Chapter 1 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 58)". Continuing to hold down the mouse button and dragging the button down will change the text in the small window to something like "1.35 (37 of 58)". Releasing the mouse button at this point moves you to Figure 1.35 of Chapter 1. The (37 of 58) indicates that Figure 1.35 resides on page 37 of the 58 pages of this document.

ANIMATIONS

A small fraction of the figures in this text have an associated animated figure that requires QuickTime™ for display. The first of these animations is associated with Figure 2.9. This animation, named Anim2_9.mov, as well as any others of interest must be independently downloaded from the server.

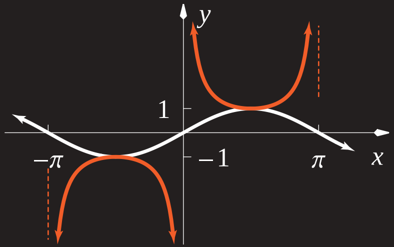

Figure 1.1
The trigonometric functions sin x and csc x = 1/sin x (color) plotted against x. The asymptotes of csc x are shown as the colored dashed lines and the y axis.

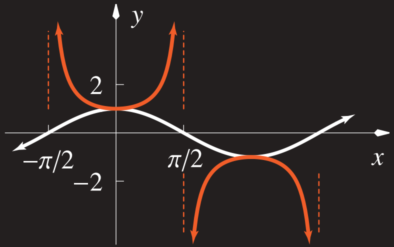

Figure 1.2
The trigonometric functions $\cos x$ and $\sec x = 1/\cos x$ (color) plotted against x. The asymptotes of $\sec x$ are shown as the colored dashed lines

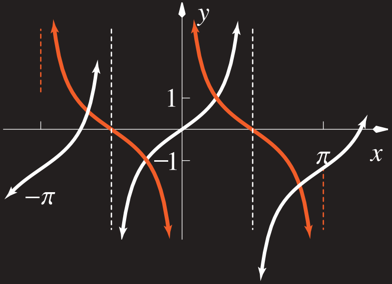

Figure 1.3
The trigonometric functions tan x and cot x = 1/tan x (color) plotted against x. The asymptotes of tan x are shown as the dashed lines at $x = -\pi/2$ and $\pi/2$. The asymptotes of cot x are shown as the colored dashed lines and the y axis.

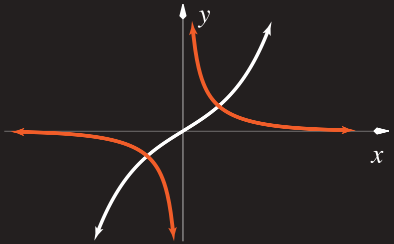

Figure 1.4
The hyperbolic functions sinh x and csch $x = 1/\sinh x$ (color) plotted against x.

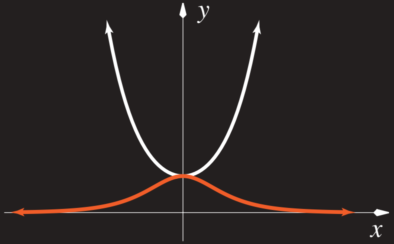

Figure 1.5
The hyperbolic functions cosh x and sech $x = 1/\cosh x$ (color) plotted against x.

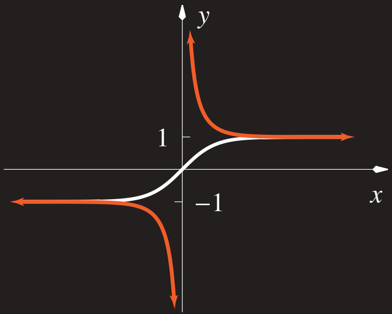

Figure 1.6
The hyperbolic functions tanh x and coth x = 1/tanh x (color) plotted against x.

