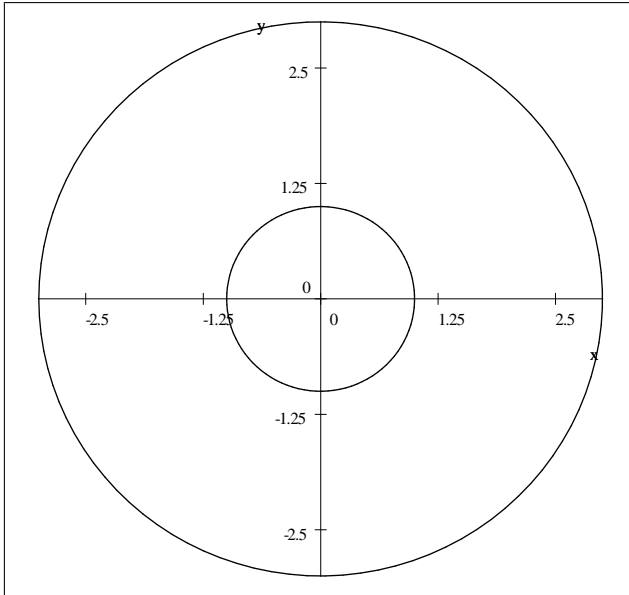


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**Q.1:** Find and sketch the domain of the function  $f(x, y) = \sqrt{x^2 + y^2 - 1} + \ln(9 - x^2 - y^2)$ .

**Sol:**  $x^2 + y^2 - 1 \geq 0 \Rightarrow x^2 + y^2 \geq 1$ , outside unit circle  
 $9 - x^2 - y^2 > 0 \Rightarrow x^2 + y^2 < 9$ , inside circle of radius 3.



**Q.2:** Show that the limit  $\lim_{(x,y) \rightarrow (0,0)} \frac{4xy}{3x^2 + 5y^2}$  does not exist.

**Sol:** Let  $y = mx$ , then  $\lim_{(x,y) \rightarrow (0,0)} \frac{4xy}{3x^2 + 5y^2} = \lim_{x \rightarrow 0} \frac{4x^2m}{3x^2 + 5m^2x^2} = \lim_{x \rightarrow 0} \frac{4m}{3 + 5m^2}$ . Thus Limit is not unique.

**Q.3:** Find all the second order partial derivatives of  $f(x, y) = \ln(3x - 5y)$ .

**Sol:**  $f(x, y) = \ln(3x - 5y) \Rightarrow f_x = \frac{3}{3x - 5y}, f_y = \frac{-5}{3x - 5y}$  and  $f_{xx} = \frac{-9}{(3x - 5y)^2}, f_{yy} = \frac{-25}{(3x - 5y)^2}, f_{xy} = \frac{15}{(3x - 5y)^2}$ .