

- This individual quiz is for you to display your personal understanding of program material.
- This quiz is closed-book and closed-notes, except that you may use your personally prepared 3 inch by 5 inch notecard.
- No consultation with anyone other than instructor is allowed during the quiz. If you have a question, please do ask the instructor!
- For each question except multiple choice/fill-in-the blank, your solution must show work/calculations and display/explain your reasoning. **You will be evaluated on clarity/completeness of process, not simply on answer.**
- You have 30 minutes to work on this quiz.

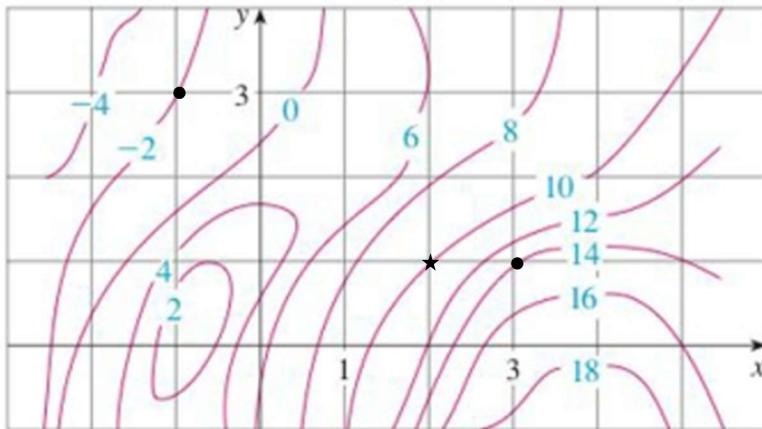
1. Given the vector function $\vec{v}(x, y, z) = (y + x)\hat{i} + (y - x)\hat{j} + (z)\hat{k}$. Calculate the divergence and the curl of this vector function.

Questions 2 and 3 refer to the contour plot of a scalar function $f(x, y)$ shown to the right.

2. The filled circles on the contour plot mark points approximately at $(-1, 3)$ and $(3, 1)$.

Carefully draw the gradient vector at those two points directly on the contour plot.

You need to get the directions correct and also show the relative magnitudes correctly (i.e. if the gradient vector is larger at the point $(-1, 3)$, the vector should be drawn so it is clearly longer). If you need it, your notecard might make a good straight-edge.



3. The point $(2, 1)$ is marked with a star. At that point, determine if the directional derivative in the direction specified is positive, negative, approximately zero, or if there's not enough information to decide. For each question below, circle one answer choice.

- | | | | | |
|---|-----------------|-----------------|---------------------------|------------------------|
| a) in the $+\hat{i}$ direction: | positive | negative | approximately zero | not enough info |
| b) in the $+\hat{j}$ direction: | positive | negative | approximately zero | not enough info |
| c) in the $-\hat{i} + \hat{j}$ direction: | positive | negative | approximately zero | not enough info |
| d) in the $+3\hat{i} + 2\hat{j}$ direction: | positive | negative | approximately zero | not enough info |

4. Consider the function $f(x, y) = 2x^2 - y^2 + 4xy$ at the point $(1, 1)$.

a) Find the gradient of $f(x, y)$ at the point $(1, 1)$, as well as its magnitude.

b) At $(1, 1)$, in what direction does $f(x, y)$ increase most rapidly? What is that rate of increase?

c) At $(1, 1)$, what is the rate of change of $f(x, y)$ in the direction $3\hat{i} + 4\hat{j}$?

d) At $(1, 1)$, in what direction does the directional derivative of $f(x, y) = 0$?