Unit 8 - Week 7

Week 7: Assignment

The due date for submitting this assignment has passed. As per our records you have not submitted this assignment.

1) Consider the flow of a viscous fluid of viscosity $\mu$ in a parallel plate microchannel of height $h$. The lower wall ($y = 0$) of the channel is hydrophobic with slip length $\beta$. The flow is driven by a constant pressure gradient $G = -d\mu/dx$ along the length of the channel. The expression for the axial velocity, $u(y)$ is

\[ u(y) = \frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) + \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

\[ u(y) = -\frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) - \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

\[ u(y) = \frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) - \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

\[ u(y) = -\frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) + \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

No, the answer is incorrect.

Score: 0

Accepted Answers:

2) The expression for the volumetric flow at any cross-section for problem 1 is

\[ \frac{1}{\rho} \frac{d\rho}{dx} + \frac{k^2}{4\mu(\phi + \beta)} \frac{d\phi}{dx} \]

\[ \frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) + \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

\[ \frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) - \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

\[ \frac{1}{2\mu} \frac{d\mu}{dx} (y^2 - h^2) - \frac{k^2}{2\mu(\phi + \beta)} \frac{d\phi}{dx} (y - h) \]

No, the answer is incorrect.

Score: 0

Accepted Answers:

3) Consider an electroosmotic flow which is driven by a constant electric field $E_0$ along the axis ($x$-axis) of the parallel plate microchannel whose height is $h$ with the surface potential $\zeta < \phi_0$ and the walls are hydrophobic with slip length $\beta$. The Debye layer is considered to thin i.e., $kh \gg 1$, where $k^{-1} = \lambda$, the Debye length. Assume Debye-Hückel approximation to hold. Consider the lower wall of the channel as the $x$-axis. The expression for $d\zeta/dx$ is:

\[ U_{HS} \kappa e^{-xy} \]

\[ -U_{HS} \kappa e^{-xy} \]

\[ U_{HS} \kappa e^{xy} \]

Due on 2017-03-16, 23:59 IST.
For problem 7, Consider the boundary value problem
\[ \frac{d^2 y}{dx^2} = x + y, \quad y(0) = y(1) = 0. \] Then \( y(0.25) \) is

- a) -0.03488
- b) 0.03488
- c) 0.06976
- d) -0.06976

No, the answer is incorrect.
Score: 0
Accepted Answers:
- a) 0.05632
- b) -0.11264

For problem 8, \( y(0.5) \) is

- a) -0.03488
- b) 0.03488
- c) 0.06976
- d) -0.06976

No, the answer is incorrect.
Score: 0
Accepted Answers:
9) \( y(0.75) \) for problem 1 is

- a) -0.03488
- b) -0.01003
- c) 0.05003
- d) -0.05003

No, the answer is incorrect.
Score: 0
Accepted Answers:
c) -0.05003

10) If the BVP given in problem 7 is computed for \( h = 0.01 \) then the order of the truncation error and the number of linear algebraic equations to solve are

- a) \( O(10^{-2}) \) and 99
- b) \( O(10^{-4}) \) and 99
- c) \( O(10^{-4}) \) and 49
- d) \( O(10^{-2}) \) and 49

No, the answer is incorrect.
Score: 0
Accepted Answers:
b) \( O(10^{-4}) \) and 99