Physics of Music and Color
CORRECTIONS to the 1st Edition

CORRECTIONS

DATE: **9/16/2018**

Chapter 2

p. 38, middle of the page; last equation should read:

$\mathcal{T} = \mu v^2 \sim (6 \times 10^{-3})(500)^2 = 1,500\ N \sim 300\ lbs$

"keys" should be **"piano keys"**

p. 42, just below equation (2.46):
With respect to f_0, the speed v is the speed in the absence of stiffness. Thus it would be clearer to write:

$$f_0 = \frac{v}{2\ell}\sqrt{\frac{\mathcal{T}}{\mu}} \tag{1}$$

Chapter 3

The discussion of the **end correction** in Chapter 3 needs to be corrected. First let us clarify the origin of the correction: The formula for the frequencies of the modes of a pipe are based upon the assumption that the sound pressure has a node at an open end. An open pipe has two open ends, while a so-called closed pipe has but one. At a closed end, the sound pressure has an anti-node.

In 1870, Lord Rayleigh showed that the sound pressure extends beyond an open end. His estimate was that the amount is 0.61 time the radius R. H. Levine and J. Schwinger derived an exact expression, which rounds off to 0.61 R. The results depend upon the condition that the wavelength is much greater than the radius. That is. $\lambda \gg R$. [1]

[1] Some organ pipes have a diameter so large and such a high frequency and therefore small wavelength that this condition can be violated. Levine and Schwinger calculated the error for a great range of frequencies.

The consequence is that the mode frequencies for a closed pipe are given by

$$f_1 = \frac{v}{4(\ell + 0.61R)}, \qquad f_2 = 3\frac{v}{4(\ell + 0.61R)}, \qquad \ldots \tag{2}$$

Effectively, the length is increased by what is referred to as an **end correction** of 0.61R.

For an open pipe, there are two open ends so that there is an end correction of 1.22 R. The frequencies are given by

$$f_1 = \frac{v}{2(\ell + 1.22R)}, \qquad f_2 = 2\frac{v}{2(\ell + 1.22R)}, \qquad \ldots \tag{3}$$

Chapter 4

Sample Problem 4-1 – The solution should read

$$KE = \frac{1}{2}(10 \times 1,000)(10)^2 = 500,000 \text{ Joules} - 500,000\ J \tag{4}$$

Sample Problem 4-2 - The solution should read

$$KE = \frac{1}{2}(10 \times 1,000)(20)^2 = 2,000,000 \text{ Joules} - 2,000,000\ J \tag{5}$$

Or, we could realize that multiplying the speed by a factor of two should multiply the KE by a factor of $2^2 = 4$. Thus

$$KE = 4 \times 500,000\ J = 2,000,000\ J \tag{6}$$

Sample Problem 4-3

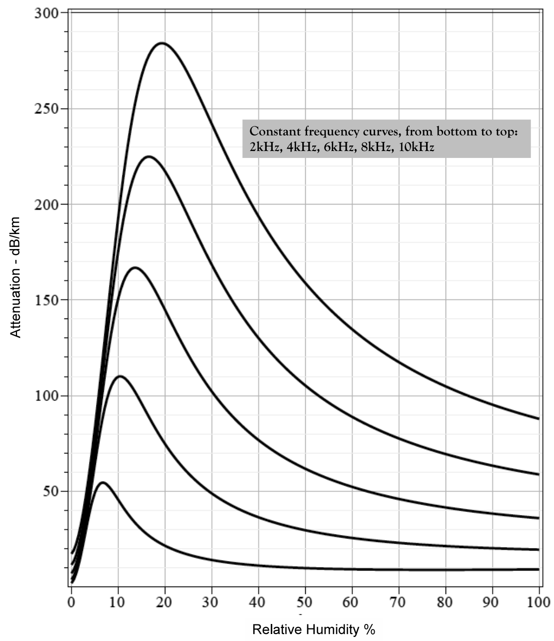
Solution should read

$$KE = \frac{1}{2}(100,000 \times 1,000)(2)^2 = 2 \times 10^8\ J \tag{7}$$

p. 112 in the Note "discernable" should be "discernible"

p. 114, the last sentence of first paragraph: "attenuation time that is a bit greater than the frequency" should read "attenuation time of the SHO that is much greater than the inverse of the frequency of the SHO"

Figure 4.10 Attenuation vs. relative humidity and frequency was missing labels of axes. Here are corrected figures, that have labeled axes. One figure focuses on high frequencies, the other on lower frequencies.



