4.

C/M (mol/l)	$5/M$	$10/M$	$15/M$	$20/M$
π	$\frac{1.03\times0.88\times9.8}{100}$	$\frac{2.1\times0.88\times9.8}{100}$	$\frac{3.22\times0.88\times9.8}{100}$	$\frac{4.39\times0.88\times9.8}{100}$
$\frac{\pi M}{C}$	$1.777\times10^{-2}M$	$1.811\times10^{-2}M$	1.851×10^{-2}	1.893×10^{-2}

$\Rightarrow$ 外差 $C/M=0 \Rightarrow \frac{\pi M}{C} = 1.737\times10^{-2}M$

$\pi = RTC\left(\frac{1}{M}+B_2C+B_3C^2+\cdots\right)$ at low concentrate

$\doteqdot RTC\left(\frac{1}{M}+B_2C\right)$

$\Rightarrow \frac{\pi M}{C} \doteqdot RT + RTB_2MC$

at $C=0 \Rightarrow \frac{\pi M}{C} \doteqdot RT = 8.314\times298 = 1.737\times10^{-2}M$

$\Rightarrow M = 143\ kg\cdot mol^{-1}$ ※

2.
(a) $m(1-\upsilon\rho)\omega^2x = f\upsilon = f\frac{dx}{dt}$ by Einsten's Law of Diffusion $Df=kT$

$\Rightarrow m(1-\upsilon\rho)\omega^2x = \frac{kT}{D}\frac{dx}{dt} \Rightarrow \frac{dx}{dt} = \frac{DM(1-\upsilon\rho)\omega^2x}{RT}$ (同乘N_A)

$\Rightarrow M = \frac{RT}{D(1-\upsilon\rho)}\left(\frac{1}{\omega^2x}\frac{dx}{dt}\right) = \frac{RT}{D(1-\upsilon\rho)}\cdot s = \frac{8.314\times293}{1.13\times10^{-10}(1-0.741\times1)}\times2.04\times10^{-13}$

$= \frac{8.314\times293\times2.04\times10^{-13}}{1.13\times10^{-10}\times0.259} = 17\ kg/mol$ ※

(b)
$f = \frac{kT}{D} = \frac{1.38\times10^{-23}\times293}{1.13\times10^{-10}} = 357.8\times10^{-13} = 3.58\times10^{-11}$

$= 6\pi\eta a = 6\pi\times10^{-3}a \Rightarrow a = 1.9\times10^{-9}m$

$\frac{4}{3}\pi a^3\times\frac{1}{\upsilon} = \frac{4}{3}\pi\times(1.9\times10^{-9})^3\times\frac{1}{0.741}\times\frac{10^6}{10^3} = 3.877\times10^{-24}kg$ (單一顆粒+水重)

$17/6.02\times10^{23} = 2.82\times10^{-23}\ kg$ (單一顆粒淨重)

[illegible]

3. by mass flow = diffusion

$$C \cdot A \frac{dx}{dt} = DA \frac{dc}{dx}$$

代入離心沈降公式

$$\frac{dx}{dt} = \frac{DM(1-\bar{v}\rho)\omega^2 x}{RT}$$

$$\Rightarrow C \cdot \frac{D \cdot M(1-\bar{v}\rho)\omega^2 x}{RT} = D\frac{dc}{dy}$$

$$\Rightarrow M = \frac{2RT \ln c_2/c_1}{(1-\bar{v}\rho)\omega^2(x_2^2 - x_1^2)}$$

$$= \frac{2 \times 8.314 \times 298 \ln \frac{c_2}{c_1}}{(1-0.75\times 1)\times\left(\frac{2\pi\times 1000}{60}\right)^2 \times 10^{-4}(x_2^2 - x_1^2)}$$

$$= 149.4 \frac{\ln \frac{c_2}{c_1}}{(x_2^2 - x_1^2)}$$

正解:

$$\frac{dc}{c} = \left(\frac{\omega^2 M(1-\bar{v}\rho)}{RT}\right) x\,dx$$

$$d \ln C = \frac{1}{2}(\qquad) x^2 + C'$$

x	x^2	.	.	.	.
c	lnc	.	.	.	.

by 回歸直線,求其正解

x from 4.9 to 4.95 $\frac{\ln \frac{1.46}{1.3}}{4.95^2 - 4.9^2} = \frac{\ln 1.12}{0.4925} = 0.230$.

x from 4.95 to 5.00 $\frac{\ln \frac{1.64}{1.46}}{5^2 - 4.95^2} = \frac{\ln 1.123}{0.4975} = 0.233$

x from 5 to 5.05 $\frac{\ln \frac{1.84}{1.64}}{5.05^2 - 5^2} = \frac{\ln 1.122}{0.5025} = 0.229$.

x from 5.05 to 5.1 $\frac{\ln \frac{2.06}{1.84}}{5.1^2 - 5.05^2} = \frac{\ln 1.12}{0.5075} = 0.223$

x from 5.1 to 5.15 $\frac{\ln \frac{2.31}{2.06}}{5.15^2 - 5.1^2} = \frac{\ln 1.121}{0.5125} = 0.223$

the average : 0.228.

M = 149.4 × 0.228 = 34.1 kg