Chapter 19 Figures 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 53)". Continuing to hold down the mouse button and dragging the button down will change the text in the small window to something like "19.4 (6 of 53)". Releasing the mouse button at this point moves you to Figure 19.4 of Chapter 19. The (6 of 53) indicates that Figure 19.4 resides on page 6 of the 53 pages of this document.

ANIMATIONS

There are no animations in this chapter at this time.

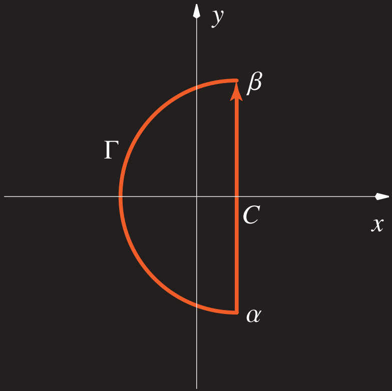

Figure 19.1
A Browmwich contour for inverting Laplace transforms. The closed contour C consists of the vertical line (α, β) and the circular arc Γ.

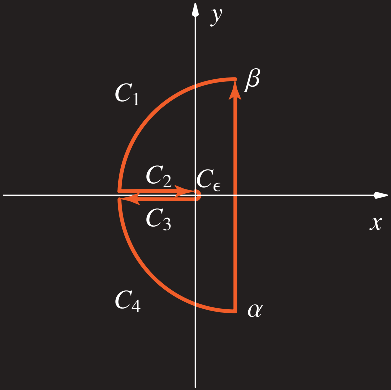

Figure 19.2
A modification of the contour shown in Figure 19.1 to accomodate a branch point at the origin and a branch cut along the negative real axis.

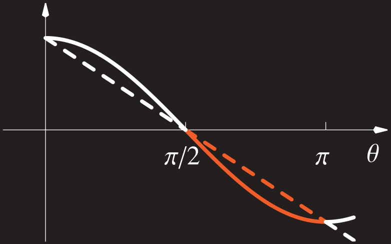

Figure 19.3
The geometirc illustration of the inequality $\cos\theta \leq 1 - 2\theta/\pi$ for $\pi/2 \leq \theta \leq \pi$. The plot of $\cos\theta$ is shown as the solid line.

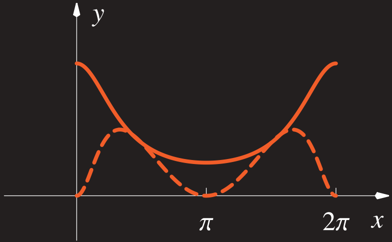

Figure 19.4

A demonstration of the symmetry of the integrands in Equation 1 (solid) and Equation 4 (dashed).

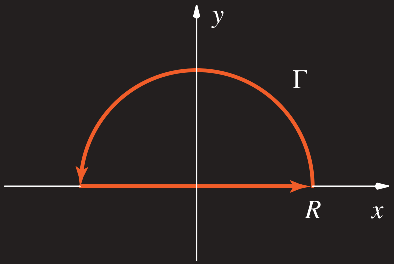

Figure 19.5
The contour used to evaluate the integral in Equation 9.

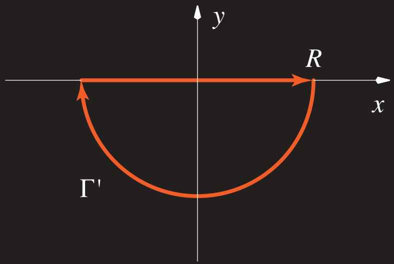

Figure 19.6
An alternative contour that can be used to evaluate the integral in Equation 9.

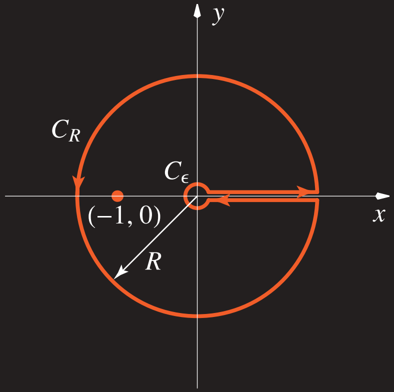

Figure 19.7
The contour used to evaluate the integral in Equation 10.

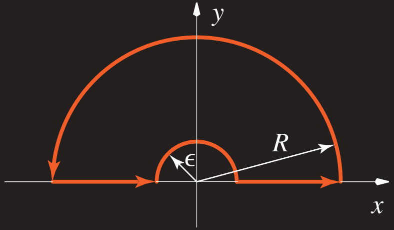

Figure 19.8
The contour used to evaluate the integral in Problem 18.

