17. $g(x) = (1+4x)^5(3+x-x^2)^8 \quad \Rightarrow$

$$\begin{aligned} g'(x) &= (1+4x)^5 \cdot 8(3+x-x^2)^7(1-2x) + (3+x-x^2)^8 \cdot 5(1+4x)^4 \cdot 4 \\ &= 4(1+4x)^4(3+x-x^2)^7[2(1+4x)(1-2x)+5(3+x-x^2)] \\ &= 4(1+4x)^4(3+x-x^2)^7[(2+4x-16x^2)+(15+5x-5x^2)] = 4(1+4x)^4(3+x-x^2)^7(17+9x-21x^2) \end{aligned}$$

18. $h(t) = (t^4-1)^3(t^3+1)^4 \quad \Rightarrow$

$$\begin{aligned} h'(t) &= (t^4-1)^3 \cdot 4(t^3+1)^3(3t^2) + (t^3+1)^4 \cdot 3(t^4-1)^2(4t^3) \\ &= 12t^2(t^4-1)^2(t^3+1)^3[(t^4-1)+t(t^3+1)] = 12t^2(t^4-1)^2(t^3+1)^3(2t^4+t-1) \end{aligned}$$

19. $y = e^{x\cos x} \quad \Rightarrow \quad y' = e^{x\cos x} \cdot \dfrac{d}{dx}(x\cos x) = e^{x\cos x}[x(-\sin x) + (\cos x)\cdot 1] = e^{x\cos x}(\cos x - x\sin x)$

20. Using Formula 5 and the Chain Rule, $y = 10^{1-x^2} \quad \Rightarrow \quad y' = 10^{1-x^2}(\ln 10)\cdot \dfrac{d}{dx}\left(1-x^2\right) = -2x(\ln 10)10^{1-x^2}$.

21. $F(z) = \sqrt{\dfrac{z-1}{z+1}} = \left(\dfrac{z-1}{z+1}\right)^{1/2} \quad \Rightarrow$

$$\begin{aligned} F'(z) &= \frac{1}{2}\left(\frac{z-1}{z+1}\right)^{-1/2} \cdot \frac{d}{dz}\left(\frac{z-1}{z+1}\right) = \frac{1}{2}\left(\frac{z+1}{z-1}\right)^{1/2} \cdot \frac{(z+1)(1)-(z-1)(1)}{(z+1)^2} \\ &= \frac{1}{2}\frac{(z+1)^{1/2}}{(z-1)^{1/2}} \cdot \frac{z+1-z+1}{(z+1)^2} = \frac{1}{2}\frac{(z+1)^{1/2}}{(z-1)^{1/2}} \cdot \frac{2}{(z+1)^2} = \frac{1}{(z-1)^{1/2}(z+1)^{3/2}} \end{aligned}$$

22. $G(y) = \left(\dfrac{y^2}{y+1}\right)^5 \quad \Rightarrow \quad G'(y) = 5\left(\dfrac{y^2}{y+1}\right)^4 \cdot \dfrac{(y+1)(2y)-y^2(1)}{(y+1)^2} = 5\cdot\dfrac{y^8}{(y+1)^4}\cdot\dfrac{y(2y+2-y)}{(y+1)^2} = \dfrac{5y^9(y+2)}{(y+1)^6}$

23. $y = \sec^2 x + \tan^2 x = (\sec x)^2 + (\tan x)^2 \quad \Rightarrow$

$y' = 2(\sec x)(\sec x\tan x) + 2(\tan x)(\sec^2 x) = 2\sec^2 x\tan x + 2\sec^2 x\tan x = 4\sec^2 x\tan x$

24. $y = e^{k\tan\sqrt{x}} \quad \Rightarrow \quad y' = e^{k\tan\sqrt{x}} \cdot \dfrac{d}{dx}(k\tan\sqrt{x}) = e^{k\tan\sqrt{x}}\left(k\sec^2\sqrt{x}\cdot\tfrac{1}{2}x^{-1/2}\right) = \dfrac{k\sec^2\sqrt{x}}{2\sqrt{x}}\,e^{k\tan\sqrt{x}}$

