Updates and Corrections to the Solutions to Statistical and Thermal Physics by Harvey Gould and Jan Tobochnik

Problem	Correction

2.4(d) The solution was inadvertently omitted. From Table 2.1 $T_{\rm steam} = 373.12\,{\rm K}$ and $T_{\rm ice} = 273.15\,{\rm K}$. Thus,

$$T_{\rm centigrade} = (T - 273.15)\frac{100}{373.12 - 273.15} = 1.0003T - 273.23. \tag{2.2}$$

Thus, the centigrade unit is 1.0003 times larger than the Celsius unit, which is the same size as the Kelvin unit.

2.51 Equation (2.54b) should be

$$= (2)(8.314)(300)\ln 10 = 11486\,{\rm J} \tag{2.54b}$$

2.54 In part (a) replace the parenthetical remark in the problem statement with *Black holes are a consequence of the general theory of relativity, and thus we expect that the radius depends only on M, G, and c.* At the end of the second line of the solution for part (b) the last result is missing a factor of k.

2.55 In the problem statement *ideal gas* should be *monatomic ideal gas* in part (a). Also change *increase the volume* to *increase the volume to V_2* in part (d).

2.56 In the problem statement *ideal gas* should be *monatomic ideal gas*. In part (d) *pressure* should be *pressure change* and *volume* should be *volume change*. Also, *is heated* should be *is cooled*. The solution for part (d) should include $Q = \Delta E - W = 36 - 115.5 = -79.5\,{\rm J}$.

3.38(a) The limits of the integral in Eq. (S3.47)should be -1 and 1:

$$\overline{x^2} = \frac{1}{2}\int_{-1}^{1} x^2 dx = \frac{1}{3}. \tag{S3.47}$$

3.40 In the problem statement $p(v_x) = (a/\pi)^{3/2}\,e^{-av_x^2}$ should be $p(v_x) = (a/\pi)^{1/2}\,e^{-av_x^2}$. In part (b) the left-hand side of Eq. (S3.56) should be $p(v_x, v_y, v_z)\,dv_x dv_y dv_z$. The corrected equations in the solution are

$$\int p(\mathbf{v})\,d\mathbf{v} = \iiint C^3 e^{-av^2}\,dv_x dv_y dv_z \tag{S3.55a}$$

Also

$$p(v_x, v_y, v_z)dv_x dv_y dv_z = C^3 e^{-av^2}\,dv_x dv_y dv_z. \tag{S3.56}$$

3.42 The value for C_4 in Eq. (S3.61) should be

$$C_4 = \frac{a^4}{5} - 0 - 3\Big(\frac{a^2}{3}\Big)^2 + 0 - 0 = -\frac{2}{15}a^4. \tag{3.61}$$

4.4(b) Equation (S4.3) should be

$$\Omega(N = 4, E = 6) = \frac{9!}{6!\,3!} = \frac{(9)(8)(7)}{(3)(2)} = 84. \tag{S4.3}$$

