

1. Sketch the domain and at least three level curves of the functions below

(a)  $f(x, y) = \ln(x + y)$

(b)  $g(x, y) = \sqrt{y^2 - x^2}$ .

2. Describe the level surfaces of the following functions of three variables,

(a)  $f(x, y, z) = 4x^2 + 9y^2 + 36z^2$

(b)  $g(x, y, z) = 2x + 3y + 6z$ .

3. Evaluate the following limits: (Hint: For (c) switch to spherical coordinates)

(a)  $\lim_{(x,y) \rightarrow (1,2)} \ln \left( \cos \left( \frac{2x - y}{x + y} \right) \right)$

(b)  $\lim_{(x,y,z) \rightarrow (1,1,2)} \frac{x - z + y}{y^2 + xy - yz}$

(c)  $\lim_{(x,y,z) \rightarrow (0,0,0)} \frac{xyz}{x^2 + y^2 + z^2}$

(d)  $\lim_{(x,y) \rightarrow (0, \sqrt{\pi})} e^{xy} \cos y^2$

(e)  $\lim_{(x,y) \rightarrow (0,0)} \frac{x + y}{\sqrt{x^2 + y^2}}$

4. Find all the points where the following functions are continuous,

(a)  $h(x, y) = \cos \left( \frac{x^2 - y^2}{x^2 + 1} \right)$

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

(c)  $f(x, y) = \begin{cases} x^2 + y^2 & x > 0 \\ x^2 - y^2 & x \leq 0 \end{cases}$

5. Calculate all the partial derivatives of the following functions.

(a)  $f(x, y) = xe^y + y \sin(x^2 + y)$

(b)  $g(x, y) = \frac{x + y^2 + z^3}{1 + x + y + z}$

(c)  $h(x, y, z) = \frac{x + y}{y - z}$ , at  $(1, -1, 1)$

(d)  $k(x, y) = e^{xy} + \ln(x - y)$ , at  $(2, 1)$