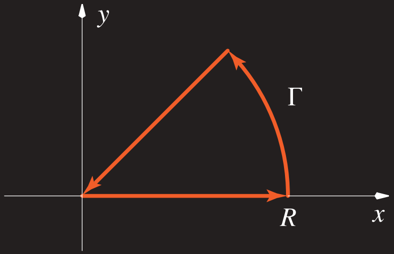

Figure 19.9
The contour used to evaluate the integrals in Problem 25.

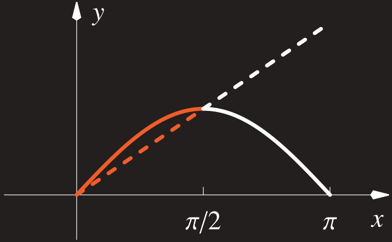

Figure 19.10
A geometric illustration of the inequality $\sin\theta \geq 2\theta/\pi$ for $0 \leq \theta \leq \pi./2$. The plot of $\sin\theta$ is shown as a solid line.

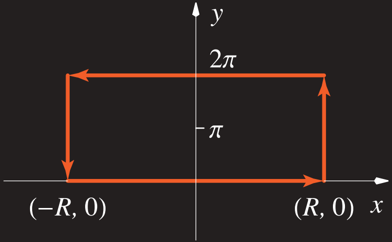

Figure 19.11
The contour used to evaluate the integral in Problem 26.

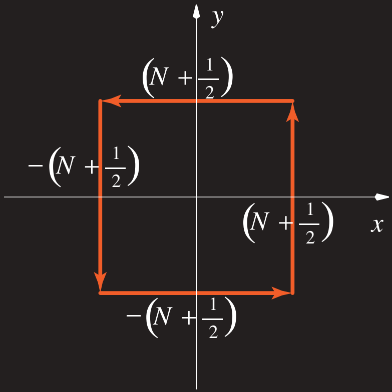

Figure 19.12

The contour used to evaluate the integral in Equation 1. Each side of the square is at a distance $N + \frac{1}{2}$ (where N is an integer) from the origin.

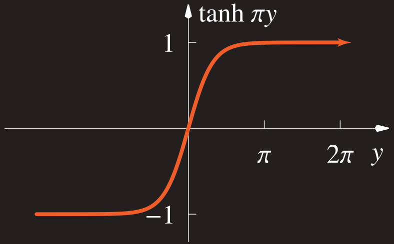

Figure 19.13
A pictorial representation of the inequalities $-1 \leq \tanh \pi y \leq 1$.

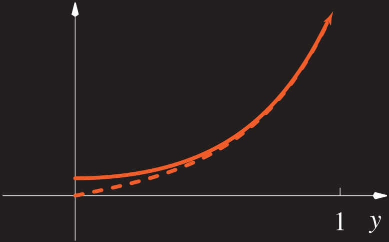

Figure 19.14
An illustration of the fact that cosh πy and sinh πy are essentially equal for $y \geq 1$.

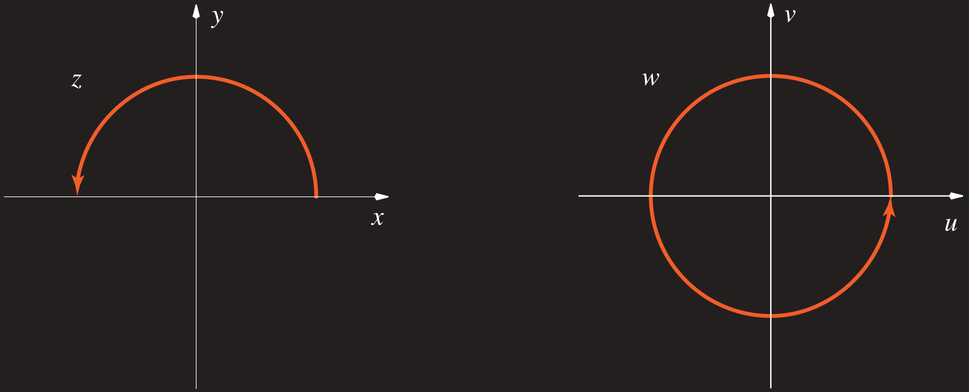

Figure 19.15
An illustration of the fact that $w = f(z) = z^2$ makes a complete circuit in the w-plane when z makes one half a circuit in the z-plane.

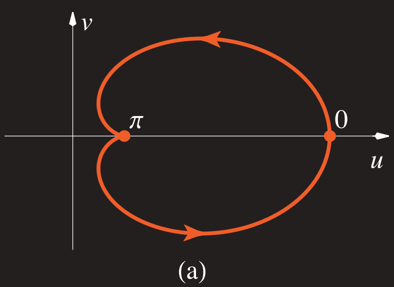

Figure19.16

(a) A plot of $v(x, y)$ against $u(x, y)$ in the w-plane for $w = f(z) = z^2 + 2z + 2$ for a one circuit of z around a unit circle in the z-plane. The numbers 0 and π represent the values of θ in the parametric representation of $v(\theta)$ and $u(\theta)$ in Equations 7. (b) Similar to (a), but in this case z traverses the circle $|z| = 3$ once.

