Určete a zakreslete definiční obor $f(x,y)$, spočtěte derivaci :

$$f(x,y) = \ln\left(1 - x^2 - 4y^2\right) + \sqrt{4x^2 + y^2 - 1}, \qquad \frac{\partial f}{\partial x}.$$

Řešení: Argument logaritmické funkce musí být vždy kladný, proto vyžadujeme splnění podmínky

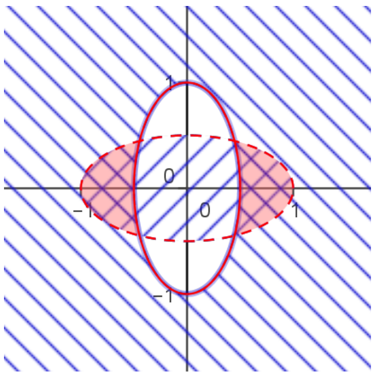
$$1 - x^2 - 4y^2 > 0 \Rightarrow 1 > x^2 + 4y^2.$$

Rovnice $1 = x^2 + 4y^2$ je rovnicí elipsy se středem v počátku, s hlavní poloosou ležící na ose x. Délka hlavní poloosy je 1 a délky poloosy vedlejší je $\frac{1}{2}$. Uvedenou podmínku pak splňují všechny body „uvnitř elipsy.“

Podmínka pro $\sqrt{4x^2 + y^2 - 1}$ je obdobná,

$$4x^2 + y^2 - 1 \geq 0 \Rightarrow 4x^2 + y^2 \geq 1.$$

I zde je o elipsu, tentokráte s hlavní poloosou na ose y. Podmínku splňují všechny body „vně elipsy.“ Protože však v podmínce připouštíme rovnost, je podmínka splněna i body samotné elipsy.



Obrázek 1: Náčrtek definičního oboru fce

Na obrázku 1 je oblast, na níž je funkce $f(x,y)$ definována, zakreslena červenou barvou. Definiční obor můžeme samozřejmě zapsat také množinově, tj.

$$D_f = \left\{[x,y] \in \mathbb{R}^2 \; | 1 > x^2 + 4y^2 \wedge 4x^2 + y^2 \geq 1\right\}.$$

Zbývá spočíst naznačenou parciální derivaci

$$\frac{\partial f}{\partial x} = \frac{\partial \ln\left(1 - x^2 - 4y^2\right) + \sqrt{4x^2 + y^2 - 1}}{\partial x} = \frac{\partial \ln\left(1 - x^2 - 4y^2\right)}{\partial x} + \frac{\partial \sqrt{4x^2 + y^2 - 1}}{\partial x} =$$
$$= \frac{1}{1 - x^2 - 4y^2} \; \frac{\partial\left(1 - x^2 - 4y^2\right)}{\partial x} + \frac{1}{2\sqrt{4x^2 + y^2 - 1}} \; \frac{\partial(4x^2 + y^2 - 1)}{\partial x} =$$
$$= \frac{1}{1 - x^2 - 4y^2} \; (-2x) + \frac{1}{2\sqrt{4x^2 + y^2 - 1}} \; (8x) =$$
$$= \frac{-2x}{1 - x^2 - 4y^2} + \frac{4x}{\sqrt{4x^2 + y^2 - 1}}.$$

Určete a zakreslete definiční obor $f(x,y)$, spočtěte derivaci :

(1) $f(x,y) = \ln\Big(x - y^2 + 1\Big)\,, \qquad \dfrac{\partial f}{\partial y}\,.$

(2) $f(x,y) = \sqrt{x^2 - y^2}, \qquad \dfrac{\partial f}{\partial x}\,.$

(3) $f(x,y) = \arcsin\Big(x^2 + y^2 - 3\Big)\,, \qquad \dfrac{\partial f}{\partial y}\,.$

(4) $f(x,y) = \dfrac{y}{x^2 - 1}, \qquad \dfrac{\partial f}{\partial x}\,.$

(5) $f(x,y) = \sqrt{1 - x\,y}, \qquad \dfrac{\partial f}{\partial y}\,.$

(6) $f(x,y) = \ln\left(1 - 2\,x - 3\,y\right)\,, \qquad \dfrac{\partial f}{\partial x}\,.$

(7) $f(x,y) = \ln xy, \qquad \dfrac{\partial f}{\partial x}\,.$

(8) $f(x,y) = \arcsin\dfrac{y-1}{x}, \qquad \dfrac{\partial f}{\partial y}\,.$

(9) $f(x,y) = \arccos\left(\dfrac{x}{y^2}\right), \qquad \dfrac{\partial f}{\partial x}\,.$

