Air at atmospheric pressure is enclosed between two vertical plates of length 1m each separated by 2 cm. The temperatures of the plates are 60°C and 100°C, respectively. Calculate the heat flux across the space.

In[1]:=
```
SetDirectory[NotebookDirectory[]];
airProps = Import["../air_props.csv"];
airProps[[2 ;;, 5]] = airProps[[2 ;;, 5]] 10^-3;
airProps[[2 ;;, 6]] = airProps[[2 ;;, 6]] 10^-5;
airProps[[2 ;;, 7]] = airProps[[2 ;;, 7]] 10^-6;
airProps[[2 ;;, 8]] = airProps[[2 ;;, 8]] 10^-6;
νI = Interpolation[airProps[[2 ;;, {1, 7}]]];
βI = Interpolation[airProps[[2 ;;, {1, 5}]] ];
PrI = Interpolation[airProps[[2 ;;, {1, 9}]]];
αI = Interpolation[airProps[[2 ;;, {1, 8}]]];
κI = Interpolation[airProps[[2 ;;, {1, 4}]]];
μI = Interpolation[airProps[[2 ;;, {1, 6}]]];
```

In[13]:=
$$Gr_L = \frac{g\,\beta\,(T_h - T_c)\,L^3}{\nu^2};$$
$$TFilm = \frac{T_h + T_c}{2};$$
```
propertyVals = {ν → νI[TFilm], α → αI[TFilm],
    β → βI[TFilm], Pr → PrI[TFilm], κ → κI[TFilm], g → 9.81};
problem = {H → 1, L → 0.02, T_h → 100, T_c → 60};
solverRule = Join[propertyVals /. problem, problem];
```

In[18]:=
```
Gr_L /. solverRule
```

Out[18]=
```
20 260.6
```

In[19]:=
$$Nu_L = 0.65\,Gr_L^{1/3}\left(\frac{H}{L}\right)^{-1/9};\quad h_L = Nu_L\,\frac{\kappa}{L};$$
$$q = h_L\,L\,(T_h - T_c);$$

In[21]:=
```
Nu_L /. solverRule
```

Out[21]=
```
11.4733
```

In[22]:=
```
h_L /. solverRule
```

Out[22]=
```
17.1526
```

In[23]:=
```
q /. solverRule
```

Out[23]=
```
13.7221
```