1. $f(x) = e^{7x} + 3x \qquad g(x) = f^{-1}(x) \qquad g'($[redacted]$) = \frac{1}{f'(0)}$

$f'(x) = 7e^{7x} + 3$

$f'(0) = 7e^{0} + 3 = 10 \qquad \boxed{g'(1) = \frac{1}{10}}$

2. $f(x) = e^{5x} - x \qquad g(x) = f^{-1}(x) \qquad g'(1) = \frac{1}{f'(0)}$

$f'(x) = 5e^{5x} - 1 \qquad \boxed{g'(1) = \frac{1}{4}}$

$f'(0) = 5e^{0} - 1 = 4$

3. $f(x) = \ln x - 3x \qquad f^{-1}(x) = g(x) \qquad g'(-3) = \frac{1}{f'(1)}$

$f'(x) = \frac{1}{x} - 3 \qquad \boxed{g'(-3) = -\frac{1}{2}}$

$f'(1) = 1 - 3 = -2$

4. $f(x) = 3e^{4x} - 2x \qquad g(x) = f^{-1}(x) \qquad g'(3) = \frac{1}{f'(0)}$

$f'(x) = 12e^{4x} - 2 \qquad \boxed{g'(3) = \frac{1}{10}}$

$f'(0) = 12e^{0} - 2 = 10$

5. $y = \sqrt{x^2 + 8}$

$y' = \frac{2x}{2\sqrt{x^2+8}} = \frac{x}{\sqrt{x^2+8}}\Big|_{x=1} = \frac{1}{\sqrt{9}} = \boxed{\frac{1}{3}}$

6. $y = e^{7x-6} \qquad y' = 7e^{7x-6}\Big|_{x=2} = \boxed{7e^{8}}$

7. $y = \ln(x^2 + 5x) \qquad y' = \frac{2x+5}{x^2+5x}\Big|_{x=3} = \boxed{\frac{11}{24}}$

8. $y = (3x-8)^6 \qquad y' = 6(3x-8)^5(3)\Big|_{x=2} = 18(-2)^5 = \boxed{-576}$

9. $y = \sqrt[3]{3x-1}$ $\quad y' = \frac{1}{3}(3x-1)^{-\frac{2}{3}}(3) = \left.\frac{1}{(3x-1)^{2/3}}\right|_{x=3} = \boxed{\frac{1}{4}}$

10. $y = \frac{2}{4x^2+5x}$ $\quad y' = \left.\frac{-2(8x+5)}{(4x^2+5x)^2}\right|_{x=1} = \frac{-2(13)}{81} = -\frac{26}{81}$

11. $y = x^3+x+5$ $\quad \frac{y(2)-y(0)}{2-0} = \frac{15-5}{2} = \boxed{5}$

12. $y = \frac{2}{x^2-2}$ $\quad \frac{y(2)-y(0)}{2-0} = \frac{1-(-1)}{2} = \boxed{1}$

13. $y = \sqrt{x+2}$ $\quad \frac{y(7)-y(2)}{7-2} = \frac{3-2}{5} = \frac{1}{5}$

14. $x^4 + 2y^3 = 2x^3 - y^2 + 4$

$$4x^3 + 6y^2\frac{dy}{dx} = 6x^2 - 2y\frac{dy}{dx} \longrightarrow \frac{dy}{dx} = \frac{6x^2-4x^3}{6y^2+2y} = \frac{3x^2-2x^3}{3y^2+y}$$

$$\frac{d^2y}{dx^2} = \frac{(3y^2+y)(6x-6x^2) - (3x^2-2x^3)(6y+1)\frac{dy}{dx}}{(3y^2+y)^2}$$

$$= \frac{(3y^2+y)(6x-6x^2) - (3x^2-2x^3)(6x+1)\left(\frac{3x^2-2x^3}{3y^2+y}\right)}{(3y^2+y)^2}$$