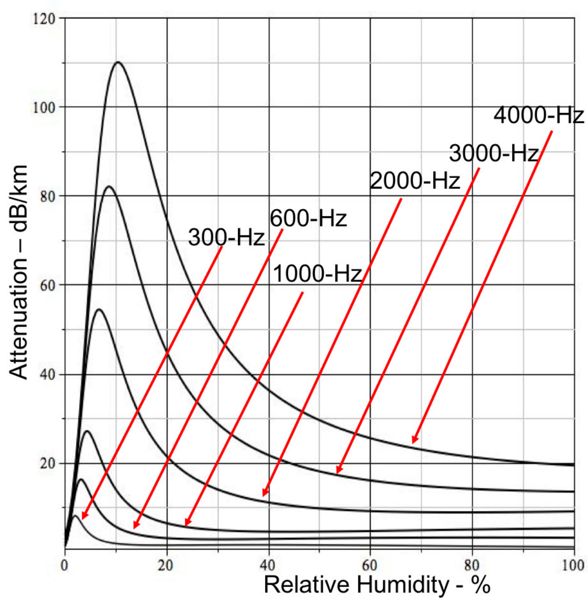


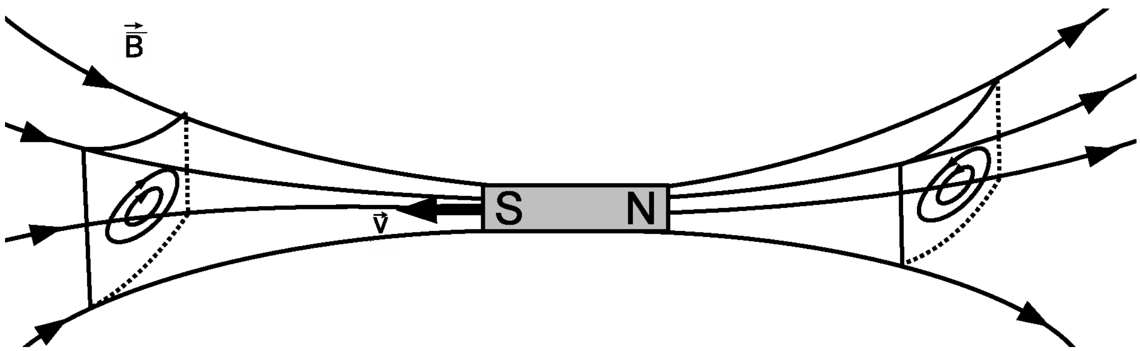
Figure 1: Attenuation Constant vs. Relative Humidity and Frequency

In equations 4.25 and 4.26, α should be replaced by α_L. Thus, we should have $\Delta SL = -\alpha_L x$

In the solution to Sample Problem 4-17, the attenuation α_L should be $\approx$ 45-dB/km so that the reduction in SL will be about -0.045 dB.

Chapter 5

Figure 5.59 had an incorrect direction of the arrows for the electric field to the right side of the magnet. Here is the correct figure.



Facing the magnet from the right, the electric field lines are counter clockwise, reversed from those in figure 5.58.

Problem 5.12
Replace "when a" with "an"

Chapter 6

Equation (6.15) should read

$$f = \frac{E_i - E_f}{\hbar} \tag{8}$$

Equation (6.16) should read

$$f = \frac{E_f - E_i}{\hbar} \tag{9}$$

Note the order of the two energies, initial and final.

Chapter 8

The last sentence of the introduction should read:

"The **polarization of light** is involved in reflection, refraction, and scattering; however, this subject is not discussed in the book."

Just before equation (8.5), replace d= 2L/d by $d = 2\lambda L/d$.

In section 8.10.7 at the end of the first paragraph, Fig. 8.42 should read Fig. 8.43.

Problem 8.7
Replace “1/,km” with “one kilometer”

Problem 8.11
This problem needs to be totally modified as follows:

The reflectance and transmission of a wave across a transparent sheet, such as a color filter, is much more complicated than the text indicates, on account of the complexity of the infinite number of reflections and transmissions across the two faces. In this problem simply treat the problem as a single reflection and transmission across the air and an infinite space of transparent material with index of refraction 1.5.

In Problem 8.22, omit the word ”arrow”.

