Chapter 16 Figures 1 To 21 From

MATHEMATICAL METHODS for Scientists and Engineers

Donald A. McQuarrie

For the Novice Acrobat User or the Forgetful

When you opened this file you should have seen a slightly modified cover of the book *Mathematical Methods for Scientists and Engineers* by Donald A. McQuarrie, a menu bar at the top, some index markers at the left hand margin, and a scroll bar at the right margin.

Select the **View** menu item in the top menu and be sure **Fit in Window** and **Single Page** are selected. Select the **Window** menu item and be sure **Bookmarks** and **Thumbnails** ARE NOT selected.

You can and probably should make the top menu bar disappear by pressing the function key F9. Pressing this key (F9) again just toggles the menu bar back on. You may see another tool bar that is controlled by function key F8. Press function key F8 until the tool bar disappears.

In the upper right hand corner margin of the window containing this text you should see a few small boxes. DO NOT move your mouse to the box on the extreme right and click in it; your window will disappear! Move your mouse to the second box from the right and click (or left click); the window containing this text should enlarge to fill the screen. Clicking again in this box will shrink the window; clicking again will return the display to full screen.

The prefered means of navigation to any desired figure is controlled by the scroll bar in the column at the extreme right of the screen image. Move your mouse over the scroll bar slider, click, and hold the mouse button down. A small window will appear with the text "README (2 of 23)". Continuing to hold down the mouse button and dragging the button down will change the text in the small window to something like "16.4 (6 of 23)". Releasing the mouse button at this point moves you to Figure 16.4 of Chapter 16. The (6 of 23) indicates that Figure 16.4 resides on page 6 of the 23 pages of this document.

ANIMATIONS

Figures 16.15, 16. 16, 16.17, 16.19, and 16.20 each has an associated animation which requires QuickTime™ for display. The animation files are named Anim16_15.mov, Anim16_16.mov, Anim16_17.mov, Anim16_19.mov, and Anim16_20.mov, respectively. Each of the animation files must be independently acquired from the server.

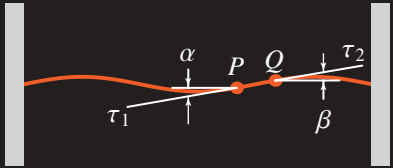

Figure 16.1
A vibrating string at an instant of time. The quantities shown in the figure are used in the derivation of the classical one-dimensional wave equation.

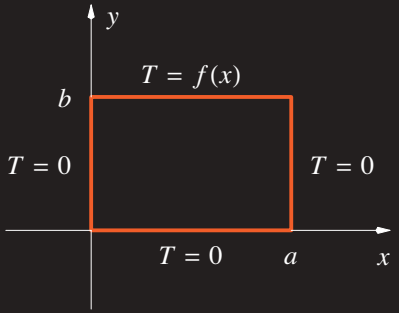

Figure 16.2
A summary of the boundary conditions for Equations 6 and 7.

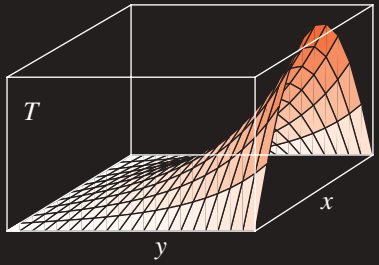

Figure 16.3
Equation 17 plotted against x and y.

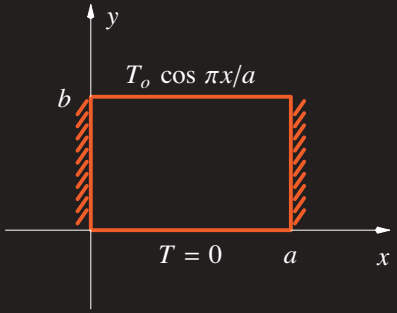

Figure 16.4
A summary of the boundary conditions for Example 1.

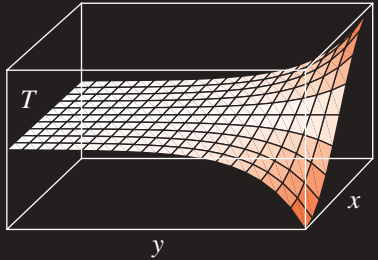

Figure 16.5
The steady-state temperature distribution for the system described in Example 1.