15. $2+6x+2y^5 = 3x^4 - y^2 \rightarrow 6 + 10y^4\frac{dy}{dx} = 12x^3 - 2y\frac{dy}{dx} \rightarrow \frac{dy}{dx} = \frac{12x^3-6}{2y+10y^4} = \frac{6x^3-3}{y+5y^4}$

$$\frac{d^2y}{dx^2} = \frac{(y+5y^4)(18x^2) - (6x^3-3)(1+20y^3)\frac{dy}{dx}}{(y+5y^4)^2}$$

$$= \boxed{\frac{(y+5y^4)(18x^2) - (6x^3-3)(1+20y^3)\left(\frac{6x^3-3}{y+5y^4}\right)}{(y+5y^4)^2}}$$

16. $\sin x + 2x^2 + 2y^3 = 4x^4 - 3y^2 + 2 \rightarrow \cos x + 4x + 6y^2 \frac{dy}{dx} = 16x^3 - 6y\frac{dy}{dx}$

$$\frac{dy}{dx} = \frac{16x^3 - \cos x - 4x}{6y^2 + 6y}$$

$$\frac{d^2y}{dx^2} = \frac{(6y^2+6y)(48x^2 + \sin x - 4) - (16x^3 - \cos x - 4x)(12y + 6)\frac{dy}{dx}}{(6y^2+6y)^2}$$

$$= \boxed{\frac{(6y^2+6y)(48x^2+\sin x - 4) - (16x^3 - \cos x - 4x)(12y+6)\left(\frac{16x^3 - \cos x - 4x}{6y^2+6y}\right)}{(6y^2+6y)^2}}$$

17. a) $y = \frac{\sin x}{\ln x} \rightarrow y' = \boxed{\frac{\ln x \cos x - \frac{\sin x}{x}}{(\ln x)^2}}$

b) $y = 3^{x\tan x} \rightarrow y' = \boxed{3^{x\tan x}(\ln 3)(x\sec^2 x + \tan x)}$

c) $y = \tan^{-1}(x^3 - \cos x)$ $\boxed{y' = \frac{3x^2 + \sin x}{1 + (x^3 - \cos x)^2}}$

d) $y = (\cos x)^{\ln x} \rightarrow \ln y = \ln x(\ln \cos x)$

$$\frac{1}{y}\frac{dy}{dx} = \ln x\left(\frac{-\sin x}{\cos x}\right) + \frac{\ln \cos x}{x}$$

$$\frac{dy}{dx} = \boxed{\left(-\tan x \ln x + \frac{\ln \cos x}{x}\right)\left(\cos x^{\ln x}\right)}$$

e) $y = (\sin 8x)(\log_2(3x^2))$ $\quad y' = \dfrac{(\sin 8x)(6x)}{(\ln 2)(3x^2)} + (8\cos 8x)(\log_2(3x^2))$

$$= \boxed{\frac{2\sin 8x}{x \ln 2} + (8\cos 8x)(\log_2 3x^2)}$$

f) $y = e^{x^2 + \sin x}$ $\quad \boxed{y' = (2x + \cos x)e^{x^2 + \sin x}}$

g) $y = \ln(3x^2 - e^x)$ $\quad y' = \boxed{\dfrac{6x - e^x}{3x^2 - e^x}}$

h) $y = \cos(7x^2 - 2x)$ $\quad y' = \boxed{(14x - 2)(-\sin(7x^2 - 2x))}$

i) $y = (\cos x)^{x^2+1} \rightarrow \ln y = (x^2+1)(\ln \cos x)$

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

$$\frac{dy}{dx} = \boxed{\left[(-\tan x)(x^2+1) + 2x \ln \cos x\right](\cos x)^{x^2+1}}$$

j) $y = \dfrac{1}{x^4 - \tan x}$ $\quad y' = \boxed{-\dfrac{4x^3 - \sec^2 x}{(x^4 - \tan x)^2}}$

k) $y = \dfrac{4}{2 - \sin^2 x}$ $\quad y' = -\dfrac{4(-2\sin x \cos x)}{(2 - \sin^2 x)^2} = \boxed{\dfrac{4\sin 2x}{(2 - \sin^2 x)^2}}$

l) $y = \sqrt{(x^2-5)^3} = (x^2-5)^{\frac{3}{2}}$

$y' = \frac{3}{2}(x^2-5)^{\frac{1}{2}}(2x) = \boxed{3x\sqrt{x^2-5}}$

m) $y = 2^{3x^2 \ln x}$ $\quad y' = 2^{3x^2 \ln x}(\ln 2)\left[\frac{3x^2}{x} + 6x\ln x\right]$

