3.4

4. $g(t) = 4\sec t + \tan t \quad \Rightarrow \quad g'(t) = 4\sec t \tan t + \sec^2 t$

7. $y = \dfrac{\tan x}{x} \quad \Rightarrow \quad \dfrac{dy}{dx} = \dfrac{x\sec^2 x - \tan x}{x^2}$

10. $y = \dfrac{\tan x - 1}{\sec x} \quad \Rightarrow$

$$\frac{dy}{dx} = \frac{\sec x \sec^2 x - (\tan x - 1)\sec x \tan x}{\sec^2 x} = \frac{\sec x\,(\sec^2 x - \tan^2 x + \tan x)}{\sec^2 x} = \frac{1 + \tan x}{\sec x}$$

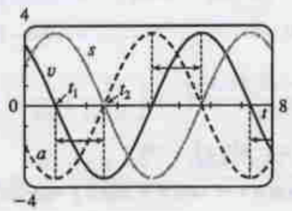
Another method: Simplify y first: $y = \sin x - \cos x \quad \Rightarrow \quad y' = \cos x + \sin x$.

14. $\dfrac{d}{dx}(\sec x) = \dfrac{d}{dx}\left(\dfrac{1}{\cos x}\right) = \dfrac{(\cos x)(0) - 1(-\sin x)}{\cos^2 x} = \dfrac{\sin x}{\cos^2 x} = \dfrac{1}{\cos x} \cdot \dfrac{\sin x}{\cos x} = \sec x \tan x$

18. $y = e^x \cos x \quad \Rightarrow \quad y' = e^x(-\sin x) + (\cos x)e^x = e^x(\cos x - \sin x) \quad \Rightarrow$ the slope of the tangent line at $(0, 1)$ is $e^0(\cos 0 - \sin 0) = 1(1 - 0) = 1$ and an equation is $y - 1 = 1(x - 0)$ or $y = x + 1$.

30. (a) $s(t) = 2\cos t + 3\sin t \quad \Rightarrow \quad v(t) = -2\sin t + 3\cos t \quad \Rightarrow \quad a(t) = -2\cos t - 3\sin t$

(b)



(c) $s = 0 \quad \Rightarrow \quad t_2 \approx 2.55$. So the mass passes through the equilibrium position for the first time when $t \approx 2.55$ s.

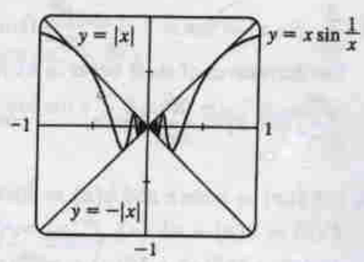
(d) $v = 0 \quad \Rightarrow \quad t_1 \approx 0.98$, $s(t_1) \approx 3.61$ cm. So the mass travels a maximum of about 3.6 cm (upward and downward) from its equilibrium position.

(e) The speed $|v|$ is greatest when $s = 0$; that is, when $t = t_2 + n\pi$, n a positive integer. The mass is speeding up when v and a have the same sign. From the figure, we see that this is the case on the intervals $(t_1 + n\pi, t_2 + n\pi)$ where n is a whole number.

37. $\displaystyle\lim_{x\to 0} \frac{\tan 4x}{x} = \lim_{x\to 0}\left(\frac{\sin 4x}{x} \cdot \frac{1}{\cos 4x}\right) = \lim_{x\to 0}\left(\frac{4\sin 4x}{4x} \cdot \frac{1}{\cos 4x}\right) = 4\lim_{x\to 0}\frac{\sin 4x}{4x} \cdot \lim_{x\to 0}\frac{1}{\cos 4x} = 4 \cdot 1 \cdot 1 = 4$

40. (a) Let $\theta = \dfrac{1}{x}$. Then as $x \to \infty$, $\theta \to 0$, and $\displaystyle\lim_{x\to\infty} x\sin\frac{1}{x} = \lim_{\theta\to 0}\frac{1}{\theta}\sin\theta = \lim_{\theta\to 0}\frac{\sin\theta}{\theta} = 1$.

(b) Since $-1 \le \sin(1/x) \le 1$, we have (as illustrated in the figure) $-|x| \le x\sin(1/x) \le |x|$. We know that $\displaystyle\lim_{x\to 0}(|x|) = 0$ and $\displaystyle\lim_{x\to 0}(-|x|) = 0$; so by the Squeeze Theorem, $\displaystyle\lim_{x\to 0} x\sin(1/x) = 0$.



(c)