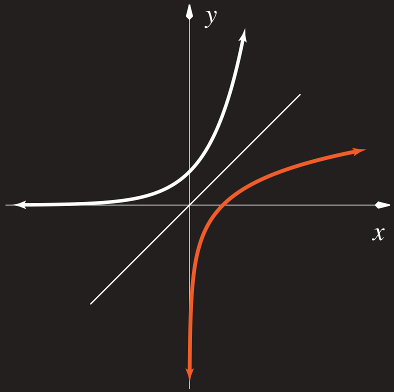

Figure 1.7
The exponential function e^x and the logarithmic function $\ln x$ (color) plotted against x. Note that the two functions are symmetric about the line $y = x$.

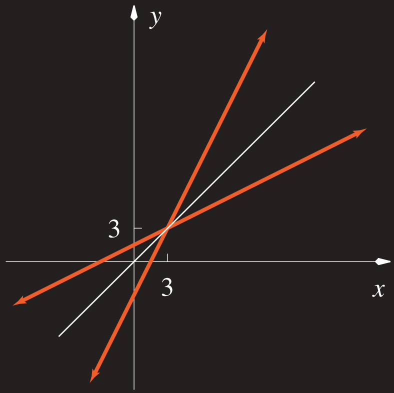

Figure 1.8
The relation between the function $y = 2x - 3$ and its inverse $y = (3 + x)/2$ [plotted as (3 + x)/2]. Note that the two functions are symmetric about the line $y = x$, just as in Figure 1.7.

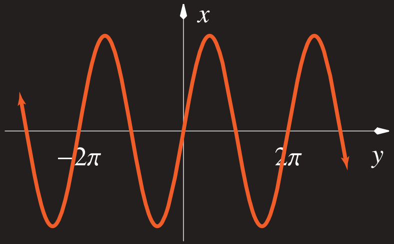

Figure 1.9
The function $x = \sin y$ is a periodic function of y with period 2π.

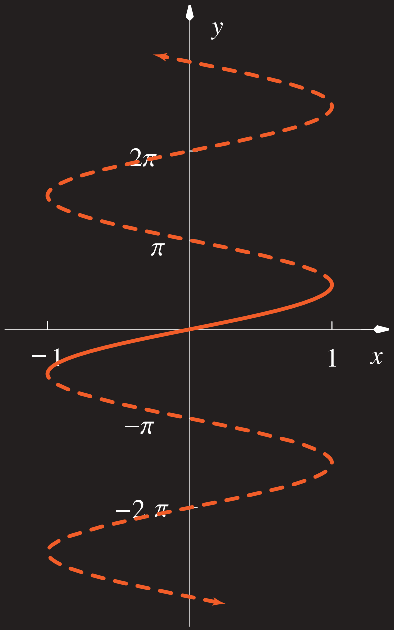

Figure 1.10
The function y = $\sin^{-1} x$ is a multiple-valued function of x .Note that sin x and $\sin^{-1} x$ can be obtained from one another by interchanging the x and y axes. The principal branch is the solid line.

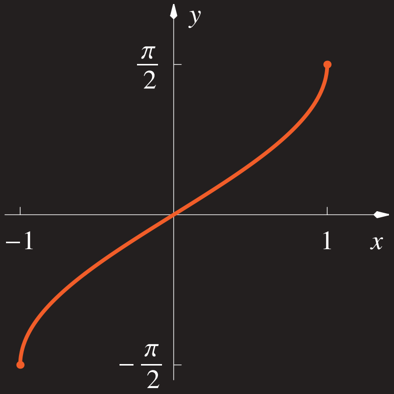

Figure 1.11

The principal branch of y = $\sin^{-1} x$.

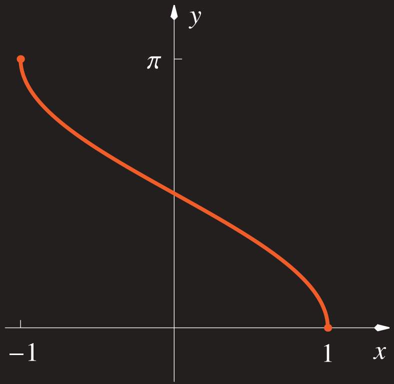

Figure 1.12
The principal branch of $y = \cos^{-1} x$.

