Section 3.5

2. Let $u = g(x) = 4 + 3x$ and $y = f(u) = \sqrt{u} = u^{1/2}$. Then $\dfrac{dy}{dx} = \dfrac{dy}{du}\dfrac{du}{dx} = \frac{1}{2}u^{-1/2}(3) = \dfrac{3}{2\sqrt{u}} = \dfrac{3}{2\sqrt{4+3x}}$.

6. Let $u = g(x) = e^x$ and $y = f(u) = \sin u$. Then $\dfrac{dy}{dx} = \dfrac{dy}{du}\dfrac{du}{dx} = (\cos u)(e^x) = e^x \cos e^x$.

16. $g(x) = e^{-5x}\cos 3x \;\Rightarrow\; g'(x) = e^{-5x}(-3\sin 3x) + (\cos 3x)(-5e^{-5x}) = -e^{-5x}(3\sin 3x + 5\cos 3x)$

28. $y = \sin(\sin(\sin x)) \;\Rightarrow\; y' = \cos(\sin(\sin x))\,\dfrac{d}{dx}(\sin(\sin x)) = \cos(\sin(\sin x))\,\cos(\sin x)\,\cos x$

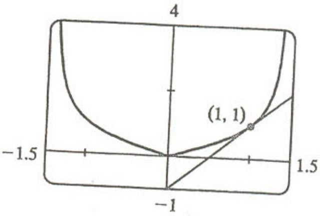
34. (a) For $x > 0$, $|x| = x$, and $y = f(x) = \dfrac{x}{\sqrt{2-x^2}} \;\Rightarrow$

$$f'(x) = \frac{\sqrt{2-x^2}\,(1) - x\left(\frac{1}{2}\right)(2-x^2)^{-1/2}(-2x)}{\left(\sqrt{2-x^2}\right)^2} \cdot \frac{(2-x^2)^{1/2}}{(2-x^2)^{1/2}}$$

$$= \frac{(2-x^2)+x^2}{(2-x^2)^{3/2}} = \frac{2}{(2-x^2)^{3/2}}$$

So at $(1,1)$, the slope of the tangent line is $f'(1) = 2$ and its equation is $y - 1 = 2(x-1)$ or $y = 2x - 1$.

(b)



42. (a) $h(x) = f(f(x)) \;\Rightarrow\; h'(x) = f'(f(x))f'(x)$.
So $h'(2) = f'(f(2))f'(2) = f'(1)f'(2) \approx (-1)(-1) = 1$.

(b) $g(x) = f(x^2) \;\Rightarrow\; g'(x) = f'(x^2)\cdot\dfrac{d}{dx}(x^2) = f'(x^2)(2x)$.
So $g'(2) = f'(2^2)(2\cdot 2) = 4f'(4) \approx 4(1.5) = 6$.

54. $f(x) = xe^{-x}$, $f'(x) = e^{-x} - xe^{-x} = (1-x)e^{-x}$, $f''(x) = -e^{-x} + (1-x)(-e^{-x}) = (x-2)e^{-x}$. Similarly, $f'''(x) = (3-x)e^{-x}$, $f^{(4)}(x) = (x-4)e^{-x}, \ldots, f^{(1000)}(x) = (x-1000)e^{-x}$.

56. (a) $s = A\cos(\omega t + \delta) \;\Rightarrow\;$ velocity $= s' = -\omega A\sin(\omega t + \delta)$.

(b) If $A \neq 0$ and $\omega \neq 0$, then $s' = 0 \;\Leftrightarrow\; \sin(\omega t + \delta) = 0 \;\Leftrightarrow\; \omega t + \delta = n\pi \;\Leftrightarrow\; t = \dfrac{n\pi - \delta}{\omega}$, n an integer.

58. $L(t) = 12 + 2.8\sin\left(\frac{2\pi}{365}(t-80)\right) \;\Rightarrow\; L'(t) = 2.8\cos\left(\frac{2\pi}{365}(t-80)\right)\left(\frac{2\pi}{365}\right)$.
On March 21, $t = 80$, and $L'(80) \approx 0.0482$ hours per day. On May 21, $t = 141$, and $L'(141) \approx 0.02398$, which is approximately one-half of $L'(80)$.