

Errata in “Statistical Mechanics in a Nutshell”

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Chapter 2. Thermodynamics

2.17 Equations of state

- **Page 40, line 12 from bottom. Read:**
obtained by deriving
correct to:
obtained by differentiating

Chapter 3. The Fundamental Postulate

3.5 Quantum States

- **Page 66, line 2. Read:**
moving in one dimension along a segment of length n .
correct to:
moving in one dimension along a line of length L .
- **Page 66, line 3. Read:**
possible energy values are $E_n = \hbar^2 \pi^2 n^2 / L^2$
correct to:
possible energy values are $E_n = \hbar^2 \pi^2 n^2 / (2mL^2)$

3.18 Fluctuations of Uncorrelated Particles

- **Page 88. From the end of line 4 to the end of the section. Read:**
In fact, one has...
... Therefore,

$$p = \frac{k_B T}{v} = \frac{N k_B T}{V}. \quad (3.153)$$

correct to:
In fact, one has

$$\langle N^2 \rangle - \langle N \rangle^2 = \left. \frac{\partial^2 \ln Z_{GC}}{\partial (\mu/k_B T)^2} \right)_{T,V} = k_B T \left. \frac{\partial N}{\partial \mu} \right)_{T,V}. \quad (3.150)$$

On the other hand, since μ is an intensive variable, function of T and of the extensive variables V and N , one has the Euler equation

$$N \left(\frac{\partial \mu}{\partial N} \right)_{T,V} + V \left(\frac{\partial \mu}{\partial V} \right)_{T,N} = 0. \quad (3.151)$$

Thus from equations (3.149–150) we obtain

$$k_B T = N \left(\frac{\partial \mu}{\partial N} \right)_{T,V} = -V \left(\frac{\partial \mu}{\partial V} \right)_{T,N} = V \left(\frac{\partial p}{\partial N} \right)_{T,V}, \quad (3.152)$$

where we have exploited a Maxwell relation. Integrating this equation with respect to N , with the obvious boundary condition $p(N=0) = 0$ yields

$$pV = N k_B T. \quad (3.153)$$

Chapter 4. Interaction-Free systems

4.1 Harmonic Oscillators

4.1.1 The Equipartition Theorem

- Page 90, line 16f. Read:
positive definitive
correct to:
positive definite

4.3 Boson and Fermion Gases

4.3.1 Electrons in Metals

- Page 109, line 5, eq. (4.96). Read:

$$C_V = \frac{\pi V^2}{3} k_B T \omega(\epsilon_F),$$

correct to:

$$C_V = \frac{\pi V^2}{3} k_B^2 T \omega(\epsilon_F),$$

4.4 Einstein condensation

- Page 114. Caption to figure 4.7, second line. Read:
the rescaled density $p\lambda^3$.
correct to:
the rescaled density $\rho\lambda^3$.

4.5 Adsorption

- Page 114, line 5 from bottom. Read:
Since the gas can freely exchange
correct to:
Since the wall can freely exchange

- Page 114. Eq. (4.114). Read:

$$Z = \sum_{\{\tau_i\}} \exp \left[k_B T \sum_{i=1}^N (\epsilon_i + \mu) \tau_i \right].$$

correct to:

$$Z = \sum_{\{\tau_i\}} \exp \left[\frac{1}{k_B T} \sum_{i=1}^N (\epsilon_i + \mu) \tau_i \right].$$

4.5.1 Myoglobin and Hemoglobin

- Page 116, line 6 from bottom. Read:

$\sum_{\alpha=1}^{N/4} \sum_{i=1}^4 \tau_{\alpha i}$ of adsorbed molecules

correct to:

$\sum_{\alpha=1}^{N/4} \sum_{i=1}^4 \langle \tau_{\alpha i} \rangle$ of adsorbed molecules

Chapter 6. Renormalization Group

Relevant and Irrelevant Operators

- Page 184, line 10, eq. (6.57). Read:

$$\langle \phi_0 \phi_{\mathbf{r}} \rangle_{\mathcal{H}} = b^{2d} \zeta^{-2} \langle \phi'_0 \phi'_{\mathbf{r}/b} \rangle_{\mathcal{H}'}$$

correct to:

$$\langle \phi_0 \phi_{\mathbf{r}} \rangle_{\mathcal{H}} = b^{-2d} \zeta^{-2} \langle \phi'_0 \phi'_{\mathbf{r}/b} \rangle_{\mathcal{H}'}$$

