

**Warm-up:** Imagine you are standing on the side of a tall hill. List three things you would want to know about your position.

**On your Mark:** Place your surface on the grid. Label the  $x$  and  $y$  directions on the grid and surface. Measure the slope *in the direction of greatest increase* of the surface at the blue dot. Include units.

Slope in steepest direction: \_\_\_\_\_

**Get Set:** The surface's height  $h$  is a function of  $x$  and  $y$ , giving  $h = h(x, y)$ . At the blue dot, measure both  $\frac{\partial h}{\partial x}$  and  $\frac{\partial h}{\partial y}$ . Then form the vector  $\frac{\partial h}{\partial x} \hat{\mathbf{x}} + \frac{\partial h}{\partial y} \hat{\mathbf{y}}$ . Include units.

$$\frac{\partial h}{\partial x} = \quad \quad \quad \frac{\partial h}{\partial y} = \quad \quad \quad \frac{\partial h}{\partial x} \hat{\mathbf{x}} + \frac{\partial h}{\partial y} \hat{\mathbf{y}} = \quad \quad \quad \hat{\mathbf{x}} + \quad \quad \quad \hat{\mathbf{y}}$$

**Go:** At the blue dot, which way does your vector  $\frac{\partial h}{\partial x} \hat{\mathbf{x}} + \frac{\partial h}{\partial y} \hat{\mathbf{y}}$  point on the surface?

1. What is your vector's magnitude?
2. How does your vector relate to the level curve through the blue dot?

**Challenge:** Rotate the surface  $30^\circ$  on the grid and redraw the  $x$  and  $y$  directions on your surface. Which of your answers to **On your Mark**, **Get Set**, and **Go** remain the same?