2. (i) $\frac{d}{dx}(e^{2\ln x} + a^{x^2} + a^{\sin x})$

$= \frac{d}{dx}(e^{\ln x^2} + a^{x^2} + a^{\sin x})$

$= \frac{d}{dx}(x^2 + a^{x^2} + a^{\sin x})$

$= 2x + a^{x^2} \cdot \ln a \cdot 2x + a^{\sin x} \cdot \cos x$

(ii) $\frac{d}{dx}(\sin\ln x + \cos\ln x + \ln\cos x)$

$= \cos\ln x \cdot \frac{1}{x} + \sin\ln x \cdot \frac{1}{x} + \frac{1}{\cos x} \cdot (-\sin x)$

$= \frac{1}{x}\cos\ln x - \frac{1}{x}\sin\ln x - \tan x$

(iii) $\frac{d}{dx}(\sqrt{\sin x^3} + a^{\ln\cos x})$

$= \frac{1}{2\sqrt{\sin x^3}} \cdot \cos x^3 \cdot 3x^2 + a^{\ln\cos x} \cdot \ln a \cdot \frac{1}{\cos x} \cdot (-\sin x)$

$= \frac{3x^2}{2\sqrt{\sin x^3}} \cdot \cos x^3 - a^{\ln\cos x} \cdot \ln a \cdot \tan x$

(iv) $\frac{d}{dx}(\sin^2\ln(x^2) + \cos^2\ln(\sec x))$

$= 2\sin\ln(x^2) \cdot \cos\ln(x^2) \cdot \frac{1}{x^2} \cdot 2x + 2\cos\ln(\sec x) \cdot (-\sin\ln(\sec x)) \cdot \frac{1}{\sec x} \cdot \sec x \cdot \tan x$

$= \frac{2}{x} \cdot \sin 2\ln(x^2) - \frac{1}{\tan x}\sin 2\ln(\sec x)$.

(v) $\frac{d}{dx}(\ln\tan x + 10^{\ln\sin x})$

$= \frac{1}{\tan x} \cdot \sec^2 x + 10^{\ln\sin x} \cdot \ln 10 \cdot \frac{1}{\sin x} \cdot \cos x$

$= \frac{\cos x}{\sin x} \cdot \frac{1}{\cos^2 x} + 10^{\ln\sin x} \cdot \ln 10 \cdot \cot x$

$= \frac{1 \times 2}{2\sin x \cdot \cos x} + 10^{\ln\sin x} \cdot \ln 10 \cdot \cot x$

$= \frac{2}{\sin 2x} + 10^{\ln\sin x} \cdot \ln 10 \cdot \cot x$

$= 2\operatorname{cosec} 2x + 10^{\ln\sin x} \cdot \ln 10 \cdot \cot x$.

(vi) $\frac{d}{dx}\left(\sin^{-1}\tan^2 x + \tan^{-1} 3x\right)$

$= \frac{1}{\sqrt{1-\tan^4 x}} \cdot \sec^2 x + \frac{1}{1+9x^2} \cdot 3$

(vii) $\frac{d}{dx}\left(\tan^{-1}\sqrt{\frac{1-\cos 2x}{1+\cos 2x}}\right)$

$= \frac{d}{dx}\left(\tan^{-1}\sqrt{\frac{2\sin^2 x}{2\cos^2 x}}\right)$

$= \frac{d}{dx}\left(\tan^{-1}\tan x\right)$

$= \frac{d}{dx} f(x)$

$= 1.$

3. (vi) $\frac{d}{dx}\left(x e^{\cos x} \ln \sin x + x a^{\sin x} \ln a^x\right)$

$= x \frac{d}{dx}\left(e^{\cos x}\right) \cdot \ln \sin x + x e^{\cos x} \cdot \frac{d}{dx}(\ln \sin x) + \frac{d}{dx}(x) \cdot e^{\cos x} \cdot \ln(\sin x)$

$+ x a^{\sin x} \frac{d}{dx}(\ln a^x) + x \frac{d}{dx}\left(a^{\sin x}\right) \cdot \ln a^x + \frac{d}{dx}(x) \cdot a^{\sin x} \cdot \ln a^x$

$= x e^{\cos x} \cdot (-\sin x) \ln \sin x + x e^{\cos x} \cdot \frac{1}{\sin x} \cdot \cos x + e^{\cos x} \cdot \ln \sin x$

$+ x a^{\sin x} \cdot \frac{1}{a^x} \cdot a^x \ln a + x a^{\sin x} \cdot \ln a \cdot \cos x \cdot \ln a^x$

$+ a^{\sin x} \ln a^x$

$= \ldots\ldots \rightarrow$

4(iii) $\frac{d}{dx}\left(\frac{\sin x + \cos x}{\sqrt{1+\sin 2x}}\right)$

$= \frac{d}{dx}\left(\frac{\sin x + \cos x}{\sqrt{\sin^2 x + \cos^2 x + 2\sin x \cdot \cos x}}\right)$

$= \frac{d}{dx}\left(\frac{\sin x + \cos x}{\sin x + \cos x}\right)$

$= \frac{d}{dx}(1) = 0$

4(iv) $\frac{d}{dx}\left(\frac{\sin x}{1-\cos x}\right)$

$= \frac{d}{dx}\left(\frac{2\sin x/2 \cdot \cos x/2}{2\sin^2 x/2}\right)$

$= \frac{d}{dx}\left(\cot x/2\right)$

$= -\operatorname{cosec}^2 x/2 \cdot \frac{1}{2}$

$= -\frac{1}{2}\operatorname{cosec}^2 x/2.$

5(ii) $\frac{d}{dx}\left(x^{x^x}\right)$

$= x^{x^x}\left[x^x \frac{d}{dx}(\ln x) + \ln x \frac{d}{dx}(x^x)\right]$

$= x^{x^x}\left[x^x \cdot \frac{1}{x} + \ln x \cdot x^x \left[x \cdot \frac{1}{x} + \ln x \cdot 1\right]\right]$

$= x^{x^x}\left[\frac{1}{x} \cdot x^x + x^x \ln x (1+\ln x)\right]$

$= x^{x^x} \cdot x^x \left[\frac{1}{x} + \ln x (1+\ln x)\right]$