- Page 184, line 10, eq. (6.57). Read:

correct to:

$$d + 2 - \eta = 2 \frac{\ln \zeta}{\ln b}$$

correct to:

$$d + 2 - \eta = -2 \frac{\ln \zeta}{\ln b}$$

6.6 Renormalization in Fourier Space

6.6.1 Introduction

- Page 190, line 12 from bottom, eq. (6.91). Read:

$$\phi_i = \sum_{\mathbf{k}} \phi_{\mathbf{k}} e^{i\mathbf{k} \cdot \mathbf{r}_i}$$

correct to:

$$\phi_i = \sum_{\mathbf{k}} \phi_{\mathbf{k}} e^{i\mathbf{k}\cdot\mathbf{r}_i}.$$

- Page 190, line 6 from bottom. Read:
For a simple cubic lattice, as we saw in chapter 2, one has
correct to:
For a simple cubic lattice, as we saw in chapter 5, one has

6.6.2 Gaussian Model

- Page 193, line 8. Read:
coefficients of κ^n with $n \neq 0$
correct to:
coefficients of k^n in $\Delta(\mathbf{k})$ with $n \neq 0$

6.6.4 Critical Exponents to First Order in ϵ

- Page 199, line 5. Read:
(as we shall from now on)
correct to:
(as we shall set from now on)

Chapter 7. Classical Fluids

7.2 Reduced Densities

7.2.3 Measure of $g(r)$

- Page 225, line 7. Read:
define the **factor structure** $S(\mathbf{k})$:
correct to:
define the **structure factor** $S(\mathbf{k})$:

7.2.4 BBGKY Hierarchy

- Page 225, line 7 from bottom, Eq. (7.47). Read:

$$\rho^{(2)}(\mathbf{x}_1, \mathbf{x}_2) = \rho^{(2)} g(\mathbf{x}_1, \mathbf{x}_2),$$

correct to:

$$\rho^{(2)}(\mathbf{x}_1, \mathbf{x}_2) = \rho^2 g(\mathbf{x}_1, \mathbf{x}_2),$$

7.3 Virial Expansion

- Page 229, line 16. Read:
Exercise 7.2 By comparing (7.70) with (7.12), show that in this approximation the $g(r)$ is expressed by

$$g(r) = 1 + f(r).$$

correct to:

Exercise 7.2 Show that in the present approximation, the $g(r)$ is expressed by

$$g(r) = 1 + f(r),$$

where $f(r)$ is the Mayer function, and that therefore equations (7.12) and (7.70) are compatible.

- Page 230, line 15. Read:

3. Express this quantity as a function of the second virial coefficient $B_2(T)$ and evaluate the inversion temperature T^* in which $\partial T/\partial p)_H$ changes sign.

correct to:

3. By expressing $\partial V/\partial T)_p$ as a function of the second virial coefficient $B_2(T)$, evaluate the inversion temperature T^* in which $\partial T/\partial p)_H$ changes sign.

7.3.1 Higher Virial Coefficients

- Page 235, line 4, eq. (7.96). Read:

$$\frac{p}{\rho k_B T} = \frac{1 + \eta + \eta^2 - \eta^3}{(1 - \eta)^3}.$$

correct to:

$$\frac{p}{\rho k_B T} = \frac{1 + \eta + \eta^2 - \eta^3}{(1 - \eta)^3}.$$

Convergence of the Fugacity and Virial Expansion

- Page 241, line 11, eq. (7.129). Read:

$$C(T) = \int d\mathbf{x} \left(e^{-u(\mathbf{x})/k_B T} - 1 \right) < +\infty.$$

correct to:

$$C(T) = \int d\mathbf{x} \left| e^{-u(\mathbf{x})/k_B T} - 1 \right| < +\infty.$$

Chapter 8. Numerical Simulation

8.4 Monte Carlo Method

8.4.1 Markov Chains

- Page 264, line 7. Read:

if, given any three different states $a, b, c \in Q$, one has

$$W_{ab}W_{bc}W_{ca} = W_{ac}W_{cb}W_{ba}. \quad (8.39)$$

correct to:

if, given any k different states $i_1, i_2, \dots, i_k \in Q$ ($k \geq 3$), one has

$$W_{i_1 i_2} W_{i_2 i_3} \cdots W_{i_k i_1} = W_{i_1 i_k} W_{i_k i_{k-1}} \cdots W_{i_2 i_1}. \quad (8.39)$$

Chapter 9. Dynamics

9.9 Response Functions

- Page 298, line 12. Read:
 $h(t) = h \delta(t - t')$.
correct to:
 $h(t) = h \delta(t - t_0)$.
- Page 298, line 13, eq. (9.111). Read:
 $\langle X(t) \rangle = h \chi(t, t')$.
correct to:
 $\langle X(t) \rangle = h \chi(t, t_0)$.
- Page 299, line 8 from bottom. Read:
 $x_{ij}(t)$. For $t > 0$,
correct to:
 $\chi_{ij}(t)$. For $t > 0$,

