

1. 10 pts. Find an equation of the plane parallel to the plane $2x + y - z = 1$ and passing through the point $(0, 2, -2)$.

2. 10 pts. Find the domain and range of the function

$$f(x, y, z) = \frac{3}{y - z}.$$

Give a geometrical description of the domain.

3. 10 pts. Determine the set of points in \mathbb{R}^2 where the function $h(x, y) = \sqrt{x - y^2}$ is continuous. Make a sketch of the set.

4. 10 pts. Graph two level curves of the function $z = \sqrt{x^2 + 4y^2}$, labeling each curve with its z -value.

5. 10 pts. Evaluate the limit

$$\lim_{(x,y) \rightarrow (-1,1)} \frac{x^2 - y^2}{x^2 - xy - 2y^2}.$$

6. 10 pts. Use the Two-Path Test to prove that the limit does not exist:

$$\lim_{(x,y) \rightarrow (0,0)} \frac{|x - y|}{|x + y|}.$$

7. 10 pts. Find the first partial derivatives of $\varphi(t, z) = z^2 \tan tz$.

8. Let $g(x, y) = \sqrt{|xy|}$.

(a) 5 pts. Is g continuous at $(0, 0)$? If not, prove it.

(b) 5 pts. Evaluate $g_x(0, 0)$ and $g_y(0, 0)$.

(c) 10 pts. Is g differentiable at $(0, 0)$? If not, why not?

9. 10 pts. Compute the directional derivative of $f(x, y) = e^x \sin y$ in the direction $\langle 1, \sqrt{3} \rangle$ at the point $(0, \pi/4)$.

10. 15 pts. Let $f(x, y) = y + x$. Let C be the path of steepest descent on the surface $z = f(x, y)$ beginning at $(2, 2, 4)$, and let C_0 be the projection of C onto the xy -plane. Find a parameterization for C_0 in the form of a vector-valued function $\mathbf{r}(t) = \langle x(t), y(t) \rangle$.