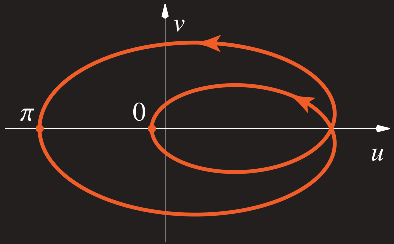

Figure 19.17
A plot of $v(\theta)$ against $u(\theta)$ in the w-plane as z traverses the unit circle once for the function given in Example 3.

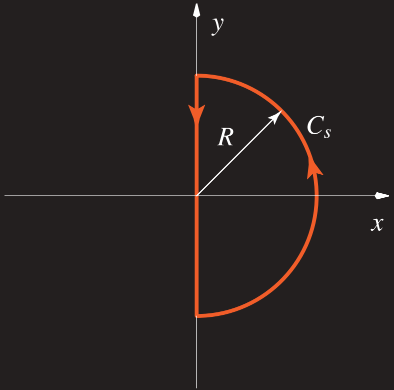

Figure 19.18
The contour used to determine if $Q(s)$ given by Equation 9 has any zeros whose real parts are positive, or lie in the right half plane of the z-plane.

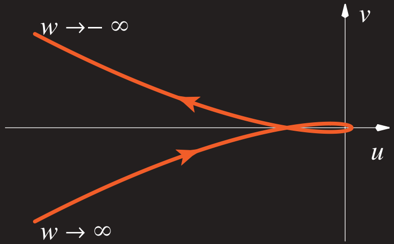

Figure 19.19

The image curve given by $Q(iw) = 6(1 - w^2) + i(10w - w^3)$ plotted in the w-plane for $-8 \leq w \leq 8$. The arrows point in the direction of decreasing w along the path.

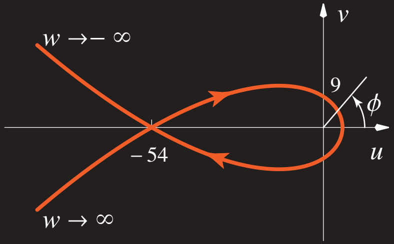

Figure 19.20
An enlargement of the curve in Figure 19.19, showing $\phi = \arg w$ and how it varies as you move along the curve toward its two extremes. The arrows point in the direction of decreasing w along the path.

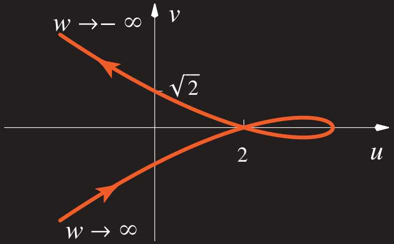

Figure 19.21
The image curve of Example 6. Note that this curve does not enclose the origin.

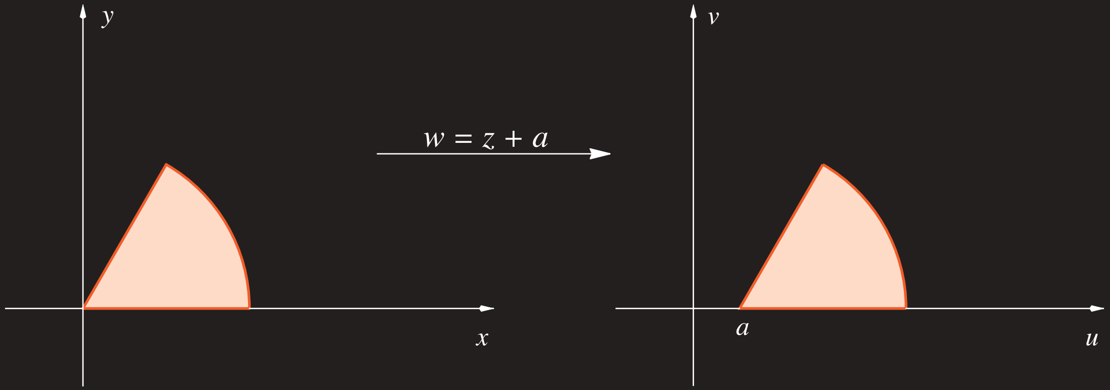

Figure 19.22
The mapping of $w = f(z) = z + a$ translates a region in the z-plane a units to the right in the w-plane.