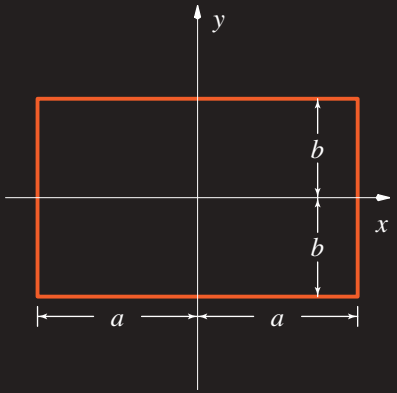

Figure 16.6
The coordinates for a cross-section describing unidirectional flow in the rectangular conduit described in Example 2.

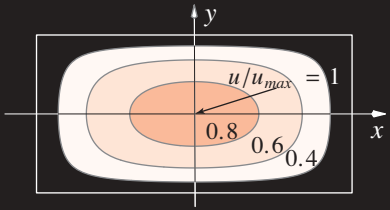

Figure 16.7
Velocity contours for the steady unidirectional flow through a rectangular conduit for $a = 2b$.

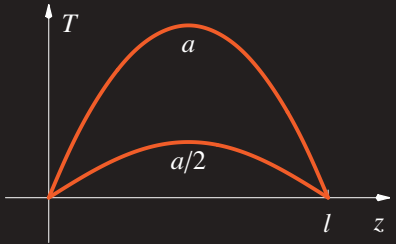

Figure 16.8
The steady-state temperature distribution $T(r, z)$ given in Example 3 for $r = a$ and $r = a/2$.

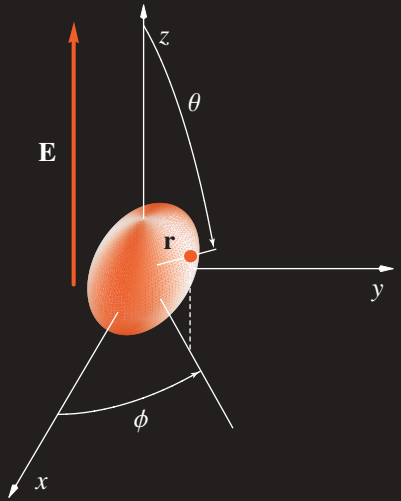

Figure 16.9
The geometry associated with a conducting sphere in a uniform electric field.

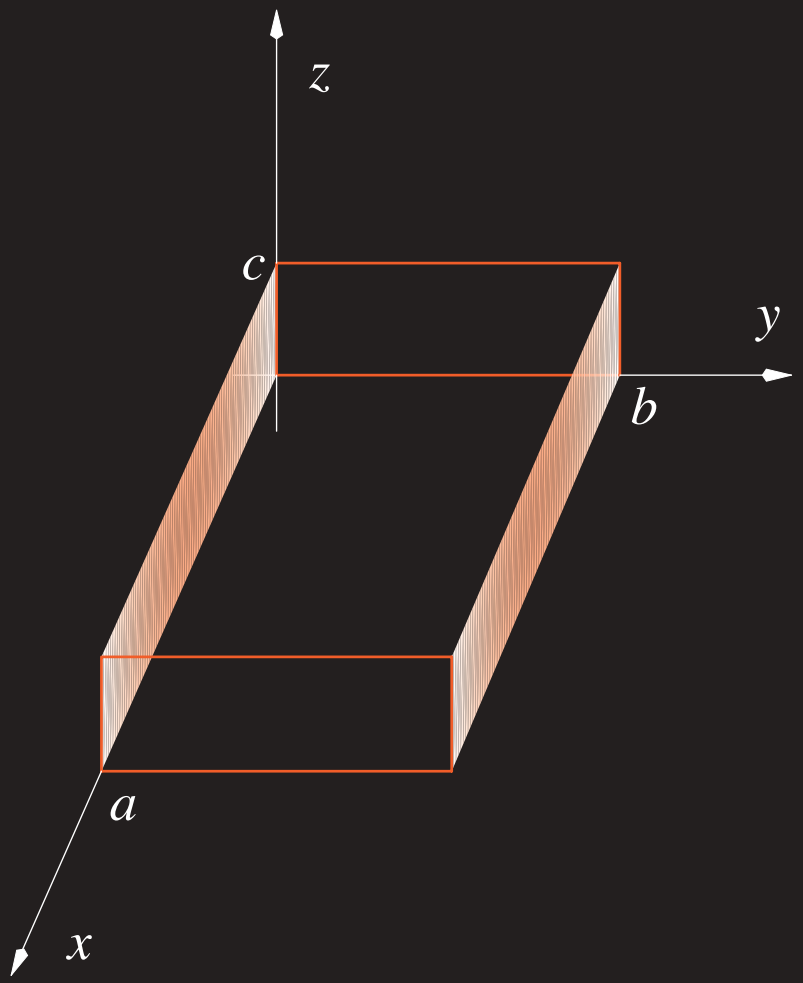

Figure 16.10
The block of metal described in Problem 4.

