1. $y = e^{\sqrt{x}}$

$y' = e^{\sqrt{x}} \cdot \frac{1}{2\sqrt{x}}$

2. $y = x^2 \cdot e^{-x}$

$y' = x^2 \cdot e^{-x}(-1) + e^{-x}(2x)$

3. $g(t) = (e^{-t} + e^t)^3$

$g'(t) = 3(e^{-t} + e^t)^2(-e^{-t} + e^t)$

4. $y = x^2 \cdot e^x - 2xe^x + 2e^x$

$y = e^x(x^2 - 2x + 2)$

$y' = e^x(2x - 2) + (x^2 - 2x + 2) \cdot e^x$

5. $y = e^x(\sin x + \cos x)$

$y' = e^x(\cos x - \sin x) + (\sin x + \cos x) \cdot e^x$

6. $f(x) = \ln(x^2)$

$f(x) = 2\ln(x)$

$f'(x) = \frac{2}{x}$

7. $y = (\ln x)^4$

$y' = 4(\ln x)^3 \cdot \frac{1}{x}$

8. $y = x \cdot \ln x$

$y' = x\left(\frac{1}{x}\right) + \ln x$

9. $y = \ln\left(x\sqrt{x^2-1}\right)$

$y = \ln x + \ln (x^2-1)^{1/2}$

$y = \ln x + \frac{1}{2}\ln(x^2-1)$

10. $f(x) = \ln\left(\frac{2x}{x+3}\right)$

$f'(x) = \frac{x+3}{2x}\left[\frac{(x+3)(2)-(2x)(1)}{(x+3)^2}\right]$

11. $g(t) = \frac{\ln(t)}{t^2}$

$g'(t) = \frac{t^2\left(\frac{1}{t}\right) - \ln(t)\cdot(2t)}{t^4}$

12. $y = \ln e^{x^2}$

$y = x^2$

$y' = 2x$

13. $y = \left(\frac{1+e^x}{1-e^x}\right)$

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

14. $y = \ln(1+e^{2x})$

$y' = \frac{1}{1+e^{2x}} \cdot e^{2x} \cdot 2$

15. $y = \ln(e^x + e^{-x}) - \ln(2)$

$y' = \frac{1}{e^x + e^{-x}}(e^x - e^{-x})$

16. $y = x^{\frac{2}{x}}$

$y = e^{\frac{2}{x}\ln x}$

$y' = e^{\frac{2}{x}\ln x} \cdot \left(\frac{2}{x}\cdot\frac{1}{x} + \ln x(-2x^{-2})\right)$

$= x^{\frac{2}{x}}\left(\frac{2}{x^2} - \frac{2\ln x}{x^2}\right)$

17. $y = (x-2)^{x+1}$

$$y = e^{(x+1)\ln(x-2)}$$

$$y' = e^{(x+1)\ln(x-2)} \cdot \left[(x+1)\cdot \frac{1}{x-2} + \ln(x-2)\cdot 1 \right]$$

$$= (x-2)^{x+1} \left(\frac{x+1}{x-2} + \ln(x-2) \right)$$

18. $\ln y = \ln\left(\frac{(x^2+5)^3 (2x-7)^8}{(3x^2+4)^5} \right)$

$$\ln y = 3\ln(x^2+5) + 8\ln(2x-7) - 5\ln(3x^2+4)$$

DIFF WRT X

$$\frac{1}{y}\frac{dy}{dx} = \frac{3}{x^2+5}(2x) + \frac{8}{2x-7}(2) - \frac{5}{3x^2+4}(6x)$$

$$\frac{dy}{dx} = y\left[\frac{6x}{x^2+5} + \frac{16}{2x-7} - \frac{30x}{3x^2+4} \right]$$

$$\frac{dy}{dx} = \left[\frac{(x^2+5)^3(2x-7)^8}{(3x^2+4)^5} \right] \left[\frac{6x}{x^2+5} + \frac{16}{2x-7} - \frac{30x}{3x^2+4} \right]$$

19. $f(x) = \log_2 \frac{x^2}{x-1}$

$$f(x) = \frac{\ln\left(\frac{x^2}{x-1}\right)}{\ln 2} = \frac{1}{\ln 2}\left[\ln(x^2) - \ln(x-1)\right]$$

$$f'(x) = \frac{1}{\ln 2}\left[\frac{1}{x^2}\cdot(2x) - \frac{1}{x-1}\right]$$

20. $h(x) = \log_3 \frac{x\sqrt{x-1}}{2} = \frac{\ln\left(\frac{x\sqrt{x-1}}{2}\right)}{\ln 3}$

$$h(x) = \frac{1}{\ln 3}\left[\ln x + \frac{1}{2}\ln(x-1) - \ln 2\right]$$

$$h'(x) = \frac{1}{\ln 3}\left[\frac{1}{x} + \frac{1}{2(x-1)}\right]$$

21. $g(t) = \frac{10 \cdot \log_4 t}{t} = \left(\frac{10}{t}\right)\left(\frac{\ln t}{\ln 4}\right) = \left(\frac{10}{\ln 4}\right)\left(\frac{\ln t}{t}\right)$

$$g'(t) = \left(\frac{10}{\ln 4}\right)\left[\frac{t\left(\frac{1}{t}\right) - \ln(t)(1)}{t^2}\right]$$

22. $y = 5^{x-2} = e^{(x-2)\ln 5}$

$$y' = e^{(x-2)\ln 5} \cdot (\ln 5 \cdot 1) = \ln 5 \cdot 5^{x-2}$$

23. $y = x(6^{-2x}) = x(e^{-2x\ln 6})$

$y' = x\left(e^{-2x\ln 6}\cdot(-2\ln 6)\right) + e^{-2x\ln 6}(1)$

$y' = 6^{-2x}(-2x\ln 6 + 1)$

24. $h(\theta) = 2^{-\theta}\cos(\pi\theta) = e^{-\theta\ln 2}\cdot\cos(\pi\theta)$

$h'(\theta) = e^{-\theta\ln 2}(-\sin(\pi\theta)\cdot\pi) + \cos(\pi\theta)\cdot e^{-\theta\ln 2}(-\ln 2)$

$= 2^{-\theta}\left(-\pi\sin(\pi\theta) - \ln 2\cos(\pi\theta)\right)$

25. $g(\alpha) = 5^{-\alpha/2}\cdot\sin(2\alpha) = e^{-\alpha/2\ln 5}\cdot\sin(2\alpha)$

$g'(\alpha) = e^{-\alpha/2\ln 5}\cdot\cos(2\alpha)\cdot 2 + \sin(2\alpha)\cdot e^{-\alpha/2\ln 5}\left(-\frac{\ln 5}{2}\right)$

$= 5^{-\alpha/2}\left(2\cos(2\alpha) - \frac{\ln 5}{2}\cdot\sin(2\alpha)\right)$