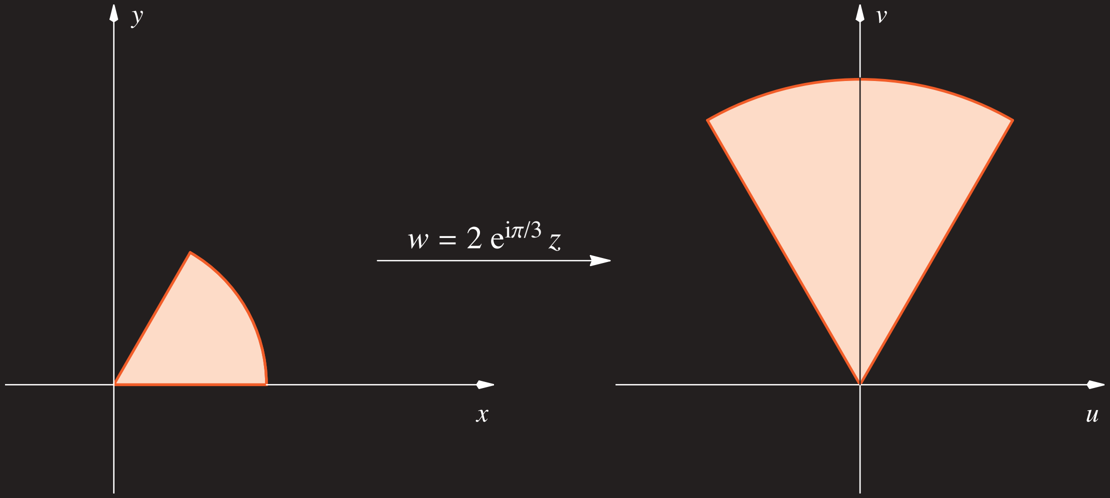

Figure 19.23
The mapping of the test region in Figure 19.22 by the scaling-rotation mapping $w = (1 + \sqrt{3}i)z = 2e^{i\pi/3}z$.

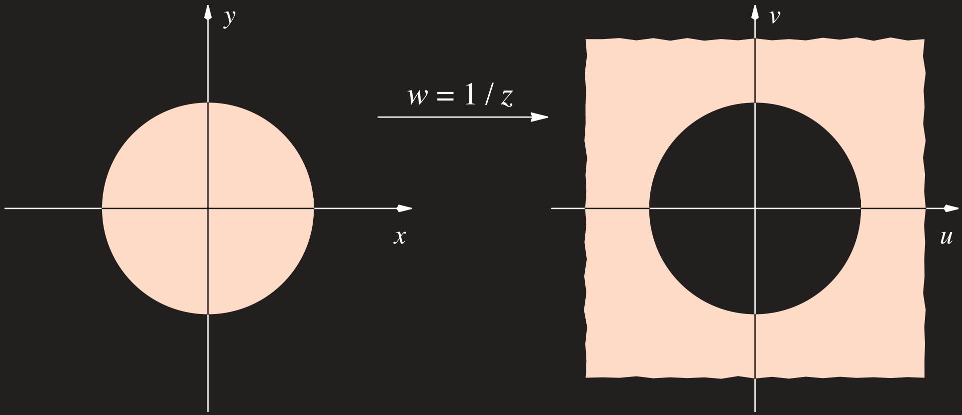

Figure 19.24
The inversion mapping $w = f(z) = 1/z$ maps the interior of a unit disk centered at the origin into the exterior of the disk.

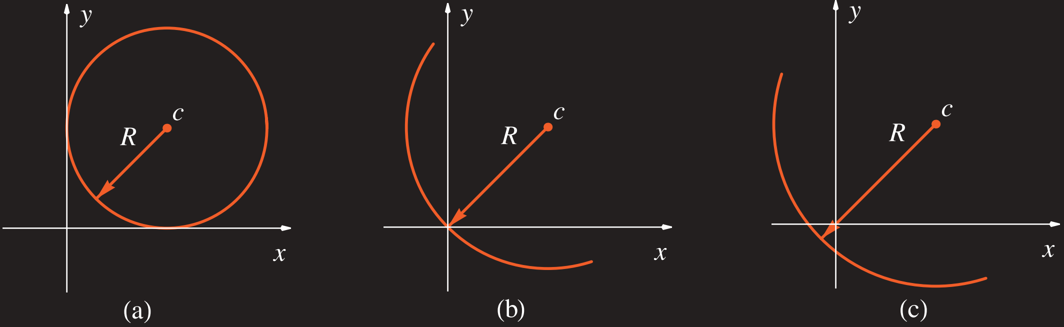

Figure 19.25

The three cases considered in Example 1. (a) If $R < |c|$, then the point $z = 0$ lies outside the disk $|z - c| < R$; (b) If $R = |c|$, then the point $z = 0$ lies on the disk $|z - c| = R$; and (c) If $R > |c|$, then the point $z = 0$ lies inside the disk $|z - c| < R$;

