

$$f_2(x) = -\frac{\pi}{2}(x-1) + \frac{\pi^3}{24}(x-1)^3 + o((x-1)^4)$$

quindi:

$$f(x) = \frac{\pi^3}{12}(x-1)^3 + o((x-1)^4)$$

Infine:

$$\begin{aligned} \frac{f(x)}{(x^x - 1)^2} &= \frac{f(x)}{(x \ln x)^2} \left(\frac{x \ln x}{x^x - 1} \right)^2 = \\ &= \frac{f(x)}{(x-1)^2} \left(\frac{x-1}{x^x - 1} \right)^2 \end{aligned}$$

e quindi il limite cercato $\neq 0$.