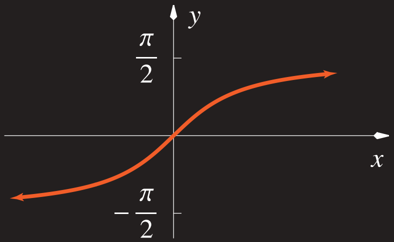

Figure 1.13
The principal branch of $y = \tan^{-1} x$.

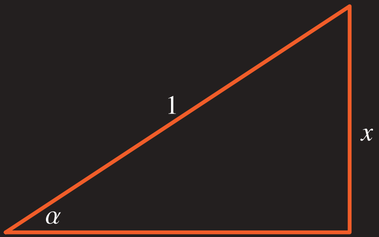

Figure 1.14
The right triangle used in Example 1.

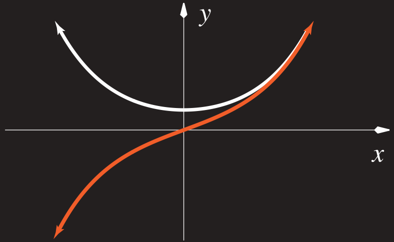

Figure 1.15

The functions sinh x (color) and cosh x plotted against x. Note that cosh x is symmetric and that sinh x is antisymmetric about the y axis.

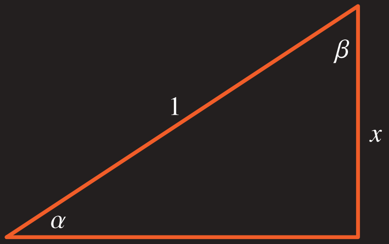

Figure 1.16
The geometry for Problem 12.

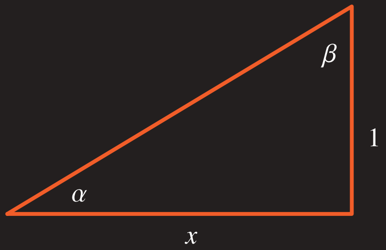

Figure 1.17
The geometry for Problem 13.

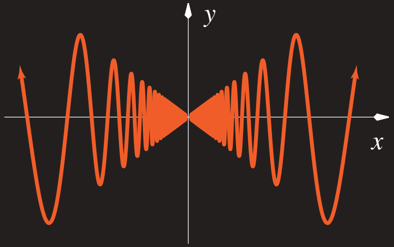

Figure 1.18
The function $y = x \sin(1/x)$ plotted against x for small values of x.

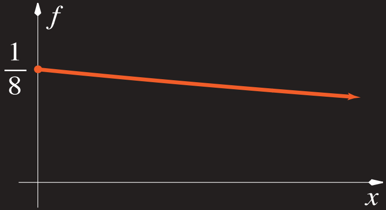

Figure 1.19
The function $f(x) = \dfrac{(x+16)^{1/2} - 4}{x}$ plotted against x for small values of x.

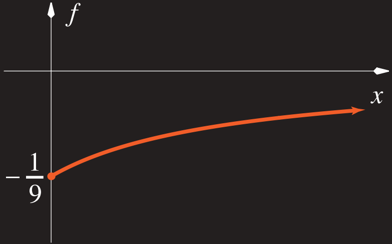

Figure 1.20

The function $f(x) = [1/(x+3) - 1/3]/x$ plotted against x for small values of x.

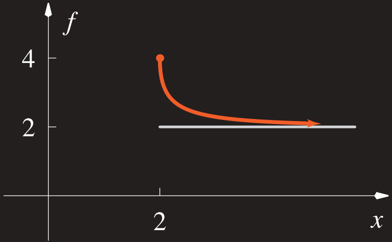

Figure 1.21
The function $f(x) = x(x - \sqrt{x^2 - 4})$ plotted against x. The graph (color) begins at the point (2, 4) and the asymptote is shown as a gray line.

