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NPTEL

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Courses » Modeling Transport Phenomena of Microparticles

Announcements

Course

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Unit 7 - Week 6

Course outline

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Week 1

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Week 6

Lecture 26: Electroosmotic flow (EOF) of ionized fluid

Lecture 27: EOF in micro-channel

Lecture 28: Non-linear EOF, Overlapping Debye Layer

Lecture 29: Two-dimensional EOF

Lecture 30: EOF near heterogeneous surface potential

Quiz : Week 6: Assignment

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Week 6: Assignment

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

Due on 2017-03-08, 23:59 IST

1) Consider the electroosmotic flow of NaCl solution in a slit microchannel with half height, $h = 50\text{nm}$ and wall ζ -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 1mol/m^3 . Consider the mid-plane of the microchannel as the x -axis. Find the electric potential, ψ at $y = 5\text{nm}$. The required electrokinetic parameters for all subsequent problems can be taken same as in Week 5 assignment.

1 point

- A) $6.405 \times 10^{-4}\text{ V}$
- B) $12.91 \times 10^{-4}\text{ V}$
- C) $6.405 \times 10^{-3}\text{ V}$
- D) $3.202 \times 10^{-4}\text{ V}$

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.

1 point

- A) $3.4324 \times 10^{-5}\text{ m/s}$
- B) $-3.4324 \times 10^{-5}\text{ m/s}$
- C) $6.8648 \times 10^{-5}\text{ m/s}$
- D) $-6.8648 \times 10^{-5}\text{ m/s}$

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.

1 point

- A) $-5.6056 \times 10^{-12}\text{ m}^3/\text{ms}$
- B) $-5.6056 \times 10^{-10}\text{ m}^3/\text{ms}$
- C) $-1.4028 \times 10^{-12}\text{ m}^3/\text{ms}$
- D) $-2.8056 \times 10^{-12}\text{ m}^3/\text{ms}$

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.

1 point

-
- A) $4.251 A/m^2$
-
- B) $12.7673 A/m^2$
-
- C) $17.03 A/m^2$
-
- D) $8.519046 A/m^2$

No, the answer is incorrect.

Score: 0

Accepted Answers:

B) $12.7673 A/m^2$

5)

Solve the following electroosmotic flow of $1 \text{ mol}/m^3$ NaCl solution in slit microchannel of channel half height $h=50 \text{ nm}$ under the influence of an external electric field of $1000 \text{ V}/m$ 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 : $\psi = \zeta_1 = 0.1 \text{ V}$ at $y = h$ and $\psi = \zeta_2 = 0.05 \text{ V}$ at $y = -h$. Find the electric potential, ψ 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) $1.1134 \times 10^{-3} \text{ V}$

6) 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) $-6.4312 \times 10^{-5} \text{ m/s}$
-
- D) $6.4312 \times 10^{-4} \text{ m/s}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

A) $-5.31185 \times 10^{-5} \text{ m/s}$

7) Calculate the volumetric flow per unit width for problem 5.

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

No, the answer is incorrect.

Score: 0

Accepted Answers:

B) $-4.20845 \times 10^{-12} \text{ m}^3/\text{ms}$

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

-
- A) $0.988678464 A/m^2$
-
- B) $4.9434 A/m^2$
-
- C) $13.1 A/m^2$



1 point



D) $19.7734 A/m^2$

No, the answer is incorrect.

Score: 0

Accepted Answers:

C) $13.1 A/m^2$

9)

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

A) $6.8292 \times 10^{-5} \text{ m}/\text{s}$

B) $-6.8292 \times 10^{-5} \text{ m}/\text{s}$

C) $-3.4146 \times 10^{-5} \text{ m}/\text{s}$

D) $3.4146 \times 10^{-5} \text{ m}/\text{s}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

B) $-6.8292 \times 10^{-5} \text{ m}/\text{s}$

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

A) $-5.61 \times 10^{-5} \text{ m}^3/\text{ms}$

B) $1.112 \times 10^{-5} \text{ m}^3/\text{ms}$

C) $5.61 \times 10^{-5} \text{ m}^3/\text{ms}$

D) $-2.805 \times 10^{-5} \text{ m}^3/\text{ms}$

No, the answer is incorrect.

Score: 0

Accepted Answers:

A) $-5.61 \times 10^{-5} \text{ m}^3/\text{ms}$

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