(10) $f(x,y) = \sqrt{4x - y^2}, \qquad \dfrac{\partial f}{\partial x}\,.$

(11) $f(x,y) = \sqrt{1 - (x^2 - y)^2}, \qquad \dfrac{\partial f}{\partial y}\,.$

(12) $f(x,y) = \arcsin(1 - x^2 - y^2), \qquad \dfrac{\partial f}{\partial x}\,.$

(13) $f(x,y) = \arctan\dfrac{2y}{x^2 + y^2 - 1}, \qquad \dfrac{\partial f}{\partial x}\,.$

(14) $f(x,y) = \arccos\dfrac{y-1}{x}, \qquad \dfrac{\partial f}{\partial x}\,.$

(15) $f(x,y) = \dfrac{xy}{\sqrt{x^2 + y^2 - 1}}, \qquad \dfrac{\partial f}{\partial x}\,.$

Určete a zakreslete definiční obor $f(x,y)$, spočtěte derivaci :

(1) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid x > y^2 - 1\right\}, \quad \dfrac{\partial f}{\partial y} = \dfrac{-2y}{x - y^2 + 1}.$

(2) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid (x \geq 0 \wedge -x < y < x) \vee (x < 0 \wedge x < y < -x)\right\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{x}{\sqrt{x^2 - y^2}}.$

(3) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid 2 \leq x^2 + y^2 \leq 4\right\}, \quad \dfrac{\partial f}{\partial y} = \dfrac{2y}{\sqrt{1 - (x^2 + y^2 - 3)^2}}.$

(4) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid x \neq \pm 1\right\}, \quad \dfrac{\partial f}{\partial x} = -\left(x^2 - 1\right)^{-2} 2xy = \dfrac{-2xy}{(x^2 - 1)^2}.$

(5) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid \left(x \geq 0 \wedge y \leq \dfrac{1}{x}\right) \vee \left(x < 0 \wedge \dfrac{1}{x} < y\right)\right\}, \quad \dfrac{\partial f}{\partial y} = -\dfrac{x}{2\sqrt{1 - x\,y}}.$

(6) $D_f = \left\{[x,y] \in \mathbb{R}^2 \mid 1 - 2\,x - 3\,y > 0\right\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{-2}{1 - 2\,x - 3\,y}.$

(7) $D_f = \{[x,y] \in \mathbb{R}^2 \mid (x > 0 \wedge y > 0) \vee (x < 0 \wedge y < 0)\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{y}{xy} = \dfrac{1}{y}.$

(8) $D_f = \{[x,y] \in \mathbb{R}^2 \mid y \geq 1 - x,\ y \leq x + 1,\ x \neq 0\}, \quad \dfrac{\partial f}{\partial y} = \dfrac{1}{x\sqrt{1 - \left(\frac{y-1}{x}\right)^2}}$

(9) $D_f = \{[x,y] \in \mathbb{R}^2 \mid x \geq -y^2,\ x \leq y^2,\ y \neq 0\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{-1}{y^2\sqrt{1 - \left(\frac{x}{y^2}\right)^2}}.$

(10) $D_f = \{[x,y] \in \mathbb{R}^2 \mid x \geq \dfrac{1}{4}y^2\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{2}{\sqrt{4x - y^2}}.$

(11) $D_f = \{[x,y] \in \mathbb{R}^2 \mid y \geq x^2 - 1,\ y \leq x^2 + 1\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{(x^2 - y)}{\sqrt{1 - (x^2 - y)^2}}.$

(12) $D_f = \{[x,y] \in \mathbb{R}^2 \mid x^2 + y^2 \leq 2\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{-2x}{\sqrt{1 - (1 - x^2 - y^2)^2}}.$

(13) $D_f = \{[x,y] \in \mathbb{R}^2 \mid x^2 + y^2 \neq 1\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{-4xy}{\left(1 + \left(\frac{2y}{x^2+y^2-1}\right)^2\right)(x^2 + y^2 - 1)^2}.$

(14) $D_f = \{[x,y] \in \mathbb{R}^2 \mid y \geq 1 - x,\ y \leq x + 1,\ x \neq 0\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{y - 1}{x^2\sqrt{1 - \left(\frac{y-1}{x}\right)^2}}.$

(15) $D_f = \{[x,y] \in \mathbb{R}^2 \mid x^2 + y^2 > 1\}, \quad \dfrac{\partial f}{\partial x} = \dfrac{y\left(y^2 - 1\right)}{\left(\sqrt{x^2 + y^2 - 1}\right)^3}.$