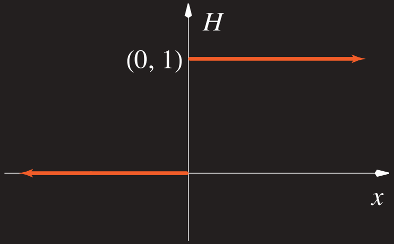

Figure 1.22
The Heaviside step function, $H(x) = 0$ when $x < 0$ and $H(x) = 1$ when $x > 0$.

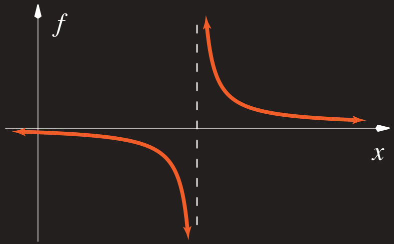

Figure 1.23
The function $f(x) = (x + 2)/(x - 1)$ plotted against x near the point $x = 1$. The asymptote of $f(x)$ is indicated by the vertical dashed line.

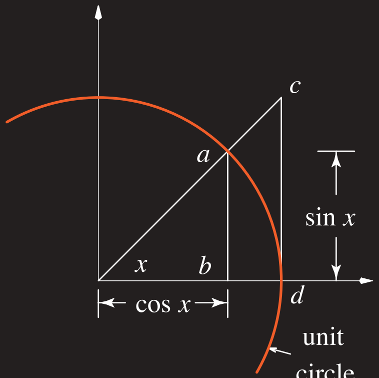

Figure 1.24

Geometry associated with the proof that $\lim_{x \to 0} (\sin x)/x = 1$

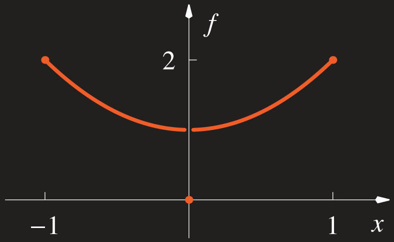

Figure 1.25
The discontinuous function $f(x) = x^2 + 1$ for $-1 \leq x \leq 1$ but $x \neq 0$ and $f(x) = 0$ when $x = 0$ plotted against x.

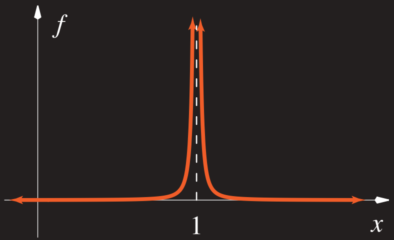

Figure 1.26
The function $f(x) = 1/(x - 1)^2$ plotted against x near the point $x = 1$.

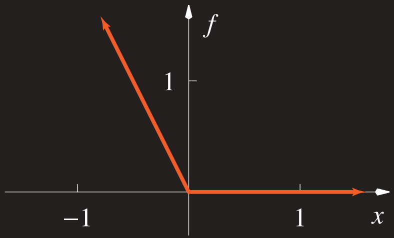

Figure 1.27
The function $f(x) = |x| - x$ plotted against x.

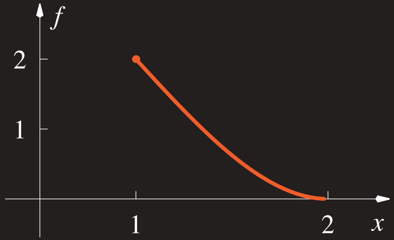

Figure 1.28
The function $f(x) = x^3 - 3x^2 + 4$ defined on the half open interval $[1, 2)$.

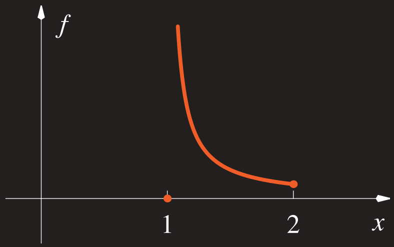

Figure 1.29
The function $f(x) = 1/(x - 1)$ when $1 < x \leq 2$ and $f(x) = 0$ when $x = 1$ plotted against x.

