7. $F(x) = \sqrt[4]{1 + 2x + x^3} = (1 + 2x + x^3)^{1/4} \quad \Rightarrow$

$$F'(x) = \tfrac{1}{4}(1 + 2x + x^3)^{-3/4} \cdot \frac{d}{dx}\left(1 + 2x + x^3\right) = \frac{1}{4(1 + 2x + x^3)^{3/4}} \cdot (2 + 3x^2)$$

$$= \frac{2 + 3x^2}{4(1 + 2x + x^3)^{3/4}} = \frac{2 + 3x^2}{4\sqrt[4]{(1 + 2x + x^3)^3}}$$

17. $y = (2x - 5)^4 \left(8x^2 - 5\right)^{-3} \quad \Rightarrow$

$$y' = 4(2x - 5)^3(2)\left(8x^2 - 5\right)^{-3} + (2x - 5)^4(-3)\left(8x^2 - 5\right)^{-4}(16x)$$

$$= 8(2x - 5)^3\left(8x^2 - 5\right)^{-3} - 48x(2x - 5)^4\left(8x^2 - 5\right)^{-4}$$

[This simplifies to $8(2x - 5)^3\left(8x^2 - 5\right)^{-4}\left(-4x^2 + 30x - 5\right)$.]

21. $y = \sin(x \cos x) \quad \Rightarrow \quad y' = \cos(x \cos x) \cdot [x(-\sin x) + \cos x \cdot 1] = (\cos x - x \sin x)\cos(x \cos x)$

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

36. $y = \sqrt{x + \sqrt{x + \sqrt{x}}} \quad \Rightarrow \quad y' = \tfrac{1}{2}\left(x + \sqrt{x + \sqrt{x}}\right)^{-1/2}\left[1 + \tfrac{1}{2}\left(x + \sqrt{x}\right)^{-1/2}\left(1 + \tfrac{1}{2}x^{-1/2}\right)\right]$

37. $y = \sin\left(\tan \sqrt{\sin x}\right) \quad \Rightarrow$

$$y' = \cos\left(\tan \sqrt{\sin x}\right) \cdot \frac{d}{dx}\left(\tan \sqrt{\sin x}\right) = \cos\left(\tan \sqrt{\sin x}\right) \sec^2 \sqrt{\sin x} \cdot \frac{d}{dx}(\sin x)^{1/2}$$

$$= \cos\left(\tan \sqrt{\sin x}\right) \sec^2 \sqrt{\sin x} \cdot \tfrac{1}{2}(\sin x)^{-1/2} \cdot \cos x = \cos\left(\tan \sqrt{\sin x}\right)\left(\sec^2 \sqrt{\sin x}\right)\left(\frac{1}{2\sqrt{\sin x}}\right)(\cos x)$$

38. $y = \sqrt{\cos\left(\sin^2 x\right)} \quad \Rightarrow \quad y' = \tfrac{1}{2}\left(\cos\left(\sin^2 x\right)\right)^{-1/2}\left[-\sin\left(\sin^2 x\right)\right](2 \sin x \cos x) = -\dfrac{\sin\left(\sin^2 x\right) \sin x \cos x}{\sqrt{\cos\left(\sin^2 x\right)}}$

55. $r(x) = f(g(h(x))) \quad \Rightarrow \quad r'(x) = f'(g(h(x))) \cdot g'(h(x)) \cdot h'(x)$, so

$$r'(1) = f'(g(h(1))) \cdot g'(h(1)) \cdot h'(1) = f'(g(2)) \cdot g'(2) \cdot 4 = f'(3) \cdot 5 \cdot 4 = 6 \cdot 5 \cdot 4 = 120$$

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

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

69.
$$\begin{aligned}\frac{d^2y}{dx^2} &= \frac{d}{dx}\left(\frac{dy}{dx}\right) && \text{[Leibniz notation for the second derivative]}\\
&= \frac{d}{dx}\left(\frac{dy}{du}\frac{du}{dx}\right) && \text{[Chain Rule]}\\
&= \frac{dy}{du}\cdot\frac{d}{dx}\left(\frac{du}{dx}\right)+\frac{du}{dx}\cdot\frac{d}{dx}\left(\frac{dy}{du}\right) && \text{[Product Rule]}\\
&= \frac{dy}{du}\cdot\frac{d^2u}{dx^2}+\frac{du}{dx}\cdot\frac{d}{du}\left(\frac{dy}{du}\right)\cdot\frac{du}{dx} && [dy/du \text{ is a function of } u]\\
&= \frac{dy}{du}\frac{d^2u}{dx^2}+\frac{d^2y}{du^2}\left(\frac{du}{dx}\right)^2
\end{aligned}$$

Or: Using function notation for $y = f(u)$ and $u = g(x)$, we have $y = f(g(x))$, so

$y' = f'(g(x)) \cdot g'(x)$ [by the Chain Rule] $\Rightarrow$

$(y')' = [f'(g(x)) \cdot g'(x)]' = f'(g(x)) \cdot g''(x) + g'(x) \cdot f''(g(x)) \cdot g'(x) = f'(g(x)) \cdot g''(x) + f''(g(x)) \cdot [g'(x)]^2$.