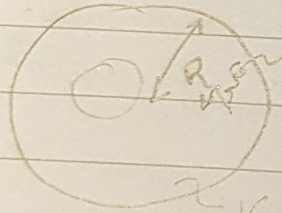
Plan → Onsdag Ex 10 Gauke
Hostferieuke ex 9 Gauke
Uke 40 + 41 forberedt Cellular Poffs
Uke 42: Cellular Poffs

Why cells are microscopic?

MSD $\langle r^2 \rangle = \langle x^2 + y^2 + z^2 \rangle = 3\langle x^2 \rangle = 6Dt$

$\Rightarrow \tau = \frac{L^2}{6D}$

n - # macromolecules in a cell ($\sim 10^{10}$)



- viscosity
- hydrodyn. interactions
- contact / crowding

$V \approx 4R^3 \quad (\approx 4r^3$

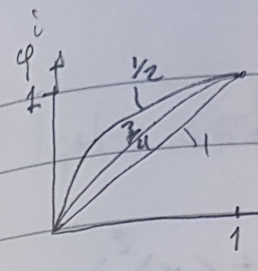
Packing fraction $\varphi = \frac{nv}{V} = n\left(\frac{r}{R}\right)^3$

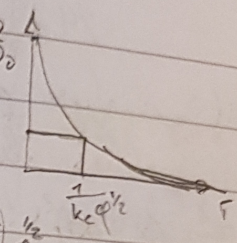
$\varphi \ll 1 \quad D_0 = \frac{kT}{6\pi\eta r}$

Crowding $D = D_0 e^{-Kr}$, $R = k_c \varphi^\gamma$, $\gamma = \{\frac{1}{2}, \frac{3}{4}, 1\}$?

in cell $\gamma = 1/2$

$\frac{D}{D_0} = e^{-k_c r \varphi^{1/2}}$

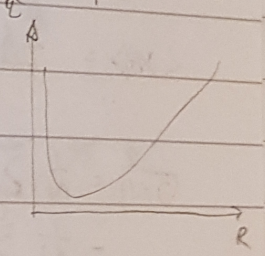




Obstruction theory $\frac{D}{D_0} = e^{-\left(\frac{r_t + r}{r_t}\right)\varphi^{1/2}}$, $\eta \sim 3$ mPas = effective visc.

(Experimentalists theory)

$\varphi^{1/2} = n\left(\frac{r}{R}\right)^{3/2}$



$\tilde{\tau}(R) = \frac{R^2}{6D_0} e^{-\alpha(r) n \left(\frac{r}{R}\right)^{3/2}}$

minimum: $R_{min} = \left(\frac{3}{2}\right)^{2/3} n^{1/3} r \Rightarrow \varphi_{min} = 0.4$

Eukaryote: $2R_{min} = 2.76 \cdot 10^{10} \cdot 3\ (nm)^2 = 15.7\mu m$

$\varphi \sim 8 \cdot 10^9 \left(\frac{3.2}{15700}\right)^3 \simeq 0.45$ $\frac{2}{c}$

Enskog theory: $\varphi_{min} \sim 0.23$, $2R_{min} \sim 2\mu m$

Simple idea $nv \sim 10^{10} \cdot 4 \cdot \left(4 \cdot 10^{-9}\right)^3 = 4^4 \cdot 10^{-17} = 2.56^{-8}$

packed radius $\varphi = 1$

$R = n^{1/3} r = 2 \cdot 10^3 \cdot r = 8\ \mu m$

Thus, necessary conclusion.