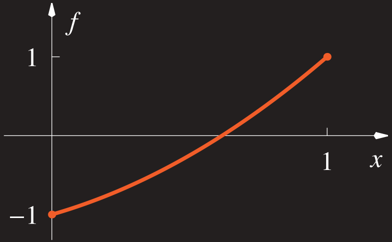

Figure 1.30
The function $f(x) = x^2 + x - 1$ plotted against x in the interval [0, 1].

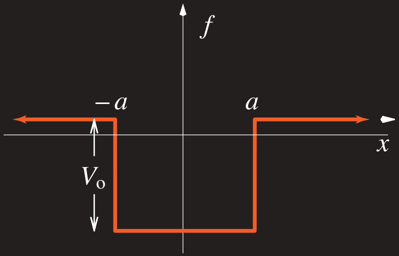

Figure 1.31
The function $f(x) = 0$ for $x < -a$, $f(x) = -V_o$ for $-a < x < a$, and $f(x) = 0$ for $x > a$.

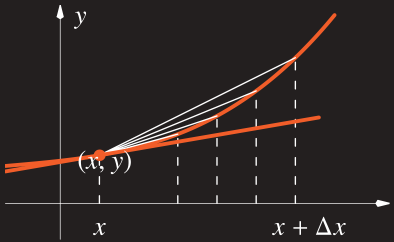

Figure 1.32
An illustration of the limiting process in the definition of the derivative of $y(x)$. As $\Delta x \to 0$, $[y(x + \Delta x) - y(x)]/\Delta x$ approaches the tangent line at the point (x, y).

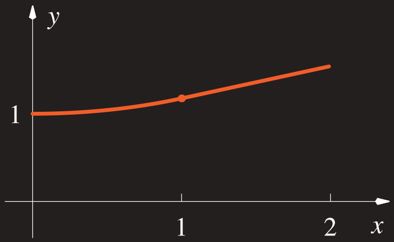

Figure 1.33
The function determined in Example 2 plotted against x.

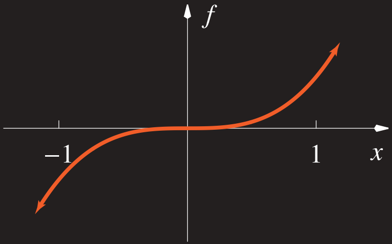

Figure 1.34
The function $f(x) = x^3$ plotted against x.

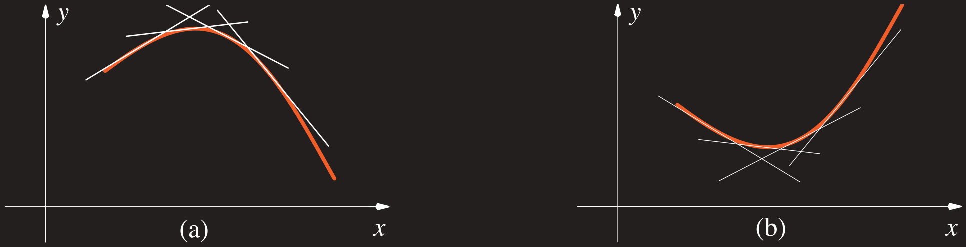

Figure 1.35
(a). The graph of a concave downward function. (b) The graph of a concave upward function.

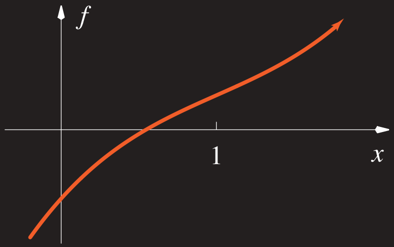

Figure 1.36
The function $f(x) = (x - 1)^3 + 2(x - 1) + 1$ plotted against x.