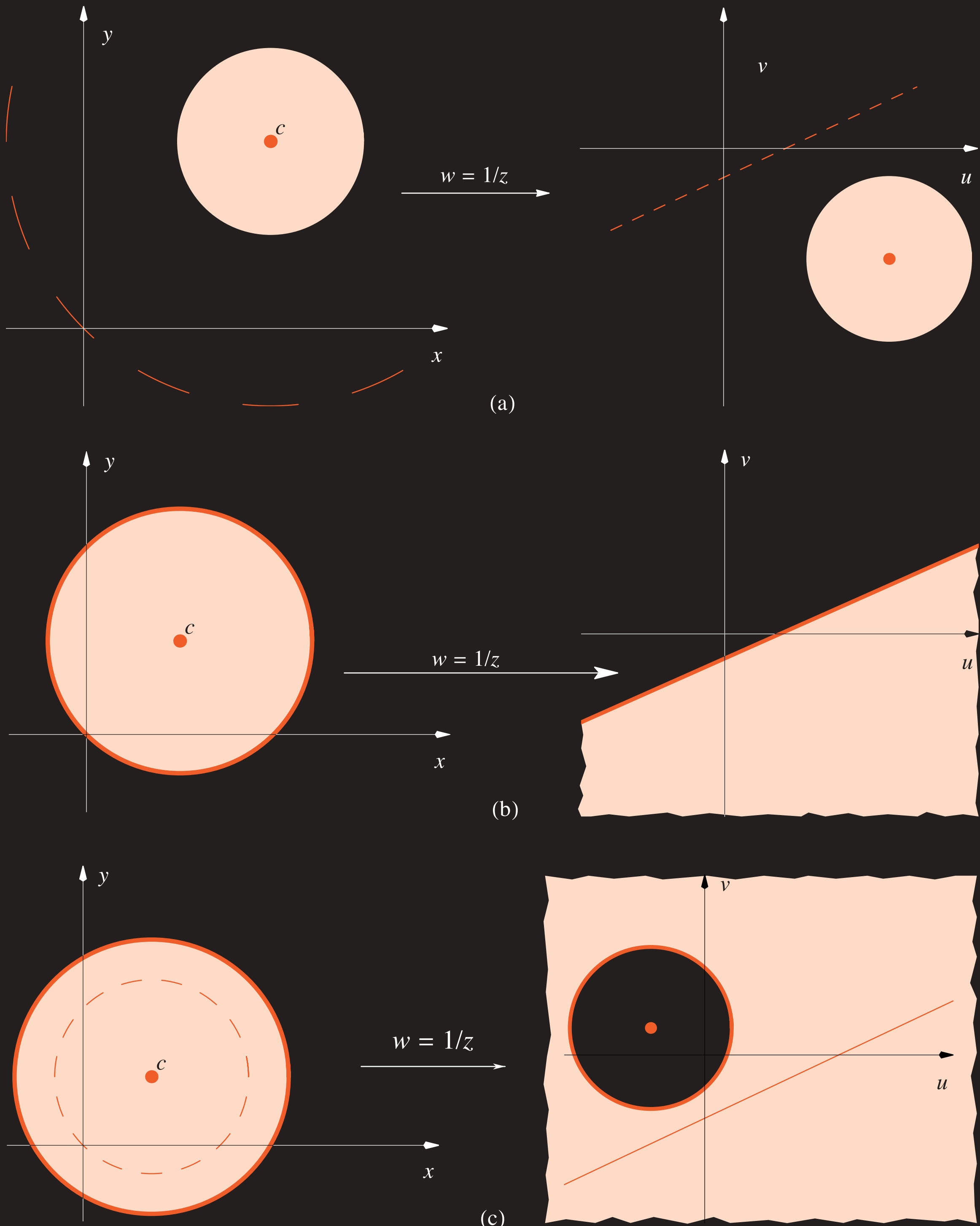

Figure 19.26
An illustration of the mapping discussed in Example 1. (a) $R < |c|$ and the interior of a disk in the z-plane is mapped into the interior of a disk in the w-plane. (b) $R = |c|$ and the disk in the z-plane is mapped into the region below a straight line in the w-plane. (c) $R > |c|$ and the interior of a disk in the w-plane is mapped into the exterior of a disk in the w-plane.

