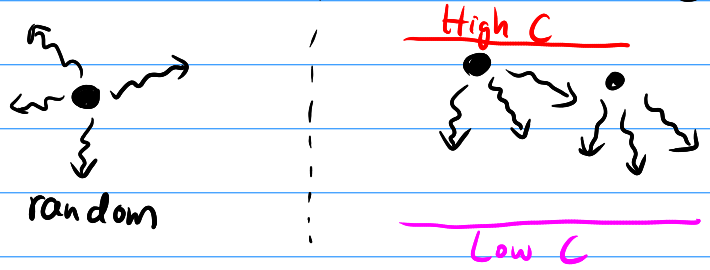
CHE318 L02

Jan-07 2026

Slide 5 Brownian motion ⇒ random direction

Ficknian diffusion ⇒ Biased Brownian Motion

Simple BM | Biased BM (Diffusion under C-gradient)



Brownian motion ⇒ D_{AB} is related to { T: how fast? / P: how crowded?

Slide 6

D_{AB} { Gas ~ 10^{-5} m^2/s / Liquid ~ 10^{-10} m^2/s / Solid Could be as slow as 10^{-18} m^2/s

In biology, cm^2/s also used

$1\ m^2/s = 10^4\ cm^2/s$

Slide 8:

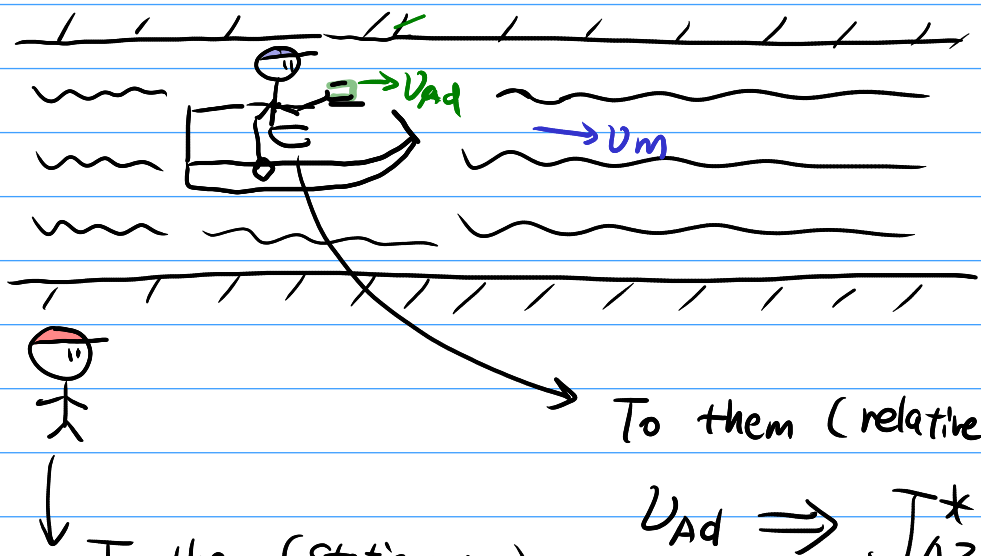
Careful diffusion experiment must get rid of convection

(which dimentionless numbers do we select?)

Slide 10

Setup Reference Frame

Analog to rowling boat down stream



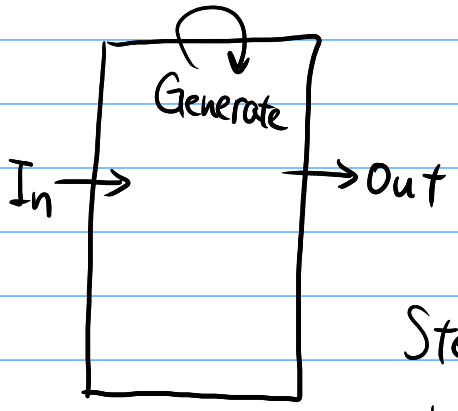
To them (relative to fluid)

$v_{Ad} \Rightarrow J^*_{Az}$

To them (Stationary lab frame)

$v_A = v_{Ad} + v_m$

Mass Balance



$[In] - [out] + [Gen] = [Acc]$

N_1 N_2 $\frac{dc}{dt}$

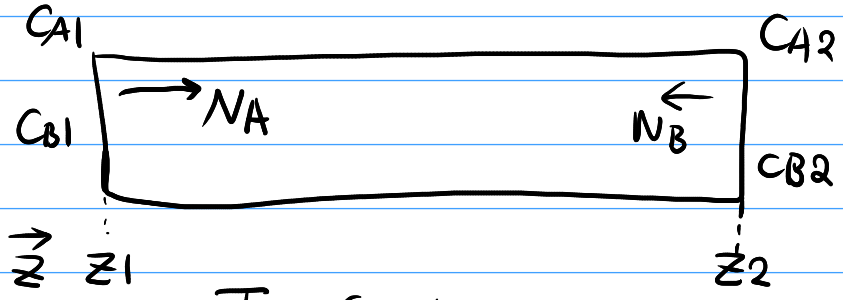
Steady state

$N_1 = N_2$

But NOT $N_1 = 0$!

Slide 11

Geometry for 1D mass transfer A, B system



N_B can look like:

$\leftarrow N_B$

$\leftarrow N_B$

$+ N_B = 0$

$\rightarrow N_B$

$T = \text{Const}$

$P_T = \text{Const}$

$C_T = C_A + C_B = \text{Const} \quad (x_A + x_B = 1)$

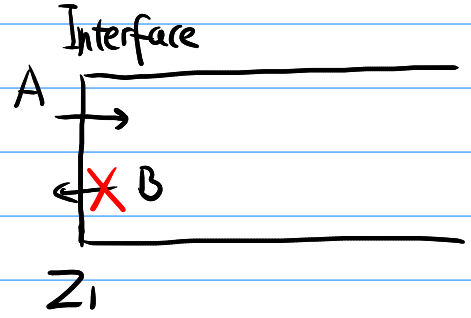
Slide 15

What is stagnant B ?

Stagnant = B phase do not have total flux

Does NOT mean B molecules are frozen / cannot move !

Typical case: at one end (often $z = z_1$)



B cannot penetrate interface at $z = z_1$

$N_B(z_1) = 0$

↓ Steady state

N_B everywhere $= 0$

(Is A moving in vacuum a stagnant B case?)

No, because P_T different

True meaning of stagnant

Slide 18 log-mean

$$P_{Bm} = \frac{P_{B2} - P_{B1}}{\ln(P_{B2}/P_{B1})} = L.M(P_B)$$

Log-mean function L.M follows

$$\underbrace{\sqrt{xy}}_{\text{Geometric mean}} \leq \underbrace{\frac{x-y}{\ln x - \ln y}}_{\text{Log-mean}} \leq \underbrace{\frac{x+y}{2}}_{\text{Arithmetric mean}}$$

Think log-mean of P_B just some average of P_B over the system

$$N_A(\text{stag } B) = \frac{C_T D_{AB}}{z_2 - z_1} \frac{P_T}{P_{Bm}} (P_{A1} - P_{A2})$$

$$> \frac{C_T D_{AB}}{z_2 - z_1} (P_{A1} - P_{A2})$$

$N_A(EMCD)$

Slide 19

See Homework 1 Q1