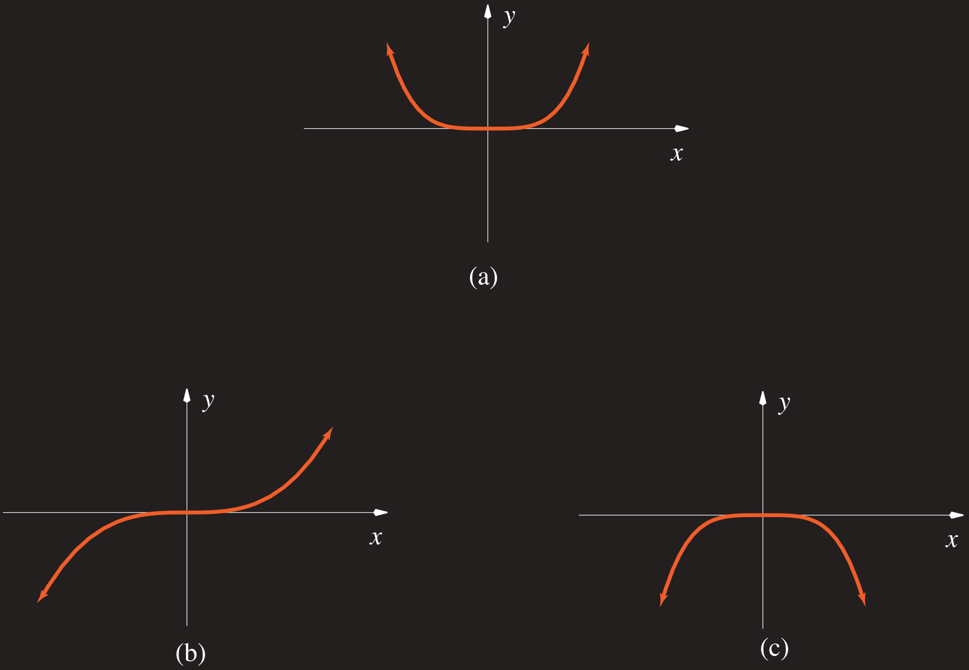

Figure 1.37
The functions (a) $f(x) = x^4$, (b) $g(x) = x^3$, and (c) $h(x) = -x^4$ plotted against x.

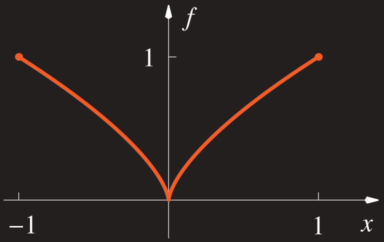

Figure 1.38
The function $f(x) = x^{2/3}$ defined on the closed interval [-1, 1] plotted against x.

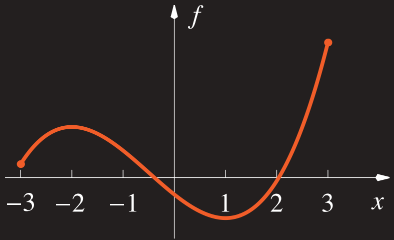

Figure 1.39
The function $f(x) = 2x^3 + 3x^2 - 12x - 5$ defined on the closed interval [-3, 3] plotted against x.

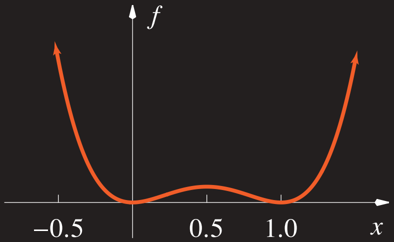

Figure 1.40
The function $f(x) = x^2(1 - x)^2$ plotted against x.

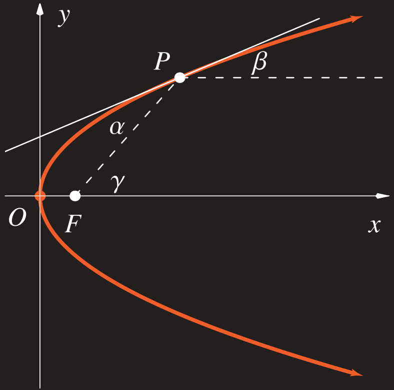

Figure 1.41
Illustration of the reflection property of a parabola (see Problem 14).