Problem	Correction
4.11	Equation (S4.10) is missing a parenthesis and should be $$\Gamma_{\rm qm}(E) = \frac{2L}{h}\Big[2m\Big(\frac{144\,h^2}{8mL^2}\Big)\Big]^{1/2} = 12. \qquad \text{(S4.10)}$$
4.18	In Eq. (S4.17), $(3/2)(N-1)/N$ should be replaced by $[(3N/2)-1]/N$. Thus, in the next sentence $(N-1)/N \to 1$ should be replaced by $\big[\frac{3}{2}N-1\big]/N \to 3/2$. We thank Jeffrey Sudol for pointing out this error.
4.29(c)	$N = 30$ should be $N = 40$.
4.29(d)	$N = 30$ should be $N = 40$.
4.30	Equation (S4.34) should read $$\overline{E}_{\rm d} = -\frac{\partial}{\partial\beta}\ln\int_0^\infty e^{-\beta E_d}\,dE_d = -\frac{\partial}{\partial\beta}\ln\beta^{-1} = \frac{1}{\beta} = kT. \qquad \text{(S4.34)}$$
4.33	Table S4.6 should refer to Program IdealThermometerEinsteinSolid. We thank Blake Laing for pointing out this error.
4.38(a)	Equation (S4.40) should be $$\Omega_B = \frac{16!}{9!\,7!} = 11440. \qquad \text{(S4.40)}$$ So the initial total number of microstates is $\Omega = \Omega_A\Omega_B = 45760$.
4.42	Equation (S4.52a) is missing parentheses and should read $$T = \frac{2}{3Nk}\Big(E + \frac{N^2a}{V}\Big) \qquad \text{(S4.52a)}$$
4.45	The pressure should be $\overline{P} = kT\partial\ln Z/\partial V = kT/V$.
4.49	The problem statement refers to microstates 1 and 2, but the solution refers to microstates 0 and 1. Hence $P_0 \to P_1$ and $P_1 \to P_2$ in the solution.
5.4	The original solution was given for $N = 3$ instead of $N = 4$. We thank Blake Laing for bringing this discrepancy to our attention. The 2^N microstates of the $N = 4$ Ising chain are $$\uparrow\uparrow\uparrow\uparrow\,(-3J) \quad \uparrow\uparrow\uparrow\downarrow\,(-J) \quad \uparrow\uparrow\downarrow\uparrow\,(+J) \quad \uparrow\downarrow\uparrow\uparrow\,(+J) \quad \downarrow\uparrow\uparrow\uparrow\,(-J)$$ There is one microstate with all spins up and four microstates with one spin down. Similarly there is one microstate with all spins down and four microstates with one spin up. The remaining six microstates with two spins up and two spins down are $$\uparrow\uparrow\downarrow\downarrow\,(-J) \quad \uparrow\downarrow\downarrow\uparrow\,(+J) \quad \downarrow\downarrow\uparrow\uparrow\,(-J) \quad \uparrow\downarrow\uparrow\downarrow\,(+3J) \quad \downarrow\uparrow\downarrow\uparrow\,(+3J) \quad \downarrow\uparrow\uparrow\downarrow\,(+J)$$ The corresponding value of Z_4 in zero external field is given by $$Z_4 = 2\big(e^{3\beta J} + 2e^{\beta J} + 2^{-\beta J}\big) + 2e^{\beta J} + 2^{-\beta J} + 2e^{-3\beta J} = 2(e^{\beta J} + e^{-\beta J})^3$$ As shown in the text, Z_3 is given by $$Z_3 = 2\big(e^{\beta J} + e^{-\beta J}\big)^2.$$ Hence $$Z_4 = (e^{\beta J} + e^{-\beta J})Z_3 = 2\cosh\beta J)Z_3.$$

Problem	Correction
5.6(c)	Equation (S5.15d) is missing ln in the first term in the brackets. Equation (S5.15e) is missing a factor of Nk outside the brackets. In Eq. (S5.15f) upper case K should be lower case. Also the first exponential in the second parentheses within the brackets has the wrong sign in the exponent.
5.36(a)	In the statement of the problem replace the last sentence with *Each spin interacts once with each horizontal or vertical nearest neighbor.* (Toroidal boundary conditions are redundant for a 2×2 lattice.)
6.19	The reference to Eq. (6.119c) just before Eq. (S6.58) should be to Eq. (6.86). In Eq. (S6.61) ϵ_k should be replaced by ϵ. Also du is missing a factor of $d\epsilon$.
6.37	In the statement of the problem the references to the left-hand side of (6.211b) should be to the right-hand side of (6.211b).
6.28	Equation (6.157) should be $$\Omega = \frac{(2m)^{3/2}V}{2\pi^2\hbar^3}\int_0^{\epsilon_F} d\epsilon\, \epsilon^{1/2}\big(\epsilon - \epsilon_F\big). \qquad (6.157)$$
6.40	In the problem statement and in the solution $N_{\rm eff}$ should be replaced by $\overline{N}_\epsilon$.
6.55	Equation (S6.221b) should be $$= (3\pi^2)^{2/3}\frac{(1.05\times 10^{-34})^2}{2(1.67\times 10^{-27})}\Big(\frac{1.2\times 10^{57}}{8\times 10^{12}}\Big)^{2/3} = 9\times 10^{-12}\,\text{J}. \qquad (\text{S6.221b})$$

7.14 The original solution converted 127 C to 300 K rather than 400 K. We thank Blake Laing for pointing out this error. Corrected solution: We have

$$\ln P(T) = -\frac{\ell}{RT} + \text{constant}, \tag{7.42}$$

where P_0 is a constant. From (7.42) for two different temperatures we obtain

$$\begin{aligned}
\ln\frac{P(T_2)}{P(T_1)} &= -\frac{\ell}{R}\Big(\frac{1}{T_2} - \frac{1}{T_1}\Big) \\
\ln 1.08/1.06 &= -\frac{5000}{8.3}\Big(\frac{1}{T_2} - \frac{1}{400}\Big) \\
0.0187 &= -\frac{602.4}{T_2} + 1.506.
\end{aligned}$$

Thus, $T_2 \approx 602.4/1.487 \approx 405\,\text{K}$ or 132°C.

Updated 17 April 2015.