

$$\textcircled{9} \quad f(x) = e^{\sin(2x)} \quad \text{chgt } x = x - \frac{\pi}{2} \Rightarrow x = \frac{\pi}{2} + X$$

$$f(x) = e^{\sin(\pi + 2X)} = e^{-\sin(2X)} = e^{-\left(2X - \frac{(2X)^3}{6} + o(x^3)\right)}$$

$$= e^{-2X + \frac{4X^3}{3} + o(x^3)}$$

$$= 1 + \left(-2X + \frac{4X^3}{3} + o(x^3)\right) + \frac{1}{2} \left(-2X + \frac{4X^3}{3} + o(x^3)\right)^2 + \frac{1}{6} \left(-2X + \frac{4X^3}{3} + o(x^3)\right)^3 + o(x^3)$$

$$= 1 - 2X + \frac{4X^3}{3} + \frac{1}{2} \cdot 4X^2 + \frac{1}{6} (-8X^3) + o(x^3)$$

$$= 1 - 2X + 2X^2 + o(x^3)$$

$$f(x) = 1 - 2\left(x - \frac{\pi}{2}\right) + 2\left(x - \frac{\pi}{2}\right)^2 + o\left(\left(x - \frac{\pi}{2}\right)^3\right)$$

tangente:  $\boxed{y = 1 - 2\left(x - \frac{\pi}{2}\right)}$  concave au dessus car  $2\left(x - \frac{\pi}{2}\right)^2 \geq 0$