Part D

$x^* = \frac{x}{Lx}$ $y^* = \frac{y}{Ly}$ $T^* = \frac{T}{T_0}$ ($T_0 = 20°C$) $t = \frac{Lx\,Ly}{K}\,t^*$

$x = x^* Lx$ $y = Ly\,y^*$ $T = T_0 T^*$ $\frac{[m^2]}{[\frac{m^2}{s}]} = s$

Dimensionless form

$$\frac{T_0}{\left(\frac{Lx\,Ly}{K}\right)}\frac{\partial T^*}{\partial t^*} = -v_x\left(\frac{T_0}{Lx}\right)\frac{\partial T}{\partial x} - v_y\left(\frac{T_0}{Ly}\right)\frac{\partial T}{\partial y} + K\left(\frac{T_0}{(Lx)^2}\frac{\partial^2 T}{\partial x^2} + \frac{T_0}{(Ly)^2}\frac{\partial^2 T}{\partial y^2}\right)$$

$$\frac{\partial T^*}{\partial t^*} = -v_x\left(\frac{Ly}{K}\right)\frac{\partial T}{\partial x} - v_y\left(\frac{Lx}{K}\right)\frac{\partial T}{\partial y} + \frac{Ly}{Lx}\frac{\partial^2 T}{\partial x^2} + \frac{Lx}{Ly}\frac{\partial^2 T}{\partial y^2}$$

($\frac{Ly}{Lx}$: dimensionless group; $\frac{Lx}{Ly}$: dimensionless)

$\frac{m}{s} \times \frac{m}{m^2/s} = 1 \Rightarrow$ dimensionless group

for calculating a Peclet number we can use

$$\frac{\text{magnitude of velocity} \times Ly}{K} = \frac{\text{advective transport}}{\text{diffusive transport}}$$

Reynolds number

$$\frac{\text{magnitude of velocity}}{\nu} \times Ly = \frac{\text{inertia}}{\text{viscous}}$$