9.13 Variational Principle

- Page 306, line 1st from bottom. Read:
an affinity F_i
correct to:
an affinity F_1
- Page 307, line 1. Read:
Then, the result we just obtained that the stationary state...
correct to:
Then, the result we just obtained implies that the stationary state...
- Page 307, line 2. Read:
In fact since...
... and we obtain $\partial \dot{S} / \partial X_k = 0$ for $J_k = 0$ ($k \neq 1$).
correct to:
In fact, upon a variation (δF_i) of the forces, we obtain from equation (9.172) the corresponding variation of \dot{S}

$$\delta \dot{S} = \sum_{ij} L_{ij} F_i \delta F_j = \sum_j J_j \delta F_j, \quad (9.179)$$

where we have used the relation (9.160). The term with $j = 1$ vanishes because F_1 is kept fixed. Thus $\delta \dot{S} = 0$ implies $J_k = 0$ for $k \neq 1$, since the δF_k with $k \neq 1$ are arbitrary.

Chapter 10. Complex systems

10.2. Percolation

10.2.1 Analogy with Magnetic Phenomena

- Page 322. Eq. (10.47). Read:

$$\sum_s s \nu_s + P(p) = 1.$$

correct to:

$$\sum_s s\nu_s + P(p) = p.$$

- Page 322, line 3 from bottom. Read:

$$\chi = \frac{J}{k_{\text{B}}T} \sum_s s^2 \nu_s(p).$$

correct to:

$$\chi = \frac{1}{k_{\text{B}}T} \sum_s s^2 \nu_s(p).$$

10.2.1 Percolation in One Dimension

- Page 324. Eq. (10.54). Read:

$$S(p) = \frac{\sum_s s^2 \nu_s(p)}{\sum_s \nu_s(p)}.$$

correct to:

$$S(p) = \frac{\sum_s s \nu_s(p)}{\sum_s \nu_s(p)}.$$

10.2.3 Percolation on the Bethe lattice

- Page 326. Eq. (10.63). Read:

$$S(p) = p \frac{1 - (\zeta - 2)p}{1 - (\zeta - 1)p}, \quad \text{for } p < p_c,$$

correct to:

$$S(p) = p \frac{1 + p}{1 - (\zeta - 1)p}, \quad \text{for } p < p_c,$$

- Page 327, line 2. Read:

while $\sum_s s\nu_s = 1$,

correct to:

while $\sum_s s\nu_s = p$,

10.3. Disordered systems

10.3.3 Random Energy Model

- Page 344, line 13. Read:

with $\epsilon \ll |E_c|$.

correct to:

with $|\epsilon| \ll |E_c|$.

10.3.5 The replica method

- Page 349. Eq. (10.168). Read:

$$f = f_0 = k_B T \ln 2 - \left(\frac{J_0^2}{4k_B T} \right)$$

correct to:

$$f = f_0 = -k_B T \ln 2 - \left(\frac{J_0^2}{4k_B T} \right)$$

- Page 349, line 2 from bottom. Read:
The minimum of this free energy is obtained when
correct to:
The extremum of this free energy is obtained when
- Page 350. Second line. Add the following sentence after eq. (10.173):
One may check that the free energy per spin reaches a *maximum*, rather than a minimum, at this value of m . This is just one of the many surprises which appear in the replica method.

Appendix

B. Saddle Point Method

0.0.1 B.1 Euler Integrals and the Saddle Point Method

- Page 366, line 3. Read:
integral we studied before, slowly changing factors.
correct to:
integral we studied before, up to slowly changing factors.

C. A Probability Refresher

C.2 Random Variables

- Page 370, line 9 from bottom. Read:

$$P(x) = \frac{1}{6} - \sum_{k=1}^6 \delta(x - k).$$

correct to:

$$P(x) = \frac{1}{6} \sum_{k=1}^6 \delta(x - k).$$

C.6 Central Limit Theorem

- Page 373, line 5, eq. (C.23), first line. Read:

$$\langle \exp(ik\bar{x}) \rangle = \left\langle \exp \left[ik \frac{1}{N} \left(\sum_{i=1}^N \right) \right] \right\rangle = \left\langle \exp \left(\frac{ikx}{N} \right) \right\rangle$$

correct to:

$$\langle \exp(ik\bar{x}) \rangle = \left\langle \exp \left[ik \frac{1}{N} \left(\sum_{i=1}^N x_i \right) \right] \right\rangle = \left\langle \exp \left(\frac{ikx}{N} \right) \right\rangle^N$$

D. Markov Chains

- **Page 337, line 4. Read:**
Let $\nu_k^{(\lambda)}$ be a right eigenvalue of W
correct to:
Let $\nu_k^{(\lambda)}$ be a right eigenvector of W

E. Fundamental Physical Constants

- **Page 380, line 2. Read:**
 $\hbar = h/(2\pi)$
correct to:
 $\hbar = h/(2\pi)$