

Find f_x and f_y if

1. $f(x, y) = \arctan \frac{x}{y}$

2. $f(x, y) = \ln(x^2 + y^2)$

3. Show that $u = e^{-4t} \sin x$ is a solution to

$$\begin{aligned}u_t &= 4u_{xx} \\u(0, t) &= 0 \\u(x, 0) &= \sin x\end{aligned}$$