Characterizing Soil Colloids (10 points)

Part A. Motions of colloidal particles (1.6 points)

A.1 (0.8pt)

$v_0 =$

$\tau =$

A.2 (0.8pt)

$v(t) =$

the inequality specifying the range of t_i that needs to be considered:

Part B. Effective equation of motion (1.8 points)

B.1 (1.0pt)
(use C, δ, t only)

$\langle \Delta x(t) \rangle =$

$\langle \Delta x(t)^2 \rangle =$

B.2 (0.8pt)

$\alpha =$

$\beta =$

Part C. Electrophoresis (2.7 points)

C.1 (0.5pt)
(use $v, \delta, n(x_0), \frac{dn}{dx}(x_0)$ only)

$N_+(x_0) =$

C.2 (0.7pt)
(use $C, \delta, n(x_0), \frac{dn}{dx}(x_0)$ only)

$J_D(x_0) =$

(use C, δ only)

$D =$

(use D, t only)

$\langle \Delta x(t)^2 \rangle =$

C.3 (0.5pt)
(use $n(x), T, Q, E, k$ only)

$\frac{dn}{dx}(x) =$

C.4 (0.5pt)

$\langle v(t) \rangle =$

$u =$

C.5 (0.5pt)
(use k, γ, T only)

$D =$

Part D. Mean square displacement (2.4 points)

D.1 (1.0pt)

$N_A =$

D.2 (0.8pt)
(use u, D, t only)

for general t:

$\langle \Delta x(t)^2 \rangle =$

for small t:

$\langle \Delta x(t)^2 \rangle \propto$

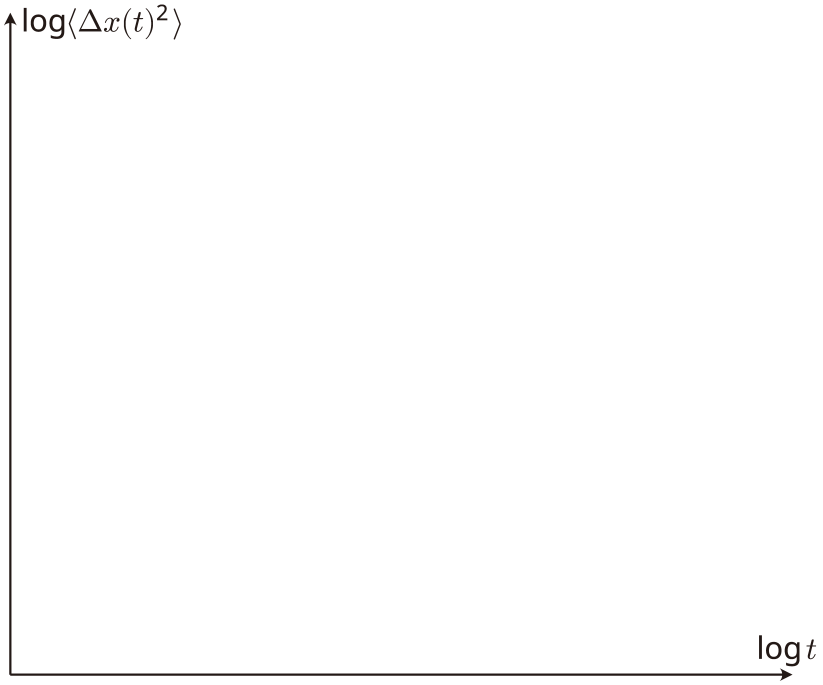
for large t:

$\langle \Delta x(t)^2 \rangle \propto$

the characteristic time t_*:

$t_* =$

Log-log plot of $\langle \Delta x(t)^2 \rangle$ against t:
(also indicate the approximate location of t_* in the graph)



D.3 (0.6pt)
(use D, u_0, δ_0, t only)
for small t:

$\langle \Delta x(t)^2 \rangle =$

for intermediate t:

$\langle \Delta x(t)^2 \rangle =$

for large t:

$\langle \Delta x(t)^2 \rangle =$

Part E. Water purification (1.5 points)

E.1 (1.5pt)

$c =$