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Advanced Convection HW1

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1 PROBLEM 1

When $u_2 = 0$ and the flow is entirely in the x-direction, the governing equations can be simplified as follows

$$u_1 \frac{\partial u_1}{\partial x_1} + \frac{1}{\rho} \frac{\partial p}{\partial x_1} = 0 \tag{1.1}$$

$$\frac{\partial p}{\partial x_2} = 0 \tag{1.2}$$

where the body-force are neglected.
It can be concluded that pressure doesn't change in y-direction when x is fixed.
Also, pressure gradient in x-direction is the driven force of the fluids.

2 PROBLEM 2

When it comes to constant property

$$\frac{\partial}{\partial y}(k\frac{\partial T}{\partial y}) = k\frac{\partial T^2}{\partial^2 y} \tag{2.1}$$

Since $i = C_p T$ when considering ideal gas

$$\rho u \frac{\partial i}{\partial x} + \rho v \frac{\partial i}{\partial y} = \rho C_p (u\frac{\partial T}{\partial x} + v\frac{\partial T}{\partial y}) \tag{2.2}$$

As $(\frac{\partial u}{\partial y})^2$ is a small term compared to other terms, it can be seen as 0.
(Sorry, haven't figured out how to eliminate $\frac{\partial p}{\partial x}$...)

3 PROBLEM 3