Problem 1. Consider the function $f(x,y) = \frac{x^2-y}{y+1}$ on $\{(x,y) \in \mathbb{R}^2 \mid y \neq -1\}$. At which (a,b) is f differentiable? What is $f'(a,b)$?

Problem 2. Consider the function

$$g(x,y) = \begin{cases} \frac{xy}{\sqrt{x^2+y^2}} & \text{if } (x,y) \neq (0,0) \\ 0 & \text{if } (x,y) = (0,0). \end{cases}$$

At which (a,b) is g differentiable? What is $g'(a,b)$?

Problem 3. Define $h : \mathbb{R} \to \mathbb{R}$ by $h(x) = x^2 \sin \frac{1}{x}$ if $x \neq 0$, and $h(0) = 0$. Show that $h'(x)$ exists for all x but that h' is dincontinuous at 0. [It follows that differentiability does not imply that a function has continuous derivatives!]