Errata of Soft Matter Physics

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page 26, eq.(2.79)

$$\mu_i = \mu_i^0(T) + Pv_i + k_BT\ln\phi_i + \sum_{j=1}^{n}(2v_iA_{ij} - k_BT)\phi_j$$

$\rightarrow$

$$\mu_i = \mu_i^0(T) + Pv_i + k_BT\ln\phi_i + \sum_{j=1}^{n}(2v_iA_{ij} - \underline{\frac{v_i}{v_j}}k_BT)\phi_j$$

page 26, problem (2.6)

eq.(2.63) $\rightarrow$ eq.(2.62)

page 27, eq.(2.82)

$$f(\phi) = \frac{k_BT}{v_c}\left[\sum_{i=1,2}\frac{1}{N_i}\phi_i\ln\phi_i - \chi(\sum_{i=1,2}\phi_i)^2\right]$$

$\rightarrow$

$$f(\phi) = \frac{k_BT}{v_c}\left[\underline{(1-\phi)\ln(1-\phi)} + \sum_{i=1,2}\frac{1}{N_i}\phi_i\ln\phi_i - \chi(\sum_{i=1,2}\phi_i)^2\right]$$

page 34

The paragraph after eq.(3.15) must be corrected. The text says "any tensor $\boldsymbol{E}$ can be written as $\boldsymbol{E} = \boldsymbol{Q}\cdot\boldsymbol{L}$, where $\boldsymbol{L}$ is a diagonal tensor, and $\boldsymbol{Q}$ is an orthogonal tensor." This statement is incorrect. The correct statement is: "any tensor $\boldsymbol{E}$ can be written as $\boldsymbol{E} = \boldsymbol{Q}\cdot\boldsymbol{L}\cdot\boldsymbol{q}$, where $\boldsymbol{L}$ is a diagonal tensor, and $\boldsymbol{Q}$ and $\boldsymbol{q}$ are orthogonal tensors." This correction is needed since from eq.(3.17) one cannot conclude that $\boldsymbol{E}$ is written as $\boldsymbol{Q}\cdot\boldsymbol{L}$ because eq.(3.17) is satisfied by any tensor having a form of $\boldsymbol{Q}\cdot\boldsymbol{L}\cdot\boldsymbol{q}$ where $\boldsymbol{q}$ is an orthogonal tensor. For given $\boldsymbol{E}$, $\boldsymbol{Q}$ and $\boldsymbol{L}$ are determined by diagonalizing $\boldsymbol{E}\cdot\boldsymbol{E}^t$, and $\boldsymbol{q}$ is given by

$$\boldsymbol{q} = (\boldsymbol{Q}\cdot\boldsymbol{L})^{-1}\cdot\boldsymbol{E} = \boldsymbol{L}^{-1}\boldsymbol{Q}^t\boldsymbol{E} \tag{1}$$

The subsequent statement "any uniform deformation is equivalent to a combination of orthogonal stretching (represented by $\boldsymbol{L}$) and rotation(represented by $\boldsymbol{Q}$)" should be corrected to "any uniform deformation is equivalent to a combination of orthogonal stretching (represented by $\boldsymbol{L}$) and rotation(represented by $\boldsymbol{Q}$ <u>and $\boldsymbol{q}$</u>)"

As an example, consider shear deformation, for which $\boldsymbol{E}$ is given by (see eq.(3.51))

$$(E_{\alpha\beta}) = \begin{pmatrix} 1 & \gamma & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{pmatrix} \tag{2}$$

For this deformation $\boldsymbol{Q}$ is given by

$$(Q_{\alpha\beta}) = \begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix} \tag{3}$$

with

$$\cos\theta = \frac{1}{\sqrt{1+\frac{1}{4}\left(\gamma-\sqrt{\gamma^2+4}\right)^2}} \tag{4}$$

$$\sin\theta = \frac{1}{\sqrt{1+\frac{1}{4}\left(\gamma+\sqrt{\gamma^2+4}\right)^2}} \tag{5}$$

$$\tag{6}$$

and the principal value of $\boldsymbol{L}$ is

$$\lambda_1 = \sqrt{1+\frac{1}{2}\gamma\left(\gamma+\sqrt{\gamma^2+4}\right)} \tag{7}$$

$$\lambda_2 = \sqrt{1+\frac{1}{2}\gamma\left(\gamma-\sqrt{\gamma^2+4}\right)} \tag{8}$$

$$\lambda_3 = 1 \tag{9}$$

The author thanks Dr. Konstantin Volokh and Dr. David Pine for pointing out this error.

page 37, margin note
$4\pi b^2 \sinh\xi \to 4\pi b^2 \sinh\xi/\xi$

page 74,
The text says "This axis is called the director, and is specified by a unit vector $\boldsymbol{n}$". Definition of $\boldsymbol{n}$ is given later, around eq.(5.7):$\boldsymbol{n}$ is defined as the unit vector along the principal axis of the tensor order parameter $\boldsymbol{Q}$ which is defined by eq.(5.6).

