3. $g(t) = t^3 \cos t \quad \Rightarrow \quad g'(t) = t^3(-\sin t) + (\cos t) \cdot 3t^2 = 3t^2 \cos t - t^3 \sin t$ or $t^2(3\cos t - t \sin t)$

4. $f(x) = \sqrt{x} \sin x \quad \Rightarrow \quad f'(x) = \sqrt{x} \cos x + \sin x \left(\frac{1}{2} x^{-1/2}\right) = \sqrt{x} \cos x + \dfrac{\sin x}{2\sqrt{x}}$

5. $y = \sec\theta \tan\theta \quad \Rightarrow \quad y' = \sec\theta(\sec^2\theta) + \tan\theta(\sec\theta\tan\theta) = \sec\theta(\sec^2\theta + \tan^2\theta)$. Using the identity $1 + \tan^2\theta = \sec^2\theta$, we can write alternative forms of the answer as $\sec\theta(1 + 2\tan^2\theta)$ or $\sec\theta(2\sec^2\theta - 1)$.

6. $y = e^u(\cos u + cu) \quad \Rightarrow \quad y' = e^u(-\sin u + c) + (\cos u + cu)e^u = e^u(\cos u - \sin u + cu + c)$

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

8. $y = \dfrac{1 + \sin x}{x + \cos x} \quad \Rightarrow$

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

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

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

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

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

$$y' = \frac{\tan x(-\sec x\tan x) - (1 - \sec x)(\sec^2 x)}{(\tan x)^2} = \frac{\sec x\left(-\tan^2 x - \sec x + \sec^2 x\right)}{\tan^2 x} = \frac{\sec x(1 - \sec x)}{\tan^2 x}$$

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

$$f'(x) = (x)'e^x \csc x + x(e^x)' \csc x + xe^x(\csc x)' = 1e^x \csc x + xe^x \csc x + xe^x(-\cot x \csc x)$$

$$= e^x \csc x(1 + x - x\cot x)$$

12. $y = \csc\theta(\theta + \cot\theta) \quad \Rightarrow$

$$y' = \csc\theta(1 - \csc^2\theta) + (\theta + \cot\theta)(-\csc\theta\cot\theta) = \csc\theta(1 - \csc^2\theta - \theta\cot\theta - \cot^2\theta)$$

$$= \csc\theta(-\cot^2\theta - \theta\cot\theta - \cot^2\theta) \qquad [1 + \cot^2\theta = \csc^2\theta]$$

$$= \csc\theta(-\theta\cot\theta - 2\cot^2\theta) = -\csc\theta\cot\theta(\theta + 2\cot\theta)$$

13. $\dfrac{d}{dx}(\csc x) = \dfrac{d}{dx}\left(\dfrac{1}{\sin x}\right) = \dfrac{(\sin x)(0) - 1(\cos x)}{\sin^2 x} = \dfrac{-\cos x}{\sin^2 x} = -\dfrac{1}{\sin x} \cdot \dfrac{\cos x}{\sin x} = -\csc x \cot x$