② $r(x,y) = \ln(x+y)$

$$r_x = \frac{1}{x+y} \qquad r_y = \frac{1}{x+y}$$

$$r_x = r_y \Rightarrow \left.\begin{matrix} r_{xx} = r_{xy} \\ r_{xy} = r_{yy} \end{matrix}\right\} \Rightarrow \boxed{r_{xx} = r_{xy} = r_{yx} = r_{yy} = \frac{-1}{(x+y)^2}}$$

$r_{xy} = r_{yx}$ (משפט שוורץ)

④ $f(x,y) = 1 - x + y - 3x^2y$

$$\frac{\partial f}{\partial x}(1,2) = \lim_{x\to 2} \frac{f(x,2) - f(1,2)}{x-2} = \lim_{x\to 2} \frac{1 - x + 2 - 6x^2 - (1 - 1 + 2 - 3\cdot 1\cdot 2)}{x-2} = \lim_{x\to 2} \frac{-6x^2 - x + 3}{x-2}$$

$$\frac{\partial f}{\partial x}(1,2) = \lim_{x\to 1} \frac{f(x,2) - f(1,2)}{x-1} = \lim_{x\to 1} \frac{1 - x + 2 - 6x^2 - (1 - 1 + 2 - 3\cdot 1\cdot 2)}{x-1}$$

$$= \lim_{x\to 1} \frac{-6x^2 - x + 7}{x-1} = \lim_{x\to 1} \frac{(-6x+7)(x-1)}{x-1} = \lim_{x\to 1} (-6x+7) = \boxed{-13}$$

$$\Rightarrow \boxed{\frac{\partial f}{\partial x} = -13}$$

$$\frac{\partial f}{\partial y}_{(1,2)} = \lim_{y\to 2} \frac{f(1,y) - f(1,2)}{y-2} = \lim_{y\to 2} \frac{1 - 1 + y - 3y - (1 - 1 + 2 - 6)}{y-2} = \lim_{y\to 2} \frac{-2y + 4}{y-2} = \lim_{y\to 2} \frac{-2(y-2)}{y-2} = -2$$

$$\Rightarrow \boxed{\frac{\partial f}{\partial y} = -2}$$