page 49, problem (3.4)
$\lambda_1 = 1 \to \lambda_3 = 1$

page 50, problem (3.7)
Add the following sentence at the end of the problem.
"Assume that the polymer in the solution cannot get into the gel."

page 81, 4th line above the bottom
while in the state of $-S < 0$ -¿ while in the state $S < 0$

page 92, eq.(5.71)

$$F[\psi] = N\left[k_BT\int d\boldsymbol{u}\ \psi(\boldsymbol{u})\ln\psi(\boldsymbol{u}) + \frac{U}{2}\int d\boldsymbol{u}\int d\boldsymbol{u}'\ (\boldsymbol{u}\cdot\boldsymbol{u}')\psi(\boldsymbol{u})\psi(\boldsymbol{u}')\right]$$

$\rightarrow$

$$F[\psi] = N\left[k_BT\int d\boldsymbol{u}\ \psi(\boldsymbol{u})\ln\psi(\boldsymbol{u}) \underline{-}\frac{U}{2}\int d\boldsymbol{u}\int d\boldsymbol{u}'\ (\boldsymbol{u}\cdot\boldsymbol{u}')\psi(\boldsymbol{u})\psi(\boldsymbol{u}')\right]$$

page 92, eq.(5.74)

$$\frac{k_BT}{U}x = \coth x$$

$\rightarrow$

$$\frac{k_BT}{U}x = \coth x - \frac{1}{x}$$

page 92, eq.(5.79)

$$\mathcal{S}(P) = -\frac{3}{2}k_B P^2 \tag{10}$$

$\rightarrow$

$$\mathcal{S}(P) = \text{const} - \frac{3}{2}k_B P^2 \tag{11}$$

page 98, eq.(6.22)

Equation (6.22) can be obtained as follows. Eq.(6.19) is a non-homogeneous linear equation. We can solve it by the method of "undetermined coefficient". First we solve the equation with the non-homogeneous term removed:

$$m\frac{dv}{dt} = -\zeta v \tag{12}$$

The solution of this equation is

$$v(t) = ae^{-t/\tau_v} \tag{13}$$

where a is a constant. We then find the solution of the original equation assuming that a is a function of time. This assumption gives

$$m\left[-\frac{a}{\tau_v} + \frac{da}{dt}\right] e^{-t/\tau_v} = -\zeta a e^{-t/\tau_v} + F_r(t) \tag{14}$$

Then

$$\frac{da}{dt} = \frac{1}{m}F_r(t)e^{t/\tau_v} \tag{15}$$

The equation is solved as

$$a(t) = a(t_0) + \frac{1}{m}\int_{t_0}^{t} dt_1 F_r(t_1)e^{t_1/\tau_v} \tag{16}$$

Hence

$$v(t) = v(t_0)e^{-(t-t_0)/\tau_v} + \frac{1}{m}\int_{t_0}^{t} dt_1 F_r(t_1)e^{-(t-t_1)/\tau_v} \tag{17}$$

Setting t_0 equal to $-\infty$, we have eq.(6.21).

page 102, eq.(6.45)

$$x_0 = \int_{-\infty}^{t} dt_1 e^{-(t-t_1)/\tau_v} v_r(t_1) \tag{18}$$

$\rightarrow$

$$x_0 = \int_{-\infty}^{t} dt_1 e^{t_1/\tau_v} v_r(t_1) \tag{19}$$

page 111, eq.(6.85)

$$\zeta_{\alpha\beta}\frac{dx_\beta}{dt} + F_{r\alpha} = 0$$

$\rightarrow$

$$\underline{-}\zeta_{\alpha\beta}\frac{dx_\beta}{dt} + F_{r\alpha} = 0$$

page 113, eq.(6.105)

$$G(n,m,t) = \frac{1}{\sqrt{2\pi\lambda t}} \exp\left[-\frac{(n-m)^2}{2\lambda t}\right]$$

$\rightarrow$

$$G(n,m,t) = \frac{1}{\sqrt{\underline{4}\pi\lambda t}} \exp\left[-\frac{(n-m)^2}{\underline{4}\lambda t}\right]$$

page 132, eq.(7.105)

$$\frac{\partial \psi}{\partial t} = D_r \mathcal{R} \cdot \left(\mathcal{R}\psi + \frac{\mu_m \boldsymbol{u} \times \boldsymbol{H}}{k_B T} \psi \right)$$

$\rightarrow$

$$\frac{\partial \psi}{\partial t} = D_r \mathcal{R} \cdot \left(\mathcal{R}\psi \underline{-} \frac{\mu_m \boldsymbol{u} \times \boldsymbol{H}}{k_B T} \psi \right)$$

page 135, eq.(7.126)

$$\Phi = \frac{\eta}{4} h \int_0^a dr\ 2\pi r \left(\frac{dv}{dr} \right)^2$$

$\rightarrow$

$$\Phi = \frac{\eta}{\underline{2}} h \int_0^a dr\ 2\pi r \left(\frac{dv}{dr} \right)^2$$

page 135, problem (7.1) (b)

