Unit 6 - Week 5

Week 5: Assignment

The due date for submitting this assignment has passed. **Due on 2017-03-04, 23:59 IST**
As per our records you have not submitted this assignment.

Modeling Transport Phenomena of Microparticles
Week 5 Assignment

SI units of electrokinetic quantities involving in all subsequent assignments are : **Pa** (Pascal) =kg $m^{-1}s^{-2}$ for pressure; **Pa s** (Pascal second) =kg $m^{-1}s^{-1}$ for Dynamic viscosity; **A** (Ampere) for electric current; **C** (Coulomb) for electric charge; **V** (Volt) for electric potential; **mol** (mole) for the quantity of mass; **S** (Siemens)=$kg^{-1}m^{-2}s^{3}A^{2}$ for electric conductance.

1) *1 point*

Consider a point charge q=0.001 C located at the origin. Determine the electric potential at a distance $5\mu m$ from the origin.

Following electrokinetic parameters can be used for all problems: $\phi_0 = RT/F = k_BT/e = 0.02586V$; permittivity, $\varepsilon_e = 695.39 \times 10^{-12} C/Vm$; elementary charge, $e = 1.602 \times 10^{-19} C$, diffusivity of Na^+ ion, $D_{Na^+} = 1.33 \times 10^{-9} m^2/s$ and diffusivity of Cl^- ion, $D_{Cl^-} = 2.03 \times 10^{-9} m^2/s$. Also, $1\mu m = 10^{-6} m$ and $1nm = 10^{-9} m$.

a) $2.2887 \times 10^{13} V$

b) $2.2887 \times 10^{10} V$

c) $11.43 \times 10^{11} V$

d) $4.577 \times 10^{10} V$

No, the answer is incorrect.
Score: 0

Accepted Answers:
b) $2.2887 \times 10^{10} V$

2) Consider a point charge $q = 0.001C$ is placed within the center of volume enclosed by a sphere. Find the flux of the electric field through the surface of the sphere. *1 point*

a) $2.867 \times 10^{6} Vm$

b) $1.438 \times 10^{6} Vm$

c) $-2.876 \times 10^{6} Vm$

d) $1.438 \times 10^{-6} Vm$

No, the answer is incorrect.
Score: 0

Accepted Answers:
b) $1.438 \times 10^{6} Vm$

3) Calculate the Debye length for $10 mol/m^3$ solution of NaCl. *1 point*

a) $3.04 \times 10^{-9} m$

b) $3.04 \times 10^{-10} m$

c) $0.328947 \times 10^{9} m^{-1}$

d) $3.28947 \times 10^{9} m^{-1}$

No, the answer is incorrect.
Score: 0

Accepted Answers:
a) $3.04 \times 10^{-9} m$

4) *1 p*

If the surface potential of a planer surface is $2.586 \times 10^{-3} V$ which is placed in 1-1 symmetric electrolyte so with bulk molar concentration $1 mol/m^3$, then find the surface charge density.

a) $0.931 \times 10^{-4} C/m^2$

b) $-0.931 \times 10^{-4} C/m^2$

c) $1.8627 \times 10^{-4} C/m^2$

d) $3.725 \times 10^{-4} C/m^2$

No, the answer is incorrect.
Score: 0

Accepted Answers:
c) $1.8627 \times 10^{-4} C/m^2$

5) *1 point*

A charged surface with surface potential $\zeta = 0.07758 V$ is placed in a 2:1 binary electrolyte of bulk ionic concentra $10 mol/m^3$. Use Debye-Huckel approximation to obtain the induced electric potential at a distance x nm from the s

a) $\psi = 0.07758 exp(0.518x) V$

b) $\psi = 0.0388 exp(-0.518x) V$

c) $\psi = 0.07758 exp(-0.518x) V$

d) $\psi = 0.07758 exp(-1.93x) V$

No, the answer is incorrect.
Score: 0

Accepted Answers:
c) $\psi = 0.07758 exp(-0.518x) V$

6) *1 point*

A charged surface with surface potential 0.2 V is in contact with an NaCl electrolyte with bulk molar concentratic $150 mol/m^3$. Find the electric potential at a point 0.5 nm far from the surface, using the Debye-Huckel approximati

a) 0.053 V
b) 1.06 V
c) 0.53 V
d) 0.106 V

No, the answer is incorrect.
Score: 0

Accepted Answers:
d) 0.106 V

7) *1 point*

Using Boltzmann equation, calculate the ionic concentration of Na^{+} at the point stated in problem 6.

a) $16.58 mol/m^3$

b) $2.486 mol/m^3$

c) $0.0656 mol/m^3$

d) $4.972 mol/m^3$

No, the answer is incorrect.
Score: 0

Accepted Answers:
b) $2.486 mol/m^3$

8) *1 point*

Using Boltzmann equation, calculate the ionic concentration of Cl^{-} at the point described in the problem 6.

a) $3.427 \times 10^5 mol/m^3$

b) $6.033 \times 10^4 mol/m^3$

c) $9.05 \times 10^3 mol/m^3$

d) $9.05 mol/m^3$

No, the answer is incorrect.
Score: 0

Accepted Answers:
c) $9.05 \times 10^3 mol/m^3$

9) Determine the net charge density at the point stated in problem 6. *1 point*

a) $-8.72835 \times 10^8 C/m^3$

b) $8.72835 \times 10^8 C/m^3$

c) $-5.7862 \times 10^6 C/m^3$

d) $5.7862 \times 10^6 C/m^3$

No, the answer is incorrect.
Score: 0

Accepted Answers:
a) $-8.72835 \times 10^8 C/m^3$

10) Evaluate the bulk electric conductivity of $10 mol/m^3$ NaCl solution at room temperature. *1 point*

a) $0.250694 S/m$

b) $0.125347 S/m$

c) $0.376041 S/m$

d) $0.501388 S/m$

No, the answer is incorrect.
Score: 0

Accepted Answers:
b) $0.125347 S/m$

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