- The material properties remain constant.

Given parameters:

- Prandtl Number: $\mathrm{Pr} = 1$
- Value range for laminar boundary layer: $1 \cdot 10^5 < \mathrm{Gr_L Pr} < 1 \cdot 10^6$
- Geometrical ratio: $W = 2 \cdot H$
- Temperatures: $T_\mathrm{H} = 2 \cdot T_\mathrm{W} = 4 \cdot T_\infty$