25. $y = \dfrac{r}{\sqrt{r^2+1}} \quad \Rightarrow$

$$\begin{aligned} y' &= \frac{\sqrt{r^2+1}\,(1) - r\cdot\frac{1}{2}(r^2+1)^{-1/2}(2r)}{\left(\sqrt{r^2+1}\right)^2} = \frac{\sqrt{r^2+1} - \dfrac{r^2}{\sqrt{r^2+1}}}{\left(\sqrt{r^2+1}\right)^2} = \frac{\dfrac{\sqrt{r^2+1}\sqrt{r^2+1}-r^2}{\sqrt{r^2+1}}}{\left(\sqrt{r^2+1}\right)^2} \\ &= \frac{\left(r^2+1\right)-r^2}{\left(\sqrt{r^2+1}\right)^3} = \frac{1}{(r^2+1)^{3/2}} \text{ or } (r^2+1)^{-3/2} \end{aligned}$$

Another solution: Write y as a product and make use of the Product Rule. $y = r(r^2+1)^{-1/2} \quad \Rightarrow$

$y' = r\cdot -\frac{1}{2}(r^2+1)^{-3/2}(2r) + (r^2+1)^{-1/2}\cdot 1 = (r^2+1)^{-3/2}[-r^2+(r^2+1)^1] = (r^2+1)^{-3/2}(1) = (r^2+1)^{-3/2}$.

The step that students usually have trouble with is factoring out $(r^2+1)^{-3/2}$. But this is no different than factoring out x^2 from x^2+x^5; that is, we are just factoring out a factor with the *smallest* exponent that appears on it. In this case, $-\frac{3}{2}$ is smaller than $-\frac{1}{2}$.

26. $y = \dfrac{e^u - e^{-u}}{e^u + e^{-u}} \quad \Rightarrow$

$$y' = \frac{(e^u + e^{-u})(e^u - (-e^u)) - (e^u - e^{-u})(e^u + (-e^{-u}))}{(e^u + e^{-u})^2}$$

$$= \frac{e^{2u} + e^0 + e^0 + e^{-2u} - (e^{2u} - e^0 - e^0 + e^{-2u})}{(e^u + e^{-u})^2} = \frac{4e^0}{(e^u + e^{-u})^2} = \frac{4}{(e^u + e^{-u})^2}$$

27. Using Formula 5 and the Chain Rule, $y = 2^{\sin \pi x} \quad \Rightarrow$

$$y' = 2^{\sin \pi x}(\ln 2) \cdot \frac{d}{dx}(\sin \pi x) = 2^{\sin \pi x}(\ln 2) \cdot \cos \pi x \cdot \pi = 2^{\sin \pi x}(\pi \ln 2) \cos \pi x$$

28. $y = \tan^2(3\theta) = (\tan 3\theta)^2 \quad \Rightarrow \quad y' = 2(\tan 3\theta) \cdot \dfrac{d}{d\theta}(\tan 3\theta) = 2 \tan 3\theta \cdot \sec^2 3\theta \cdot 3 = 6 \tan 3\theta \sec^2 3\theta$

29. $y = \cot^2(\sin \theta) = [\cot(\sin \theta)]^2 \quad \Rightarrow$

$$y' = 2[\cot(\sin \theta)] \cdot \frac{d}{d\theta}[\cot(\sin \theta)] = 2 \cot(\sin \theta) \cdot [-\csc^2(\sin \theta) \cdot \cos \theta] = -2 \cos \theta \, \cot(\sin \theta) \, \csc^2(\sin \theta)$$

30. $y = \sin(\sin(\sin x)) \quad \Rightarrow \quad y' = \cos(\sin(\sin x)) \dfrac{d}{dx}(\sin(\sin x)) = \cos(\sin(\sin x)) \, \cos(\sin x) \, \cos x$

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

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

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

37. (a) $y = \dfrac{2}{1 + e^{-x}} \quad \Rightarrow \quad y' = \dfrac{(1 + e^{-x})(0) - 2(-e^{-x})}{(1 + e^{-x})^2} = \dfrac{2e^{-x}}{(1 + e^{-x})^2}$.

At $(0, 1)$, $y' = \dfrac{2e^0}{(1 + e^0)^2} = \dfrac{2(1)}{(1+1)^2} = \dfrac{2}{2^2} = \dfrac{1}{2}$. So an equation of the tangent line is $y - 1 = \frac{1}{2}(x - 0)$ or $y = \frac{1}{2}x + 1$.

(b)