(1) Let $f\colon R^2 \to R$ be given by
$$f(x,y) = \begin{cases} \sqrt{|xy|} \text{ if } x \geq 0 \\ -\sqrt{|xy|} \text{ if } x < 0 \end{cases}$$
Show that $D_h f((0,0))$ exists for any $h \in R^2$ but f is not differentiable at $(0,0)$.

(2) Let $x(t_1, t_2) = t_1 e^{t_2}$, $y(t_1, t_2) = t_1^2 + \sin(t_1 t_2)$. Let $f(x,y)$ be a differentiable function $f\colon R^2 \to R$. Let $g(t_1, t_2) = f(x(t_1, t_2), y(t_1, t_2))$. Express $\frac{\partial g}{\partial t_1}(1,0)$ and $\frac{\partial g}{\partial t_2}(1,0)$ in terms of partial derivatives of f.