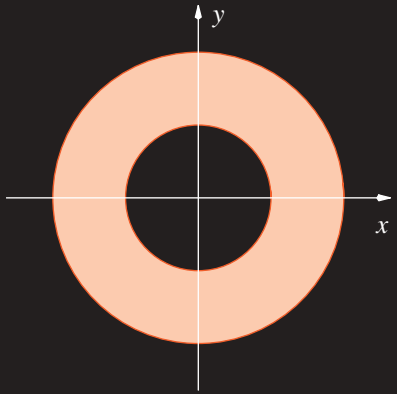

Figure 16.11
A circular annulus of inner radius 1 and outer radius 2. (See Problem 18.)

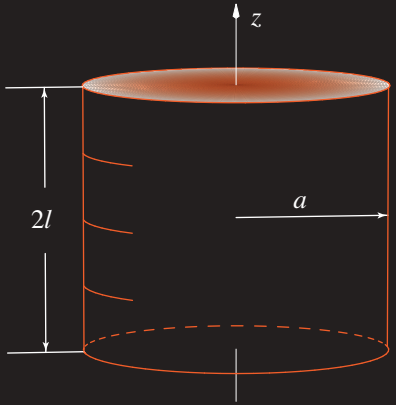

Figure 16.12
The right cylinder described in Problem 19.

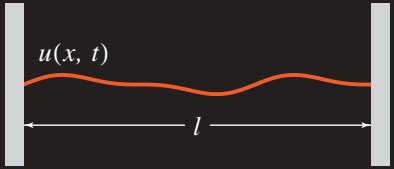

Figure 16.13
A taut, flexible string fixed at its two endpoints, 0 and l, so that its displacement satisfies $u(0, t) = u(l, t) = 0$.

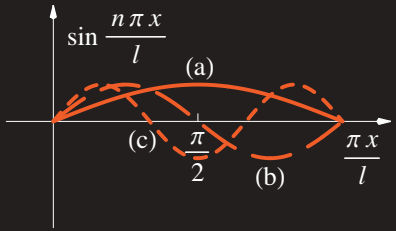

Figure 16.14
The spatial dependence of the first few terms in Equation 6: (a) n = 1, (b) n = 2, and (c) n = 3.

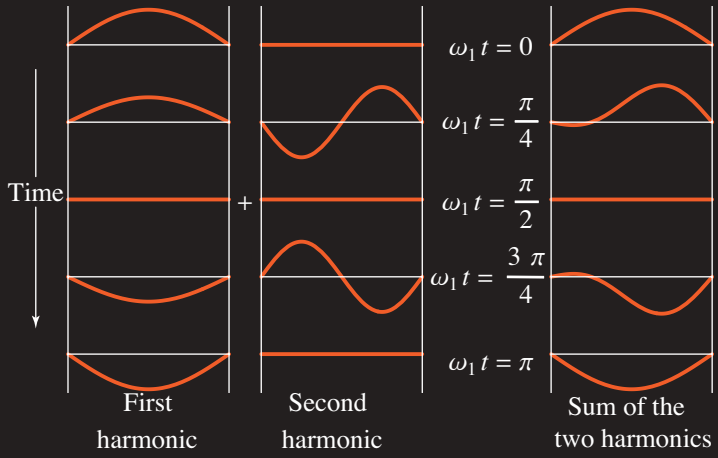

Figure 16.15
An illustration of how two standing waves can combine to give a traveling wave. In both parts, time increases downward. The left-hand portion shows the independent motion of the first two harmonics. Both harmonics are standing waves; the first harmonic goes throught half a cycle and the second harmonic goes through one complete cycle in the time shown. The right side shows the sum of the two harmonics. The sum is not a standing wave. As shown, the sum is a traveling wave that travels back and forth between the fixed ends. The traveling wave has gone through one-half a cycle in the time shown.

