

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[*]:= 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}]]];
```

$$\text{In[*]}:= \text{Gr}_L = \frac{g \beta (T_h - T_c) L^3}{\nu^2};$$

$$\text{TFilm} = \frac{T_h + T_c}{2};$$

```
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[*]:= Gr_L /. solverRule
```

```
Out[*]=
20260.6
```

$$\text{In[*]}:= \text{Nu}_L = 0.65 \text{Gr}_L^{1/3} \left(\frac{H}{L}\right)^{-1/9}; \quad h_L = \text{Nu}_L \frac{\kappa}{L};$$

$$q = h_L L (T_h - T_c);$$

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

```
Out[*]=
11.4733
```

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

```
Out[*]=
17.1526
```

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

```
Out[*]=
13.7221
```