CONCEPT: CALCULATING ELECTRIC FIELD AS DERIVATIVE OF POTENTIAL

● Some problems will give a function for the electric potential and ask you for the electric field.

Potential Difference From Electric Field

$$V_a - V_b = \int_a^b \vec{E} \cdot d\vec{l}$$

Electric Field from Potential Function

Given $V(x, y, z)$,

E_x = ______

E_y = ______

E_z = ______

● The symbol ∂ stands for a __________ derivative: only 1 variable is differentiated while others are treated as constants.

- For example, $\frac{\partial}{\partial x}$ means any term with x is differentiated with respect to x.

● In vector form, the electric field $\vec{E}$ is written as: $\vec{E}$ = – ______ – ______ – ______

EXAMPLE: In a certain region, the electric potential is given by the function $V = 5x^2y - 8xy^2$. **a)** Calculate the x- and y-components of the electric field. **b)** What is the magnitude of the electric field at the coordinates x = 2, y = 0.4?

PRACTICE

In a region of space, the electric potential is $V(x, y, z) = 4xy - 7x^2 + 3yz$. Calculate the x, y, and z components of the electric field.

EXAMPLE

The electric potential in a region of space is given by the electric potential $V(x, y) = 2x^2y - 5xy^2$. Calculate the magnitude and direction of the electric field at the point $x = 1.6$m, $y = 0.9$m.