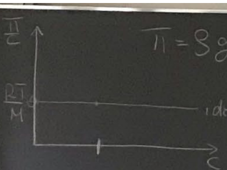


$\Pi = \rho g h$ $\quad \Pi V = nRT$

$\frac{\Pi}{c} = \frac{RT}{M}$

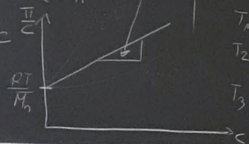
$\lim_{c \to 0} \frac{\Pi}{c} = RT \sum \frac{c_i}{M_i} = \frac{RT}{\bar{M}_n}$

real concent.

$\frac{\Pi}{c} = RT\left(\frac{1}{M_n} + A_2 c + A_3 c^2 + \dots\right)$

$\frac{\Pi}{c}$ vs c

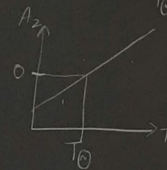
$\frac{\Pi}{cRT}$ vs c



T_1	$\bar{M}_n$	$A_2(T_1)$
T_2	$\bar{M}_n$	$A_2(T_2)$
T_3	$\bar{M}_n$	$A_3(T_3)$

$A_2 = 0 \rightarrow \Theta$ - conditions

T_Θ ?



$\eta = \eta_{Solvent}(1 + [\eta]c + K_H[\eta]^2 c^2 + \dots)$ (1) $\Rightarrow \underbrace{\frac{\eta}{\eta_s} - 1}_{\eta_{sp}} = [\eta]c + K_H[\eta]^2 c^2 \quad | : c$

$\frac{\eta_{sp}}{c} = [\eta] + K_H[\eta]^2 c$ (Huggins)

small / low c : $\eta = \eta_s(1 + [\eta]c)$

$[\eta] = \lim_{c \to 0}\left(\frac{\eta - \eta_s}{c\,\eta_s}\right) \sim M$?

Einstein $\eta = \eta_s(1 + \frac{5}{2}\underset{\substack{\uparrow \\ \text{volume occupied by spheres}}}{\nu} + 4\nu^2 + \dots)$ (2)

$\nu = \frac{c}{M} \times$ (volume of a mole of solute polymer)

$V = N_A \frac{4\pi}{3} R^3$

rigid spheres

$V_h = \frac{\nu M}{c N_A} \rightsquigarrow \nu = \frac{V_h N_A c}{M}$

insert in (2) $\eta = \eta_s(1 + \frac{5}{2}\frac{c}{M} N_A V_h + \dots)$ (3)

$[\eta] = \frac{5}{2} N_A \frac{V_h}{M}$

$V_h \sim R_g$

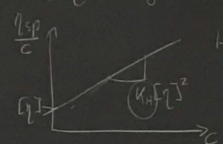
$\sim \frac{4}{3}\pi R_g^3$

$R_g \sim M^\nu$

$[\eta] \approx \frac{R_g^3}{M} \sim \frac{M^{3\nu}}{M} \sim M^{3\nu - 1}$

$$\boxed{[\eta] = K M^a}$$

$\log[\eta] = \log K + a \log M$



$[\eta] = k \frac{\sum n_i M_i^{1+a}}{\sum n_i M_i} \rightarrow$

$\left(\frac{\sum n_i M_i^{1+a}}{\sum n_i M_i}\right)^{1/a} \equiv \bar{M}_v$

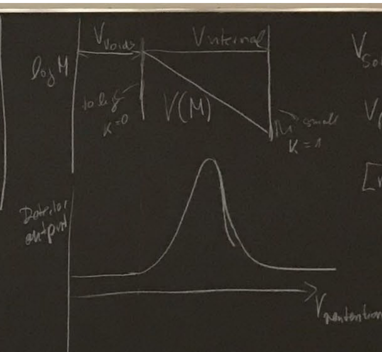
If $a = 1$ $\quad \bar{M}_v = \bar{M}_w$

ln use $\ln(1 + x + K_H x^2) = x + (K_H - \frac{1}{2})x^2$

small x

Kramer equation $\frac{\ln\left(\frac{\eta}{\eta_s}\right)}{c} = [\eta] + (K_H - \frac{1}{2})[\eta]^2 c$

GPC



$V_{Solvent} = V_v + V_i$

$V_R = V_v + K V_i$ $\quad K = 0$ big, $K = 1$ small

$[\eta]M$ vs V_h

$V_h = \frac{\nu M}{c N_A}$ $\quad V_h \sim \frac{4\pi}{3} R_g^3$

Osmometry $\overline{M}_n$

osmotic pressure

$$\frac{\Pi}{RTc} = \frac{1}{\overline{M}_n} + A_2 c$$

$A_2 = 0$ Θ-cond.

Viscosimetry

$$[\eta] = K \overline{M}_v^{a}$$

$a = 1$ $\overline{M}_v = \overline{M}_w$

$$\eta_{rel} = \frac{\eta}{\eta_{solvent}} \approx \frac{t_{polymer\ solution}}{t_{solvent}}$$

Flory-Fox-equation

$$[\eta] M \sim V \sim R^3$$

$$I_{scattered} = \frac{16\pi^4}{\lambda^4 r^2} \alpha^2 I_i$$

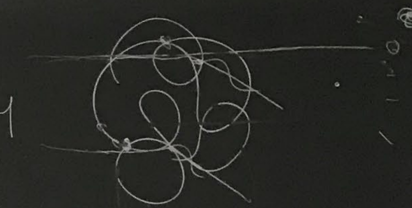
$$\alpha = \frac{n}{2\pi} \frac{dn}{dc} \frac{M}{N_A}$$

$$\frac{c N_A}{M} \ll \frac{1}{\alpha}$$

Rayleigh Ratio

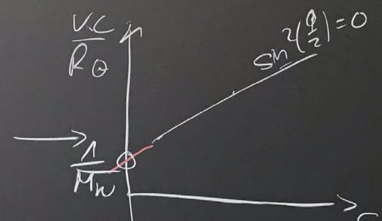
$$R_\Theta = \frac{I r^2}{I_i} = \frac{4\pi^2 n^2}{\lambda^4} \left(\frac{dn}{dc}\right)^2 \frac{cM}{N_A} = K c M$$

K: optical constant



$$\frac{Kc}{R_\Theta} = \frac{1}{\overline{M}_w} + S \sin^2\left(\frac{\Theta}{2}\right) + \underbrace{2A_2}_{B} c$$

① $\frac{Kc}{R_\Theta}$ vs $\sin^2\left(\frac{\Theta}{2}\right)$



② $\frac{Kc}{R_\Theta}$ vs c