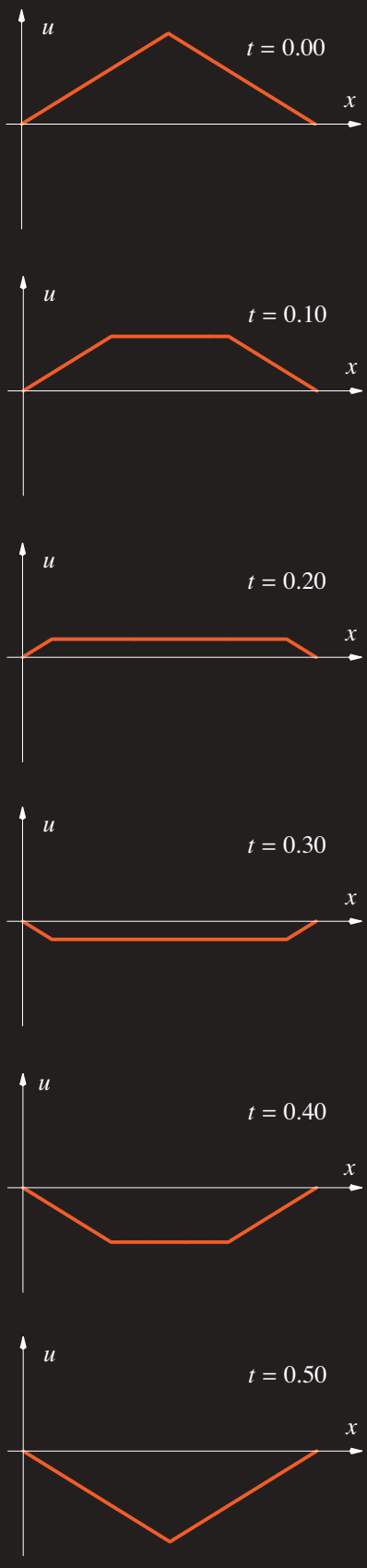

Figure 16.16
The time-dependence of the displacement of the string described in Example 3.

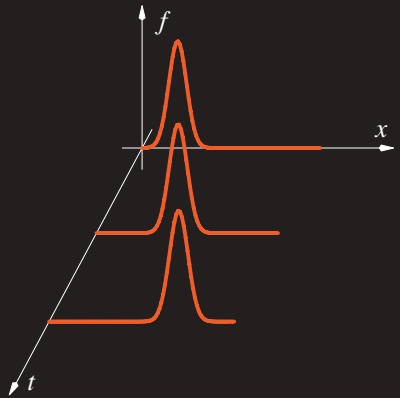

Figure 16.17
An illustration that $f(x - v\,t)$ is a waveform $f(x)$ traveling from left to right.

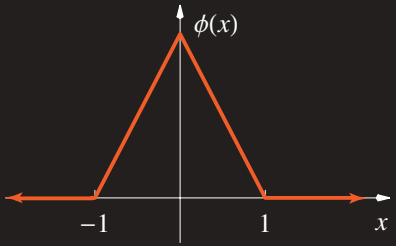

Figure 16.18
A plot of the initial disturbance $\phi(x) = 1 - |x|$ when $-1 \le x \le 1$ and $\phi(x) = 0$ otherwise.

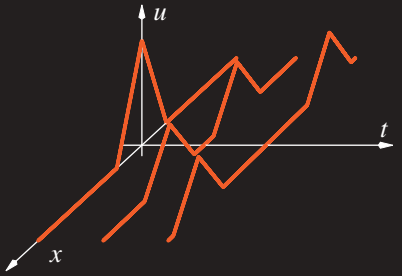

Figure 16.19
An initial triangular waveform breaking into two and moving in opposite directions.

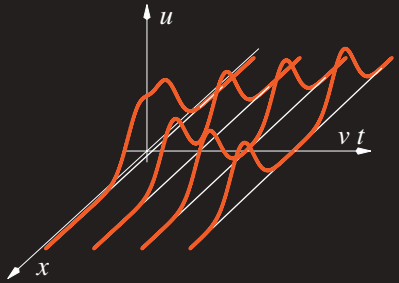

Figure 16.20
The displacement in Example 5 at $vt = 0.25, 0.50, 0.75$ and 1.0.

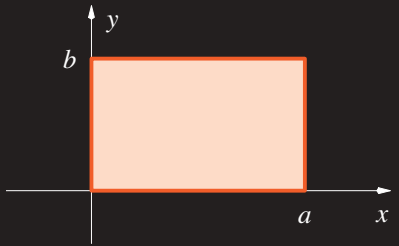

Figure 16.21
The Geometry associated with a rectangular drumhead clamped along its perimeter.