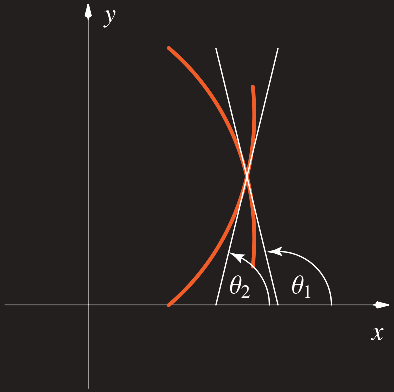

Figure 19.27
A pictorial aid to the proof that a mapping $w = f(z)$ that is analytic is conformal, or angle preserving.

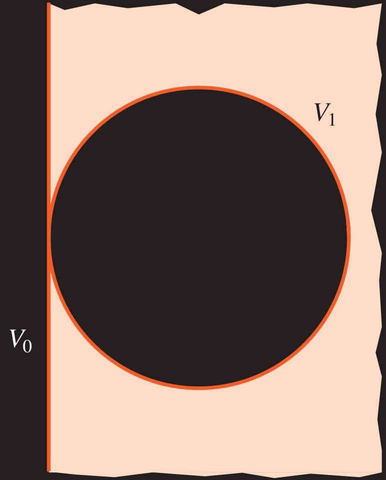

Figure 19.28
The cross-section of a long cylindrical conducting sheet touching, but insulated from, a planar conducting sheet perpendicular to the page.

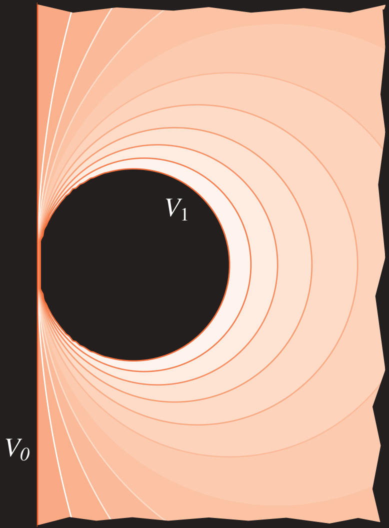

Figure 19.29
Equipotential curves for the system depicted in Figure 19.28.

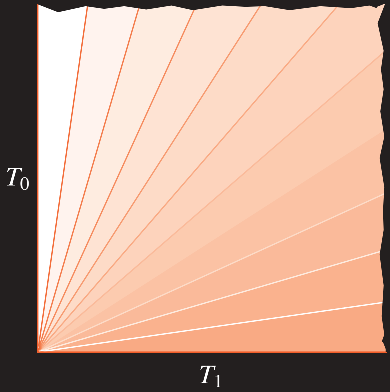

Figure 19.30
Equipotential lines for the system in Example 1.

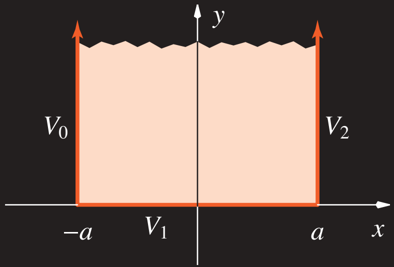

Figure 19.31
The geometry associated with Example 2.

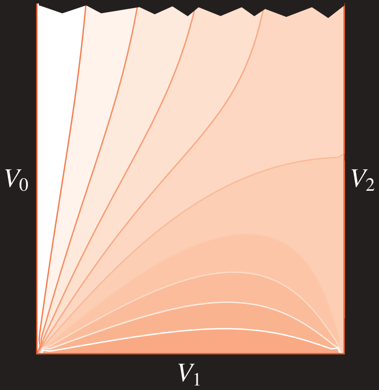

Figure 19.32
Some equipotential lines for the potential given in Example 2.

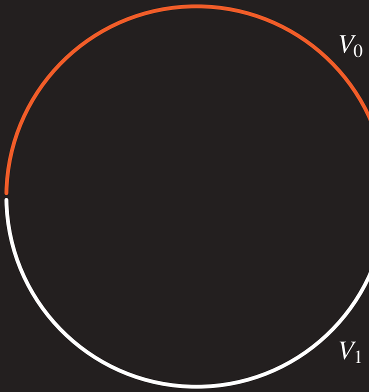

Figure 19.33
The unit disk referred to in Example 3.

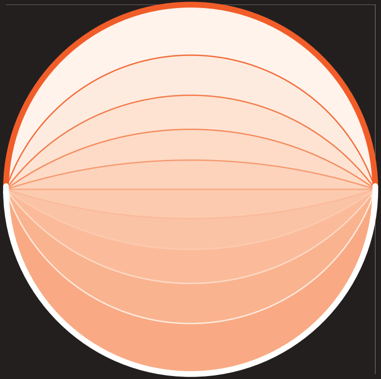

Figure 19.34
Some equipotential lines of the potential in Example 3.

