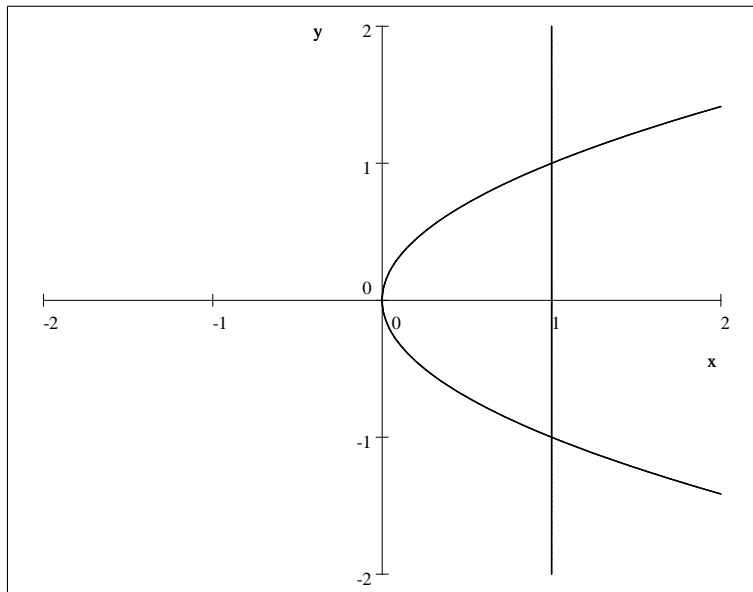1. Find and sketch the domain of the function $f(x, y) = \dfrac{\sqrt{x - y^2}}{1 - x^2}$.

   Solution:

   In the domain of f, we must have $x - y^2 \geq 0$ and $x \neq \pm 1$. This gives all points inside or on the parabola $x = y^2$ but not on the line $x = 1$.

2. Find $\lim_{(x,y)\to(0,0)} \dfrac{6xy^3}{2x^4 + y^4}$ or show that it does not exist.

   Solution:

   Approach through the line $x = 0$ to get

   $$\lim_{y \to 0} \frac{0}{y^4} = 0.$$

   Approach through the line $y = x$ to get

   $$\lim_{x \to 0} \frac{6x^4}{2x^4 + x^4} = 2.$$

   Since the two limits are different, $\lim_{(x,y)\to(0,0)} \dfrac{6xy^3}{2x^4 + y^4}$ does not exist.

3. Find the first partial derivatives of the function $u = te^{w/t}$.

   Solution:

   $u_t = e^{w/t} - \frac{w}{t}e^{w/t}$.

   $u_w = e^{w/t}$.