1. $y = x^2 + \cos 5x$ → $\cos u$ $u = 5x$

$$\frac{dy}{dx} = 2x - 5\sin 5x$$

2. $y = \sin(x^3 + e^x)$ $\sin u$ $u = x^3 + e^x$

$$\frac{dy}{dx} = \cos(x^3 + e^x)\left[3x^2 + e^x\right]$$

3. $y = \sin^3 x$ u^3 $u = \sin x$

$$\frac{dy}{dx} = 3\sin^2 x \cos x$$

4. $y = 7x - 3\cos(x^3)$ → $3\cos u$ $u = x^3$

$$\frac{dy}{dx} = 7 + 3\sin(x^3)\left[3x^2\right] = 7 + 9x^2\sin(x^3)$$

5. $y = \dfrac{x^2+3}{x^2-3}$

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

$$= \frac{-12x}{(x^2-3)^2}$$

6. $y = x^5 e^x$

$$\frac{dy}{dx} = x^5 e^x + 5x^4 e^x = x^4 e^x (x+5)$$

7. $y = \sqrt{x^3 - 1}$ $\quad \sqrt{u} \quad u = x^3 - 1$

$$\frac{dy}{dx} = \frac{3x^2}{2\sqrt{x^3-1}}$$

8. $y = e^{\sqrt{x}}$ $\quad e^u \quad u = \sqrt{x}$

$$\frac{dy}{dx} = \frac{e^{\sqrt{x}}}{2\sqrt{x}}$$

9. $y = x^2 \tan(x^2)$ $\quad \tan u \quad u = x^2$

$$\frac{dy}{dx} = x^2\left[\sec^2(x^2)[2x]\right] + 2x\tan(x^2)$$

$$= 2x\left[x^2\sec^2(x^2) + \tan(x^2)\right]$$

10. $y = \sqrt{x^3 + x - 11}$ $\quad \sqrt{u} \quad u = x^3 + x - 11$

$$\frac{dy}{dx} = \frac{3x^2 + 1}{2\sqrt{x^3 + x - 11}}$$

11. $y = \dfrac{x^2+1}{x^3-1}$ $\quad \dfrac{dy}{dx} = \dfrac{(x^3-1)(2x) - (x^2+1)(3x^2)}{(x^3-1)^2}$

$$= \frac{2x^4 - 2x - 3x^4 - 3x^2}{(x^3-1)^2} = \frac{-x^4 - 3x^2 - 2x}{(x^3-1)^2}$$

12. $y = \dfrac{3+\sec x}{\tan x}$ $\qquad \dfrac{dy}{dx} = \dfrac{\tan x(\sec x \tan x) - (3+\sec x)(\sec^2 x)}{\tan^2 x}$

$$= \frac{\sec x \tan^2 x - 3\sec^2 x - \sec^3 x}{\tan^2 x} = \frac{\sec x(\tan^2 x - 3\sec x - \sec^2 x)}{\tan^2 x}$$

$$= \frac{\sec x(-1-3\sec x)}{\tan^2 x} = \boxed{\frac{-\sec x(1+3\sec x)}{\tan^2 x}}$$

13. $y = \sqrt{x^2 - e^x}\,(\sin x)$

$$\frac{dy}{dx} = \sqrt{x^2-e^x}\,(\cos x) + \frac{(\sin x)(2x-e^x)}{2\sqrt{x^2-e^x}}$$