$= \boxed{2^{3x^2 \ln x}(\ln 2)(3x + 6x\ln x)}$

n) $y = \sqrt{\tan(x^3)} = \sqrt{u}$ $\quad u = \tan(x^3)$

$u = \tan v \quad v = x^3$

$\frac{dy}{dx} = \frac{1}{2\sqrt{u}}(\sec^2 v)(3x^2) = \boxed{\frac{3x^2\sec^2(x^3)}{2\sqrt{\tan(x^3)}}}$

o) $y = x^{\tan^{-1}x} \rightarrow \ln y = (\tan^{-1}x)(\ln x)$

$\frac{1}{y}\frac{dy}{dx} = \frac{\tan^{-1}x}{x} + \frac{\ln x}{1+x^2}$

$\boxed{\frac{dy}{dx} = \left[\frac{\tan^{-1}x}{x} + \frac{\ln x}{1+x^2}\right]\left(x^{\tan^{-1}x}\right)}$

p) $y = \frac{4}{7}x^{\frac{8}{3}} - 2\sqrt[3]{x} + x^{\frac{2}{5}}$ $\quad y' = \boxed{\frac{32}{21}x^{\frac{5}{3}} - \frac{2}{3}x^{-\frac{2}{3}} + \frac{2}{5}x^{-\frac{3}{5}}}$

2) $y = 3x^2 - 8x + 1$ $\quad y' = \boxed{6x - 8}$

r) $y = (5x^2 - \cos x)^{\pi}$ $\boxed{y' = \pi(5x^2 - \cos x)^{\pi - 1}(10x + \sin x)}$

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

t) $y = \ln(\log_2 x)$ $y' = \boxed{\dfrac{1}{(\log_2 x)(\ln 2)(x)}}$

u) $xy + \ln y + x^2 = y - 5 \rightarrow x\frac{dy}{dx} + y + \frac{1}{y}\frac{dy}{dx} + 2x = \frac{dy}{dx}$

$$\boxed{\frac{dy}{dx} = \frac{y + 2x}{1 - x - \frac{1}{y}}}$$

v) $\sin(xy) - x^2 + y^3 = x - 2 \rightarrow \cos(xy)\left[x\frac{dy}{dx} + y\right] - 2x + 3y^2\frac{dy}{dx} = 1$

$$x\cos(xy)\frac{dy}{dx} + y\cos(xy) - 2x + 3y^2\frac{dy}{dx} = 1$$

$$\boxed{\frac{dy}{dx} = \frac{1 + 2x - y\cos(xy)}{x\cos(xy) + 3y^2}}$$

w) $x\ln y - y\ln x = 1 \rightarrow \frac{x}{y}\frac{dy}{dx} + \ln y - \frac{y}{x} - (\ln x)\frac{dy}{dx} = 0$

$$\boxed{\frac{dy}{dx} = \frac{\frac{y}{x} - \ln y}{\frac{x}{y} - \ln x}}$$

x) $x^3y + \cos x - \sin y = e^x e^y$

$$x^3 \frac{dy}{dx} + 3x^2y - \sin x - \cos y \frac{dy}{dx} = e^x e^y \frac{dy}{dx} + e^x e^y$$

$$\boxed{\frac{dy}{dx} = \frac{e^x e^y + \sin x - 3x^2 y}{x^3 - \cos y - e^x e^y}}$$

y) $y = \sqrt{x^3 - \sqrt{x}}$ $\quad y = \sqrt{u} \quad u = x^3 - \sqrt{x}$

$$y' = \frac{1}{2\sqrt{x^3 - \sqrt{x}}}\left(3x^2 - \frac{1}{2\sqrt{x}}\right)$$

$$\boxed{\frac{3x^2 - \frac{1}{2\sqrt{x}}}{2\sqrt{x^3 - \sqrt{x}}}}$$

z) $x^y = y^x \rightarrow y \ln x = x \ln y$

$$\frac{y}{x} + (\ln x)\frac{dy}{dx} = \frac{x}{y}\frac{dy}{dx} + \ln y$$

$$\boxed{\frac{dy}{dx} = \frac{\frac{y}{x} - \ln y}{\frac{x}{y} - \ln x}}$$