

$$7. y = \frac{x}{\cos x} \Rightarrow y' = \frac{(\cos x)(1) - (x)(-\sin x)}{(\cos x)^2} = \frac{\cos x + x \sin x}{\cos^2 x}$$

$$9. f(\theta) = \frac{\sec \theta}{1 + \sec \theta} \Rightarrow$$

$$f'(\theta) = \frac{(1 + \sec \theta)(\sec \theta \tan \theta) - (\sec \theta)(\sec \theta \tan \theta)}{(1 + \sec \theta)^2} = \frac{(\sec \theta \tan \theta)[(1 + \sec \theta) - \sec \theta]}{(1 + \sec \theta)^2} = \frac{\sec \theta \tan \theta}{(1 + \sec \theta)^2}$$

$$11. \text{ Using Exercise 3.2.45(a), } f(x) = xe^x \csc x \Rightarrow$$

$$\begin{aligned} f'(x) &= (x)'e^x \csc x + x(e^x)' \csc x + xe^x(\csc x)' = 1e^x \csc x + xe^x \csc x + xe^x(-\cot x \csc x) \\ &= e^x \csc x(1 + x - x \cot x) \end{aligned}$$

$$26. (a) g(x) = f(x) \sin x \Rightarrow g'(x) = f(x) \cos x + \sin x \cdot f'(x), \text{ so}$$

$$g'\left(\frac{\pi}{3}\right) = f\left(\frac{\pi}{3}\right) \cos \frac{\pi}{3} + \sin \frac{\pi}{3} \cdot f'\left(\frac{\pi}{3}\right) = 4 \cdot \frac{1}{2} + \frac{\sqrt{3}}{2} \cdot (-2) = 2 - \sqrt{3}$$

$$(b) h(x) = \frac{\cos x}{f(x)} \Rightarrow h'(x) = \frac{f(x) \cdot (-\sin x) - \cos x \cdot f'(x)}{[f(x)]^2}, \text{ so}$$

$$h'\left(\frac{\pi}{3}\right) = \frac{f\left(\frac{\pi}{3}\right) \cdot (-\sin \frac{\pi}{3}) - \cos \frac{\pi}{3} \cdot f'\left(\frac{\pi}{3}\right)}{[f\left(\frac{\pi}{3}\right)]^2} = \frac{4 \left(-\frac{\sqrt{3}}{2}\right) - \left(\frac{1}{2}\right)(-2)}{4^2} = \frac{-2\sqrt{3} + 1}{16} = \frac{1 - 2\sqrt{3}}{16}$$

27. $f(x) = x + 2 \sin x$ has a horizontal tangent when $f'(x) = 0 \Leftrightarrow 1 + 2 \cos x = 0 \Leftrightarrow \cos x = -\frac{1}{2} \Leftrightarrow x = \frac{2\pi}{3} + 2\pi n$ or $\frac{4\pi}{3} + 2\pi n$, where n is an integer. Note that $\frac{4\pi}{3}$ and $\frac{2\pi}{3}$ are $\pm \frac{\pi}{3}$ units from π . This allows us to write the solutions in the more compact equivalent form $(2n + 1)\pi \pm \frac{\pi}{3}$, n an integer.

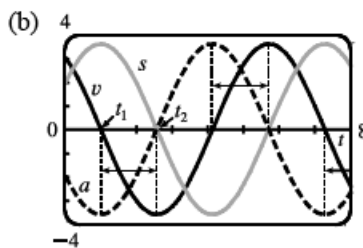
$$31. (a) x(t) = 8 \sin t \Rightarrow v(t) = x'(t) = 8 \cos t \Rightarrow a(t) = x''(t) = -8 \sin t$$

(b) The mass at time $t = \frac{2\pi}{3}$ has position $x\left(\frac{2\pi}{3}\right) = 8 \sin \frac{2\pi}{3} = 8\left(\frac{\sqrt{3}}{2}\right) = 4\sqrt{3}$, velocity $v\left(\frac{2\pi}{3}\right) = 8 \cos \frac{2\pi}{3} = 8\left(-\frac{1}{2}\right) = -4$, and acceleration $a\left(\frac{2\pi}{3}\right) = -8 \sin \frac{2\pi}{3} = -8\left(\frac{\sqrt{3}}{2}\right) = -4\sqrt{3}$. Since $v\left(\frac{2\pi}{3}\right) < 0$, the particle is moving to the left. Because v and a have the same sign, the particle is speeding up.

$$32. (a) s(t) = 2 \cos t + 3 \sin t \Rightarrow$$

$$v(t) = -2 \sin t + 3 \cos t \Rightarrow$$

$$a(t) = -2 \cos t - 3 \sin t$$



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

(d) $v = 0 \Rightarrow t_1 \approx 0.98$, $s(t_1) \approx 3.61$ 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.