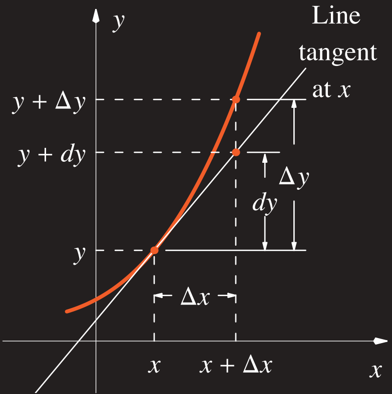

Figure 1.42
An illustration of the difference between dy and Δy.

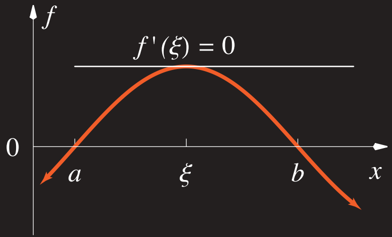

Figure 1.43
An illustration of Rolle's theorem.

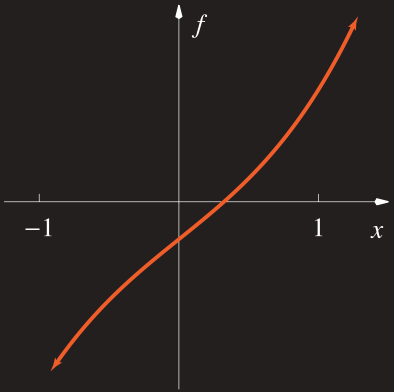

Figure 1.44
The function $f(x) = x^3 + 3x - 1$ plotted against x.

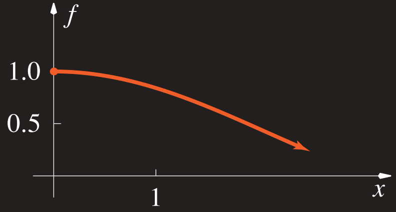

Figure 1.45
The behavior of the function $f(x) = (\sin x)/x$ as $x \to 0$.

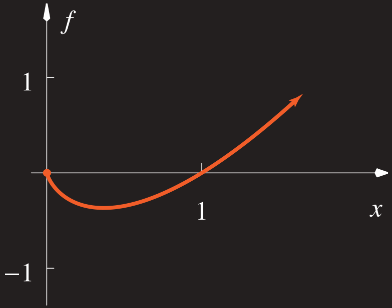

Figure 1.46
The behavior of the function $f(x) = x \ln x$ as $x \to 0$.

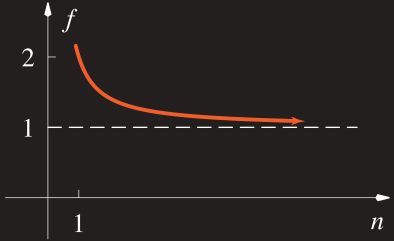

Figure 1.47
The function $f(n) = \sqrt[n]{2}$ plotted against n. The asymptote is shown as a dashed line.

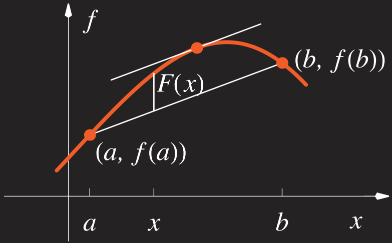

Figure 1.48

An aid to the proof of the mean value theorem of derivatives.

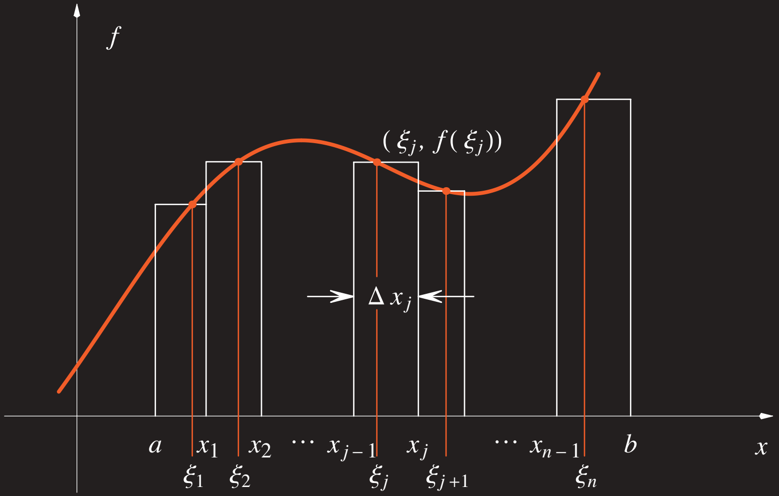

Figure 1.49
The construction associated with a Riemann sum.

