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2. Practice Exam

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1

1/1 point (ungraded)

Suppose that $f(x, y) = xy + y^3$. At the moment, $x = 2$ and $y = 1$. We can either increase x by 0.04 or increase y by 0.01 . We would like to make f as large as we can. Which of the two options makes f bigger?

☐ increase x by 0.04

☒ increase y by 0.01

☐ they both change f by the same amount



Solution:

Computing the partial derivatives of $f(x, y)$ at $(2, 1)$ gives

$$\begin{aligned} f_x = y &\implies f_x(2, 1) = 1, \\ f_y = x + 3y^2 &\implies f_y(2, 1) = 5. \end{aligned}$$

This means:

- 1. Increasing x by 0.04 changes f by about $f_x(2, 1) \cdot \Delta x = (1)(0.04) = 0.04$.
- 2. Increasing y by 0.01 changes f by about $f_y(2, 1) \cdot \Delta x = (5)(0.01) = 0.05$.

Therefore the **second option** makes f bigger.

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Answers are displayed within the problem

2

1/1 point (ungraded)

Suppose that the height above sea-level at the point (x, y) is $h(x, y)$. At every point, a hiker going in the positive y direction is going downhill. Which one of the following functions could be the function $h(x, y)$?

☒ $x^3 - x^2y - y$

☐ $x^3 - x^2y + y$

☐ $x^3 + x^2y + y$

☐ None of the above



Solution:

We are given that any hiker going in the positive y -direction is going downhill; that is, f decreases when y increases along the hiker's path. Therefore, $f_y(x, y) < 0$. Computing f_y for each of the three options gives

- $f_y = -x^2 - 1,$

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- $f_y = -x^2 + 1,$
- $f_y = x^2 + 1.$

The first option is the only one for which f_y is always negative.

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 (Staff) [A typo in the solution 2](#)
"is going hill" - not "downhill"?

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