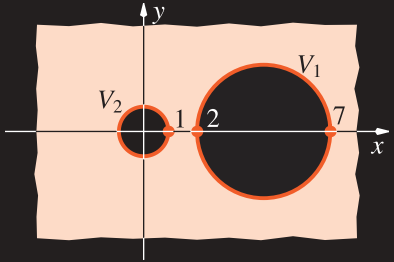

Figure 19.35
The geometry referred to in Example 4.

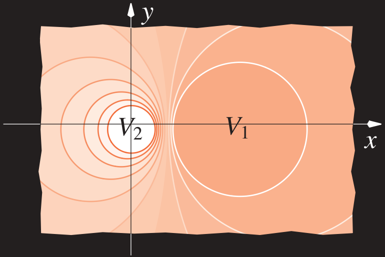

Figure 19.36
The solution given in Example 4 for $V_1 = 0$ and $V_2 = 100$.

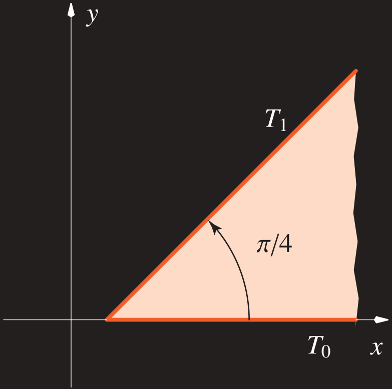

Figure 19.37
The wedge referred to in Problem 7.

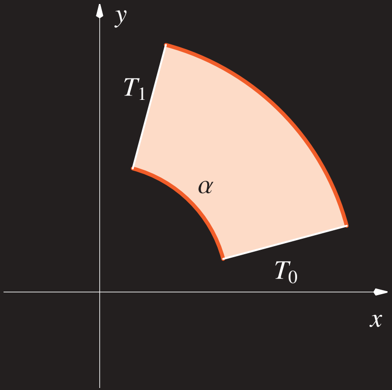

Figure 19.38
The region referred to in Problem 8.

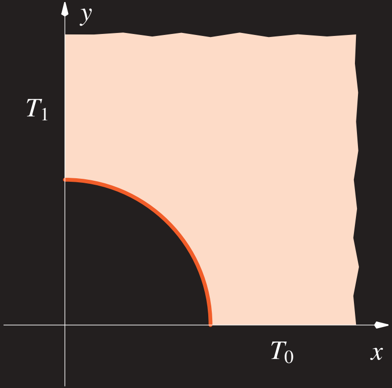

Figure 19.39
The region referred to in Problem 9.

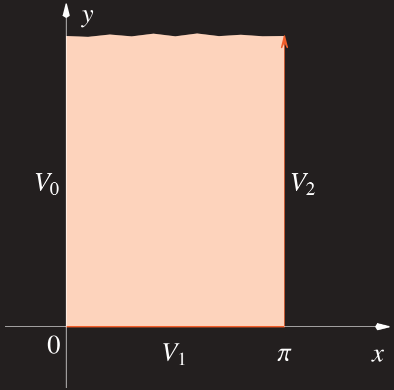

Figure 19.40
The region referred to in Problem 10.

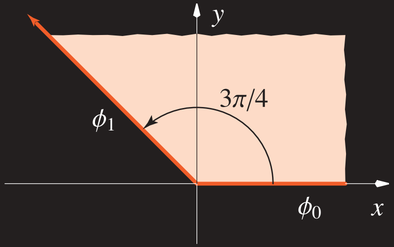

Figure 19.41
The region referred to in Problem 11.

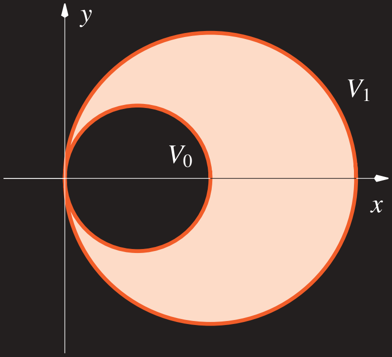

Figure 19.42
The geometry associated with Problem 17.

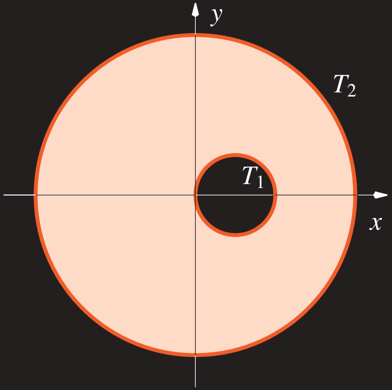

Figure 19.43
The region referred to in Problem 18.

