1. $\frac{\partial f}{\partial x} = \begin{cases} \frac{y^3(x^2+y^2)-(2x)(xy^3)}{(x^2+y^2)^2} & (x,y) \neq (0,0) \\ 0, & (x,y)=(0,0) \end{cases}$

$\frac{\partial f}{\partial y} = \begin{cases} \frac{3xy^2(x^2+y^2)-2y(xy^3)}{(x^2+y^2)^2}, & (x,y)\neq(0,0) \\ 0, & (x,y)=(0,0) \end{cases}$

$$\frac{\partial}{\partial y}(x,y) = \lim_{h\to 0} \frac{g(\vec{a}+h\vec{u})-g(\vec{a})}{h} \qquad \vec{u}=(0,1)$$

$$= \lim_{h\to 0} \frac{g(0,h)-0}{h}$$

$$= \lim_{h\to 0} \frac{h^3(0+h^2)-2(0)(0h^3)}{(0^2+h^2)^2} \cdot \frac{1}{h}$$

$$= \lim_{h\to 0} \frac{h^5}{h^4} \cdot \frac{1}{h}$$

$$= 1$$

$$\frac{\partial}{\partial x}k(x,y) = \lim_{h\to 0} \frac{k(\vec{a}+h\vec{u})-g(\vec{a})}{h} \qquad \vec{u}=(1,0)$$

$$= \lim_{h\to 0} \frac{k(h,0)}{h}$$

$$= \lim_{h\to 0} \frac{3h(0)(h^2+0)-2(0)(h(0))}{(h^2+0)^2} \cdot \frac{1}{h}$$

$$= \lim_{h\to 0} \frac{0}{h^3}$$

$$= 0$$

Not equal

2. Mixed paritials not equal $\therefore$ not C^2 by contrap.