11. (a) Since
$$y' = (3x^7 - 7x^3 + 21x^2)' = 21x^6 - 21x^2 + 42x,$$
we have that
$$y'' = (21x^6 - 21x^2 + 42x)' = 126x^5 - 42x + 42.$$

(b) We calculate that
$$\frac{db}{dz} = \frac{d}{dx}\left(-2z^{-1} + 4z^{-2}\right) = 2z^{-2} - 8z^{-3} = \frac{2}{z^2} - \frac{8}{z^3}.$$

12. (a) We have
$$\frac{dr}{d\theta} = \frac{d}{d\theta}\big((1+\sec\theta)\sin\theta\big) = \frac{d}{d\theta}\big(\sin\theta + \tan\theta\big) = \cos\theta + \sec^2\theta.$$

(b) We calculate that
$$\begin{aligned} \frac{d}{dx}(-2\sin x) &= -2\cos x, \\ \frac{d^2}{dx^2}(-2\sin x) &= (-2\cos x)' = 2\sin x, \\ \frac{d^3}{dx^3}(-2\sin x) &= (2\sin x)' = 2\cos x, \\ \frac{d^3}{dx^3}\big(-2\sin x\big)\bigg|_{x=\pi} &= 2\cos\pi = -2. \end{aligned}$$

13. Since $\frac{dy}{dx} = \frac{d}{dx}\sin(\pi x) = \pi\cos\pi x$, the slope of the graph at $(\frac{1}{6}, \frac{1}{2})$ is $\frac{dy}{dx}\Big|_{x=\frac{1}{6}} = \pi\cos\frac{\pi}{6} = \frac{\pi\sqrt{3}}{2}$.

14. First note that
$$y = \frac{x^2+3}{(x-1)^3 + (x+1)^3} = \frac{x^2+3}{2x^3+6x} = \frac{1}{2x} = \frac{1}{2}x^{-1}.$$
Then it follows that
$$\frac{dy}{dx} = -\frac{1}{2}x^{-2} = \frac{-1}{2x^2}.$$

15. (a) By the chain rule, we have that
$$\begin{aligned} \frac{dy}{dx} &= \frac{d}{dx}\left((5-2x)^{-3} + \frac{1}{8}\left(\frac{2}{x}+1\right)^4\right) \\ &= -3(5-2x)^{-4}\frac{d}{dx}(5-2x) + \frac{4}{8}\left(\frac{2}{x}+1\right)^3 \frac{d}{dx}\left(\frac{2}{x}+1\right) \\ &= \frac{6}{(5-2x)^4} + \frac{1}{2}\left(\frac{2}{x}+1\right)^3\left(\frac{-2}{x^2}\right) \\ &= \frac{6}{(5-2x)^4} - \left(\frac{1}{x^2}\right)\left(\frac{2}{x}+1\right)^3 \\ &= \frac{6}{(5-2x)^4} - \frac{(2+x)^3}{x^5}. \end{aligned}$$

(b) Again using the chain rule, we have that
$$\begin{aligned} p' &= \frac{d}{dt}\left(\sqrt{3t + t\sin 3t}\right) \\ &= \left(\frac{1}{2\sqrt{3t+t\sin 3t}}\right)\frac{d}{dt}(3t + t\sin 3t) \\ &= \left(\frac{1}{2\sqrt{3t+t\sin 3t}}\right)(3 + \sin 3t + 3t\cos 3t) \\ &= \left(\frac{3+\sin 3t + 3t\cos 3t}{2\sqrt{3t+t\sin 3t}}\right). \end{aligned}$$