$\Phi = (\pi/2)\eta h \dot{h}^2 \rightarrow \Phi = 4\pi\eta h \dot{h}^2$

page 136, eq.(7.132)

$$\mu(x, x') = -\frac{\partial}{\partial x} \left[\frac{n(x)}{\zeta} \frac{\partial}{\partial x'} \delta(x - x') \right]$$

$\rightarrow$

$$\mu(x, x') = -\frac{\partial}{\partial x} \left[\frac{n(x)}{\zeta} \frac{\partial}{\partial \underline{x}} \delta(x - x') \right]$$

page 162, three lines below eq.(8.126)

by eq.(8.20) $\rightarrow$ by eq.(8.20) except for numerical factor $\sqrt{3}$

page 163, eq.(8.137)

$$\chi(\boldsymbol{r}, \boldsymbol{r}', t) = \frac{\bar{n}}{k_B T} \left[g_{md}(\boldsymbol{r} - \boldsymbol{r}', 0) - g_{md}(\boldsymbol{r} - \boldsymbol{r}', t) \right]$$

$\rightarrow$

$$\chi(\boldsymbol{r}, \boldsymbol{r}', t) = \frac{\bar{n}}{k_B T} \left[\underline{g_d}(\boldsymbol{r} - \boldsymbol{r}', 0) - \underline{g_d}(\boldsymbol{r} - \boldsymbol{r}', t) \right]$$

page 164, eq.(8.141)

$$\frac{\partial \delta\phi}{\partial t} = \frac{\phi_c}{\xi} \nabla^2 \left[a(T - T_c)\delta\phi + \phi_c \kappa_s \nabla^2 \delta\phi - h(\boldsymbol{r}) \right]$$

$\rightarrow$

$$\frac{\partial \delta\phi}{\partial t} = \frac{\underline{\phi_c^2}}{\xi} \nabla^2 \left[a(T - T_c)\delta\phi \underline{-} \kappa_s \nabla^2 \delta\phi - h(\boldsymbol{r}) \right]$$

page 164, eq.(8.142)

$$S_d(\boldsymbol{k}, t) = \frac{k_B T}{a(T - T_c) + \underline{\phi_c} \kappa_s \boldsymbol{k}^2} \exp[-\alpha_{\boldsymbol{k}} t]$$

$\rightarrow$

$$S_d(\boldsymbol{k}, t) = \frac{k_B T}{a(T - T_c) + \kappa_s \boldsymbol{k}^2} \exp[-\alpha_{\boldsymbol{k}} t]$$

page 164, eq.(8.143)

$$\alpha_{\boldsymbol{k}} = \frac{\phi_c \boldsymbol{k}^2}{\xi} \left[a(T - T_c) + \underline{\phi_c} \kappa_s \boldsymbol{k}^2 \right]$$

$\rightarrow$

$$\alpha_{\boldsymbol{k}} = \frac{\underline{\phi_c^2} \boldsymbol{k}^2}{\xi} \left[a(T - T_c) + \kappa_s \boldsymbol{k}^2 \right]$$

page 164, eq.(8.145)

$$A = \int_0^h dx \frac{K_e}{2} \left(\frac{\partial u}{\partial x} \right)^2 - [u(h) - u(0)]w$$

$\rightarrow$

$$A = \int_0^h dx \frac{K_e}{2} \left(\frac{\partial u}{\partial x} \right)^2 \underline{\pm}[u(h) - u(0)]w$$

page 164, eq.(8.146)

$$\Phi = \frac{1}{2} \int_0^h dx \frac{\dot{u}^2}{\underline{2}\kappa}$$

$\rightarrow$

$$\Phi = \frac{1}{2} \int_0^h dx \frac{\dot{u}^2}{\kappa}$$

page 196, problem (9.7)

$d = 1nm$ in water $\rightarrow$ $d = 5nm$ in water

page 199, 3 lines below eq.(10.8)

Delete the following last sentence of the paragraph "The pK of acid is less than 7 and the pK of base is larger than 7."

This is completely my mistake. I may add the following in the text.
The dissociation of base BOH

$$\mathrm{BOH} \leftrightarrow \mathrm{B}^+ + \mathrm{OH}^- \tag{20}$$

is described by

$$\log_{10} \frac{1 - \alpha}{\alpha} = \mathrm{pK_{BOH}} - \mathrm{pOH} = \mathrm{pK_{BOH}} - 14 + \mathrm{pH} \tag{21}$$

page 221, problem (10.1)

pK=9.3 for NH_4OH $\rightarrow$ pK=4.7 for NH_4OH

page 221, problem (10.4)

by eq.(10.30) $\rightarrow$ by eq.(10.27)

page 235, line 2

(see eq.(5.11)) $\rightarrow$ (see eqs.(5.11) and (5.23))

page 246, Fig.E.1

The label of the y-axis: $\langle F_j(t) \rangle_{x+\delta x}$ $\rightarrow$ $\langle F_{\underline{i}}(t) \rangle_{x+\delta x}$