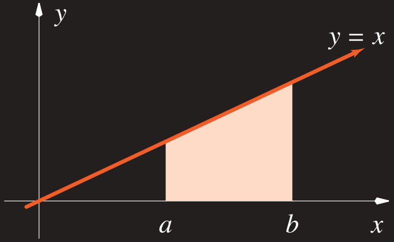

Figure 1.50
The integral $\int_a^b x\,dx$ is given by the shaded area.

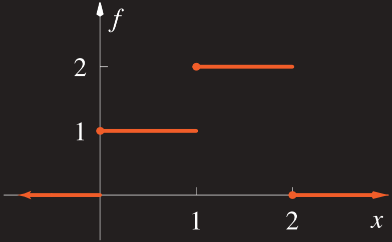

Figure 1.51
The function $f(x) = 0$ for $x < 0$; $f(x) = 1$ for $0 \le x < 1$; $f(x) = 2$ for $1 \le x < 2$; $f(x) = 0$ for $x \ge 2$.

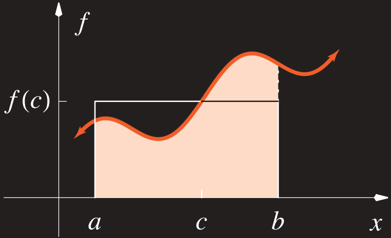

Figure 1.52
A pictorial representation of the mean value theorem of integration, Equation 10. The area within the solid rectangle equals the shaded area under the colored curve.

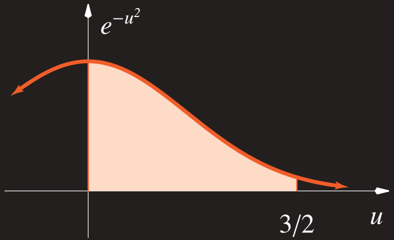

Figure 1.53
The area between the u-axis and the graph of e^{-u^2} from 0 to 3/2 is equal to $\int_0^{3/2} e^{-u^2} du$.

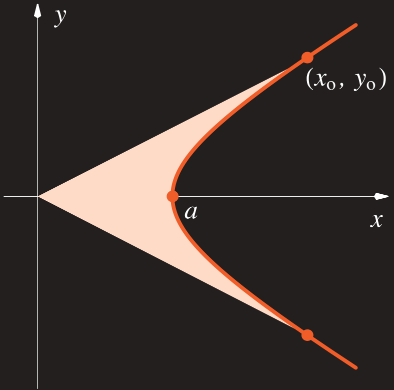

Figure 1.54
An illustration of a hyperbolic radian.

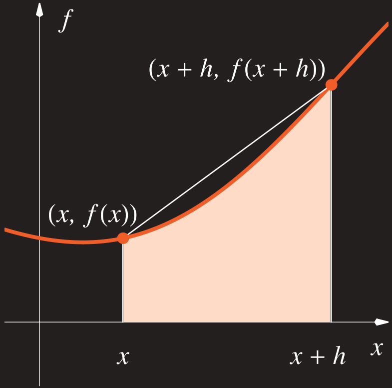

Figure 1.55
A pictorial aid for Problem 20.

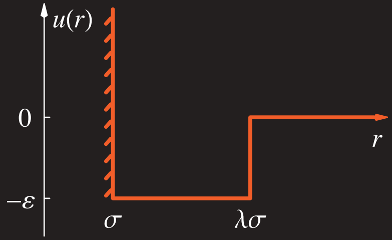

Figure 1.56
The square-well potential for the interaction of two spherically symmetric molecules.