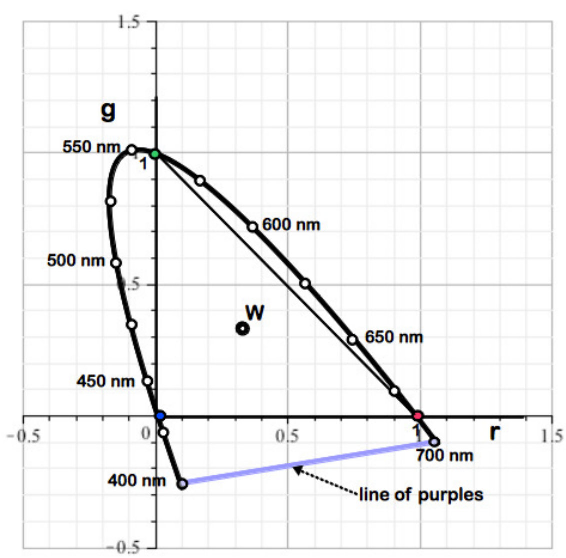
Chapter 11

Chapter 12

Line after equation (12.4)
Replace “$d_{ie} = 200cm$” with “$d_{ie} = 24.0mm$”

Chapter 14

Figure 14.4 is mislabeled, with wavelengths incorrectly running clockwise from left to right from 700nm to 400nm. Here is the correctly labeled figure, running clockwise from 400nm to 700nm.



The caption of **Figure 14.5** should read "Wright-Guild ... "

The caption of **Table 14.10** should refer to "Stiles and Burch" not "stiles and burch". The wavelengths of the primaries are indicated in the table, as 444.44-nm, 526.32-nm, and 645.16-nm.

On page 450, in the fourth complete paragraph, **415, 515, and 700 nm** should read **435.8, 546.1, and 700 nm**.

In the third paragraph of section 14.12, **S, M, and L** refer to the cones in the retina.

Revise caption of figure 14.17
"Absorption by the rods (R) and by the three color pigments:
long wavelength red cones (L), midrange wavelength green cones (M), and short wavelength blue cones (S). The curves are 'normalized' so that all peak values are set to 100%."

Problem 21(b)
Incorrect figure references: Use Fig. 14.4 - noting that the correct figure is shown above.

Problem 14.29(d)

REDONE in a new chapter 14
Replace with the following:
The suggested expression in the textbook for $\{r, g\}$ is incorrect. The correct analysis is based upon eqs. (14.26) and (14.27).

When the upper disc appears to be uniform in color, it is of interest to express the resulting color coordinates $\{r, g\}$ in terms of the color coordinates of each of the two squares.

Let us label the two squares, by the numbers 1 and 2.
You are to show that the correct solution is that the color coordinates are given by

$$r = \frac{S_1 r_1 + S_2 r_2}{S_1 + S_2} \quad , \quad g = \frac{S_1 g_1 + S_2 g_2}{S_1 + S_2} \tag{10}$$

where (R_1, G_1, B_1) and (R_2, G_2, B_2) are the corresponding sets of tristimulus values. The corresponding color color coordinates are (r_1, g_1) and (r_2, g_2). Furthermore $S_1 = R_1 + G_1 + B_1$ and similarly, $S_2 = R_2 + G_2 + B_2$. The resulting color coordinates are said to be a **weighted average** of the two sets of color coordinates.

Note that when $S_1 = S_2$, the color coordinates are a simple average of the original two.

$$r = \frac{r_1 + r_2}{2} \quad , \quad \frac{g_1 + g_2}{2} \tag{11}$$

To produce the proof, you can proceed as follows:

1. At a great distance, a single cone will receive a spectral intensity from one of the squares.

Let $I_1(\lambda)$ and $I_2(\lambda)$ be the spectral intensities of the light when the checkerboard is viewed from close up so that they produce distinct images on the retina. They are associated with the pair of tristimulus values $\{R_1, G_1, B_1\}$ and $\{R_2, G_2, B_2\}$ along with their corresponding color coordinates $\{r_1, g_1\}$ and $\{r_2, g_2\}$.

Let us now proceed with the analysis:

When viewed from far away, each of these spectral intensities is reduced by the same factor. For simplicity, we will assume the reduction is by a factor of two. The tristimulus values are reduced by the same factor, while the color coordinates don't depend upon the actual factor.

(i) In terms of the above symbols what are the resulting sets of tristimulus values?

(ii) What are the resulting color coordinates of the respective squares?
Explain why the ultimate resulting color coordinates cannot depend upon the actual factor.
Each cone will receive the sum of these two spectral intensities.

(iii) Now complete the process of proving the above equation 10.
Start by finding the tristimulus values produced by a sum of the two spectral intensities.