Consider the electroosmotic flow of NaCl solution in a slit microchannel with half height, \( h = 50 \, \text{nm} \) and wall \( \zeta \)-potential 0.05 V under the influence of an external electric field of 1000 V/m acting along the axis of channel (x-axis). The bulk ionic concentration of NaCl solution is \( 1 \, \text{mol}/\text{m}^3 \). Consider the mid-plane of the microchannel as the x-axis. Find the electric potential, \( \phi \) at \( y = 5 \, \text{nm} \). The required electrokinetic parameters for all subsequent problems can be taken same as in Week 5 assignment.

\[ \begin{align*}
A) & \quad 6.405 \times 10^{-4} \, \text{V} \\
B) & \quad 12.91 \times 10^{-4} \, \text{V} \\
C) & \quad 6.405 \times 10^{-3} \, \text{V} \\
D) & \quad 3.202 \times 10^{-4} \, \text{V}
\end{align*} \]

No, the answer is incorrect.
Score: 0
Accepted Answers:
A) \( 6.405 \times 10^{-4} \, \text{V} \)

2) Obtain the velocity along the x-axis i.e., \( u \) at \( y = 5 \, \text{nm} \) for the problem 1.

\[ \begin{align*}
A) & \quad 3.4324 \times 10^{-5} \, \text{m/s} \\
B) & \quad -3.4324 \times 10^{-5} \, \text{m/s} \\
C) & \quad 6.8648 \times 10^{-5} \, \text{m/s} \\
D) & \quad -6.8648 \times 10^{-5} \, \text{m/s}
\end{align*} \]

No, the answer is incorrect.
Score: 0
Accepted Answers:
B) \( -3.4324 \times 10^{-5} \, \text{m/s} \)

3) Find the volumetric flow per unit width for the problem 1.

\[ \begin{align*}
A) & \quad 5.6056 \times 10^{-12} \, \text{m}^3/\text{ms} \\
B) & \quad -5.6056 \times 10^{-10} \, \text{m}^3/\text{ms} \\
C) & \quad 1.4028 \times 10^{-12} \, \text{m}^3/\text{ms} \\
D) & \quad -2.8056 \times 10^{-12} \, \text{m}^3/\text{ms}
\end{align*} \]

No, the answer is incorrect.
Score: 0
Accepted Answers:
D) \( -2.8056 \times 10^{-12} \, \text{m}^3/\text{ms} \)

4) Find the current density at \( y = 5 \, \text{nm} \) for the problem 1.
Solve the following electroosmotic flow of 1 mol/l NaCl solution in a slit microchannel of channel half height, h=50 nm under the influence of an external electric field of 1000 V/m acting along the axis of the channel (x-axis). Consider the mid-plane of the microchannel as x-axis. Here the surface potentials are given as: \( \psi = \zeta_1 = 0 \text{V} \) at \( y = h \) and \( \psi = \zeta_2 = 0.05 \text{V} \) at \( y = -h \). Find the electric potential, \( \psi \) at \( y = 5 \text{nm} \).

A) \( 2.2336 \times 10^{-3} \text{V} \)
B) \( 1.1134 \times 10^{-4} \text{V} \)
C) \( 1.1134 \times 10^{-3} \text{V} \)
D) \( 2.2336 \times 10^{-4} \text{V} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
C) \( 1.1134 \times 10^{-3} \text{V} \)

Find the axial velocity \( u \) at \( y = 5 \text{nm} \) for the problem 5.

A) \( -5.31185 \times 10^{-5} \text{m/s} \)
B) \( 3.2156 \times 10^{-4} \text{m/s} \)
C) \( -6.4312 \times 10^{-4} \text{m/s} \)
D) \( 6.4312 \times 10^{-4} \text{m/s} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
A) \( -5.31185 \times 10^{-5} \text{m/s} \)

Calculate the volumetric flow per unit width for problem 5.

A) \( -1.41516185 \times 10^{-12} \text{m}^3/\text{m/s} \)
B) \( -4.20845 \times 10^{-12} \text{m}^3/\text{m/s} \)
C) \( -1.41516185 \times 10^{-10} \text{m}^3/\text{m/s} \)
D) \( -5.6606474 \times 10^{-12} \text{m}^3/\text{m/s} \)

No, the answer is incorrect.
Score: 0
Accepted Answers:
B) \( -4.20845 \times 10^{-12} \text{m}^3/\text{m/s} \)

Find the current density at \( y = 5 \text{nm} \) for the problem 5.

A) \( 0.988678464 \text{A/m}^2 \)
B) \( 4.9434 \text{A/m}^2 \)
C) \( 13.1 \text{A/m}^2 \)
9) Consider a combined electroosmosis and pressure driven flow of 1 mol/m$^3$ NaCl electrolyte solution in a slit microchannel of half channel height $h = 50$ nm under the influence of an external electric field of 1000 V/m acting along the channel along with a constant pressure gradient ($dp/dx$) along the length of the channel. Consider the mid-plane of the microchannel as the x-axis. The channel wall $\zeta$-potential is 0.1 V. The constant axial pressure gradient $dp/dx = -0.36 \, Pa/m$. The axial velocity, $u$ at $y = 10$ nm is

- A) $6.8292 \times 10^{-5} \, m/s$
- B) $-6.8292 \times 10^{-5} \, m/s$
- C) $-3.4146 \times 10^{-5} \, m/s$
- D) $3.4146 \times 10^{-5} \, m/s$

No, the answer is incorrect.
Score: 0
Accepted Answers:

10) Find the volumetric fluid flow rate per unit width for the problem 9.

- A) $-5.61 \times 10^{-5} \, m^3/s$
- B) $1.112 \times 10^{-5} \, m^3/s$
- C) $5.61 \times 10^{-5} \, m^3/s$
- D) $2.805 \times 10^{-5} \, m^3/s$

No, the answer is incorrect.
Score: 0
Accepted Answers: