$f(x) = \cot^2(2x) + 2 \quad @\, x = \frac{\pi}{4}$

1) $f\left(\frac{\pi}{4}\right) = \underline{\cot^2\left(\frac{\pi}{2}\right)} + 2 = \left(\cot \frac{\pi}{2}\right)^2 + 2 = \left(\frac{\cos\left(\frac{\pi}{2}\right)}{\sin\left(\frac{\pi}{2}\right)}\right)^2 + 2$

$= \left(\frac{0}{1}\right)^2 + 2 = 2 \qquad \boxed{\left(\frac{\pi}{4}, 2\right)}$

2) $f(x) = \underbrace{(\cot 2x)}^{2} + 2 \qquad -\csc^2(2x) \cdot \underbrace{\frac{d}{dx} 2x}_{=2}$

$f'(x) = \underline{2\cot(2x)} \cdot \frac{d}{dx}(\cot(2x))$

$$f'(x) = 2\cot(2x)\left[-\csc^2(2x)\right](2)$$

$$f'\left(\frac{\pi}{4}\right)$$

$$= 2\,\boxed{\frac{\cos\left(2\cdot\frac{\pi}{4}\right)}{\sin\left(2\cdot\frac{\pi}{4}\right)}}\left[\frac{-2}{\sin^2\left(2\cdot\frac{\pi}{4}\right)}\right] = 0$$

$$\left(\frac{\pi}{4}, 2\right) \quad m = 0$$

$$y - 2 = 0\left(x - \frac{\pi}{4}\right) \rightarrow \boxed{y = 2}$$

$$f(x) = e^{\cos(x^2)}$$

$$\frac{d}{dx} e^{\star} = \underline{e^{\star} \frac{d}{dx}(\star)}$$

$$f'(x) = e^{\cos(x^2)} \cdot \underbrace{\frac{d}{dx} \cos(x^2)}$$

$$-\sin(x^2) \cdot \underbrace{\frac{d}{dx} x^2}$$

$$= 2x$$

$$\boxed{f'(x) = e^{\cos(x^2)} \left[-\sin(x^2)\right](2x)}$$

$$f(x) = \pi^{\sqrt{x^2+1}}$$

$$\frac{d}{dx} n^{\star} = n^{\star} \cdot \ln(n) \cdot \frac{d}{dx}(\star)$$

$$f'(x) = \pi^{\sqrt{x^2+1}} \cdot \ln(\pi) \cdot \underbrace{\frac{d}{dx}(x^2+1)^{1/2}}$$

$$\frac{1}{2}(x^2+1)^{-1/2} \cdot \underbrace{\frac{d}{dx}(x^2+1)}_{=2x}$$

$$\boxed{f'(x) = \pi^{\sqrt{x^2+1}} \cdot \ln(\pi) \cdot \frac{1}{2}(x^2+1)^{-1/2} \cdot 2x}$$