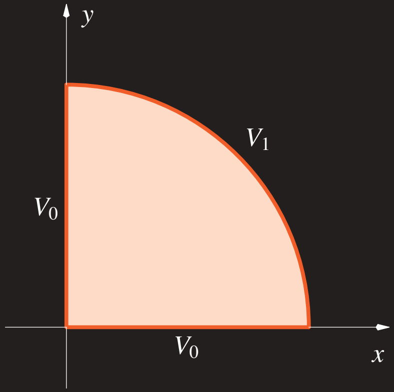

Figure 19.44
The region referred to in Problem 19.

Figure 19.45
The flow corresponding to stream lines given by $\psi(x, y) = 2xy = c$.

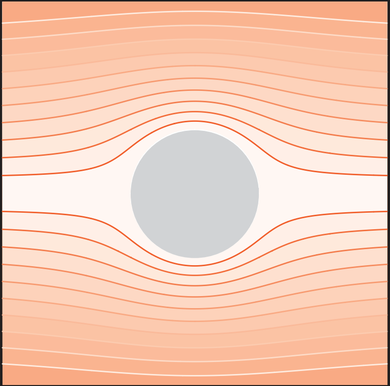

Figure 19.46
The flow of a fluid around a cylindrical obstacle that is perpendicular to the flow.

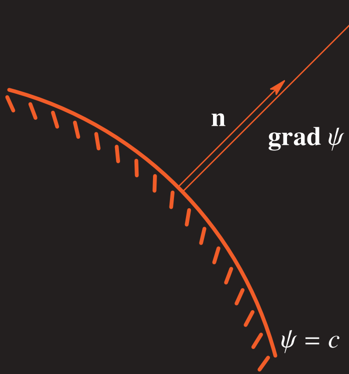

Figure 19.47
A pictorial aid to the proof that the stream function $\psi(x, y)$ is constant along any boundary surface.

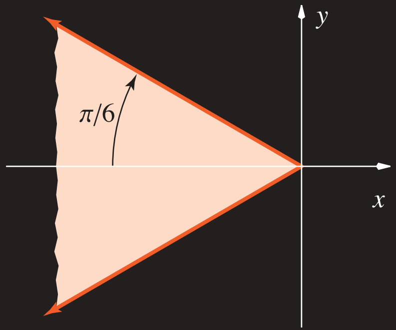

Figure 19.48
The wedge past which fluid flows in Example 3.

Figure 19.49
The streamlines for fluid flow past a wedge according to Example 3.

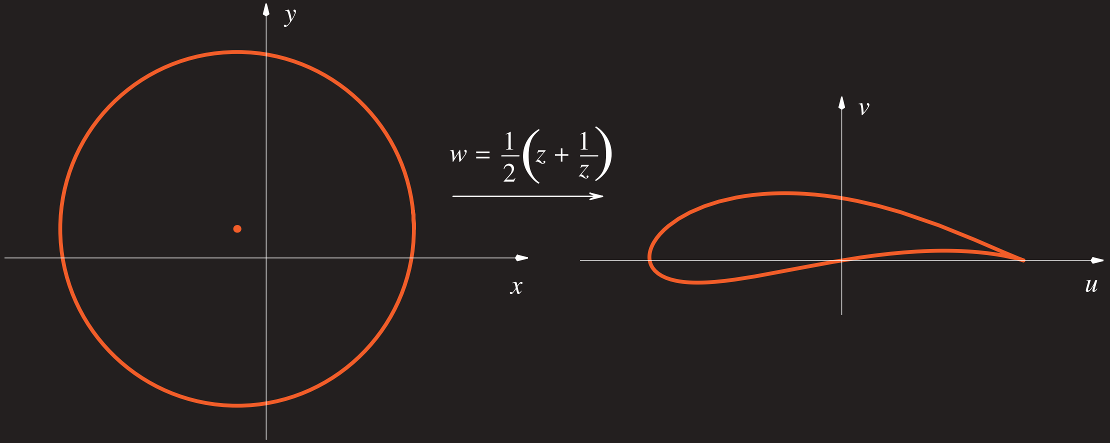

Figure 19.50
The mapping of the circle described by $|z + \frac{1}{5} - \frac{i}{5}| = \frac{(37)^{1/2}}{5}$ into the *w*-plane by the mapping in Equation 7.

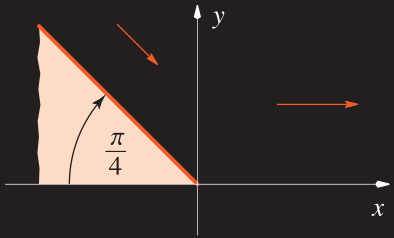

Figure 19.51
The wedge referred to in Problem 13.