$$\begin{cases} -\varepsilon \Delta u + \underline{b} \cdot \nabla u = f & \text{in } \Omega \\ u = g & \text{on } \partial\Omega \end{cases}$$

$$u_{ex} = \sin(\pi x)\cos(\pi y)$$

$$\nabla u_{ex} = \begin{bmatrix} \pi \cos(\pi x)\cos(\pi y) \\ -\pi \sin(\pi x)\sin(\pi y) \end{bmatrix}$$

$$g := u_{ex}$$

$$\Delta u = -\pi^2 \sin(\pi x)\cos(\pi y) - \pi^2 \sin(\pi x)\cos(\pi y) =$$

$$= -2\pi^2 \sin(\pi x)\cos(\pi y) = -2\pi^2 u_{ex}$$

$$\underline{b} = \begin{bmatrix} 1 \\ 1 \end{bmatrix} \rightarrow \underline{b} \cdot \nabla u_{ex} = \pi \cos(\pi(x+y))$$

$$f := -\varepsilon \Delta u_{ex} + \underline{b} \cdot \nabla u_{ex} = 2\varepsilon \pi^2 u_{ex} + \pi \cos(\pi(x+y))$$

$$\begin{cases} -\varepsilon \Delta u + \underline{b} \cdot \nabla u = 2\varepsilon \pi^2 u_{ex} + \pi \cos(\pi(x+y)) & \text{in } \Omega \\ u = u_{ex} & \text{on } \partial\Omega \end{cases}$$