$$= \boxed{\frac{2(x^2-e^x)\cos x + \sin x(2x-e^x)}{2\sqrt{x^2-e^x}}}$$

14. $y = \cot^3 x$ $\qquad u^3 \quad u = \cot x$

$$\frac{dy}{dx} = 3\cot^2 x(-\csc^2 x) = \boxed{-3\cot^2 x \csc^2 x}$$

15. $y = 3^x \csc(x^3)$ $\qquad \csc u \quad u = x^3$

$$\frac{dy}{dx} = 3^x(-\csc x^3 \cot x^3)(3x^2) + 3^x(\ln 3)\csc x^3$$

$$= \boxed{3^x \csc x^3\left[\ln 3 - 3x^2 \cot x^3\right]}$$

16. $y = \sqrt[3]{x - \sin^2 x}$ $\sqrt[3]{u}$ $u = x - \sin^2 x$

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

17. $y = e^{\sin^5 x}$ e^u $u = \sin^5 x$

↳ $u = v^5$ $v = \sin x$

$$\frac{dy}{dx} = \left(e^{\sin^5 x}\right)\left(5\sin^4 x\right)(\cos x)$$

18. $y = \cos(e^{4x})$ $\cos u$ $u = e^{4x}$

↳ $u = e^v$ $v = 4x$

$$\frac{dy}{dx} = -\sin(e^{4x})\left[e^{4x}\right](4) = -4e^{4x}\sin(e^{4x})$$

19. $y = \frac{e^x}{2^x}$ $\frac{dy}{dx} = \frac{2^x e^x - e^x(2^x)\ln 2}{(2^x)^2}$

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

20. $y = (\sin x)(\cos x)e^x = \left(\frac{1}{2}\sin 2x\right)e^x$

$$\frac{dy}{dx} = \left(\frac{1}{2}\sin 2x\right)e^x + e^x \cos 2x$$

$$= e^x\left[\frac{1}{2}\sin 2x + \cos 2x\right]$$

21. $y = \sin(\cos(\tan x))$ $\quad \sin u \quad u = \cos(\tan x)$

$\quad \hookrightarrow u = \cos v \quad v = \tan x$

$$\frac{dy}{dx} = \cos(\cos(\tan x))\left[-\sin(\tan x)\right](\sec^2 x)$$

22. $y = e^{(e^x)}$ $\quad e^u \quad u = e^x$

$$\frac{dy}{dx} = e^{(e^x)} e^x = e^{e^x + x}$$

23. $x^2 y^3 + \sin x = y \cos y$

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

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

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

24. $(\sin x)(\cos y) = x + y - 7$

$$(\sin x)(-\sin y)\tfrac{dy}{dx} + (\cos x)(\cos y) = 1 + \tfrac{dy}{dx}$$

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

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

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

$$\frac{1}{2\sqrt{x+y}}\left[1+\frac{dy}{dx}\right] = x^2(2y)\frac{dy}{dx} + 2xy^2$$

$$1+\frac{dy}{dx} = 4x^2y\sqrt{x+y}\,\frac{dy}{dx} + 4xy^2\sqrt{x+y}$$

$$1-4xy^2\sqrt{x+y} = \frac{dy}{dx}\left(4x^2y\sqrt{x+y} - 1\right)$$

$$\boxed{\frac{dy}{dx} = \frac{1-4xy^2\sqrt{x+y}}{4x^2y\sqrt{x+y}-1}}$$

26. $e^{xy} - x = y^3$

$$e^{xy}\left[x\frac{dy}{dx} + y\right] - 1 = 3y^2\frac{dy}{dx}$$

$$xe^{xy}\frac{dy}{dx} + ye^{xy} - 1 = 3y^2\frac{dy}{dx}$$

$$ye^{xy} - 1 = \frac{dy}{dx}\left(3y^2 - xe^{xy}\right)$$

$$\boxed{\frac{dy}{dx} = \frac{ye^{xy}-1}{3y^2-xe^{xy}}}$$

27. $x - xy = y^2 + y^3$

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

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

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

28. $x\sin y - y\cos x = 10$

$$x\cos y \frac{dy}{dx} + \sin y + y\sin x - \cos x \frac{dy}{dx} = 0$$

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

$$\boxed{\frac{dy}{dx} = \frac{\sin y + y\sin x}{\cos x - x\cos y}}$$

29. $e^x e^y - xy = 2 - \cos x$

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

$$\frac{dy}{dx}(e^x e^y - x) = y + \sin x - e^x e^y$$

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

30. $xy^2 - x^3y^4 + x^5y^6 = 7$

$$2xy\frac{dy}{dx} + y^2 - 4x^3y^3\frac{dy}{dx} - 3x^2y^4 + 6x^5y^5\frac{dy}{dx} + 5x^4y^6 = 0$$

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

$$\frac{dy}{dx} = \frac{3x^2y^4 - y^2 - 5x^4y^6}{2xy - 4x^3y^3 + 6x^5y^5} = \boxed{\frac{3x^2y^3 - y - 5x^4y^5}{2x - 4x^3y^2 + 6x^5y^4}}$$