



# Calculus 3 Workbook

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Partial derivatives

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MATH

## PARTIAL DERIVATIVES

- 1. Find  $f_x + f_y$ .

$$f(x, y) = \sqrt{\sin(x + y)}$$

- 2. Find  $f_r$  and  $f_\theta$ .

$$f(r, \theta) = r^2(\sin 2\theta - \cos 2\theta)$$

- 3. Find  $u_s$  and  $u_t$ .

$$u(t, s) = 2^{\frac{t}{s}}$$

- 4. Find the point  $(x, y)$  where  $f_x = f_y = 0$ .

$$f(x, y) = 3x^2 - 2xy + 3y^2 - 4x + 2y - 1$$



## PARTIAL DERIVATIVES IN THREE OR MORE VARIABLES

- 1. Find  $f_x^2 + f_y^2 + f_z^2$ .

$$f(x, y, z) = \tan(x^2 + y^2 + z^2)$$

- 2. Find  $f_u$ ,  $f_v$ , and  $f_w$ .

$$f(u, v, w) = u^{v^w}$$

- 3. Find the point  $(a, b, c, d)$  where  $f_a = f_b = f_c = f_d = 0$ .

$$f(a, b, c, d) = a^2 + b^2 - c^2 - d^2 + 4ab - 4cd - 6a + 6c + 8 = 0$$



## HIGHER ORDER PARTIAL DERIVATIVES

- 1. Find  $f_{uvw}$ .

$$f(u, v, w) = \sqrt{u^2 + v^2 + w^2}$$

- 2. Find and identify the curve for the set of the points  $(x, y)$  where  $f_{xx} = f_{yy}$ .

$$f(x, y) = 3x^3 - 4x^2y + y^3 - x^2 + 5y + 7$$

- 3. Find and identify the curve(s) for the set of the points  $(x, y)$  where  $f_{xx} = f_{yy}$ .

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

- 4. Find all four second-order partial derivatives for the function. Is  $f_{ts} = f_{st}$ ?

$$f(t, s) = e^{ts}$$

- 5. Find the  $n$ th-order partial derivatives  $\partial^n / \partial x^n$  and  $\partial^n / \partial y^n$  by looking for patterns in the partial derivatives with respect to  $x$  and  $y$ .

$$f(x, y) = 2^{2x+4y}$$



