## CLASS QUIZ: FRIDAY FEBRUARY 1: MULTIVARIABLE FUNCTION BASICS

MATH 195, SECTION 59 (VIPUL NAIK)

Your name (print clearly in capital letters): ______________________________________

**PLEASE DISCUSS *ONLY* THE STARRED OR DOUBLE-STARRED QUESTIONS.**

(1) Suppose $f$ is a function of two variables, defined on all of $\mathbb{R}^2$, with the property that $f(x, y) = f(y, x)$ for all real numbers $x$ and $y$. What does this say about the symmetry of the graph $z = f(x, y)$ of $f$? *Last time:* 16/21 *correct* – DO NOT DISCUSS.
(A) It has mirror symmetry about the plane $z = x + y$.
(B) It has mirror symmetry about the plane $x = y$.
(C) It has mirror symmetry about the plane $z = x - y$.
(D) It has half turn symmetry about the line $x = y = z$.
(E) It has half turn symmetry about the origin.

Your answer: ____________________________

(2) (**) Consider the function $f(x, y) := ax + by$ where $a$ and $b$ are fixed nonzero reals. The level curves for this function are a bunch of parallel lines. What vector are they all parallel to? *Last time:* 5/21 *correct*
(A) $\langle a, b\rangle$
(B) $\langle a, -b\rangle$.
(C) $\langle b, a\rangle$
(D) $\langle b, -a\rangle$
(E) $\langle a - b, a + b\rangle$

Your answer: ____________________________

(3) (**) Suppose $f$ is a function of one variable and $g$ is a function of two variables. What is the relationship between the level curves of $f \circ g$ and the level curves of $g$? *Last time:* 7/21 *correct*
(A) Each level curve of $f \circ g$ is a union of level curves of $g$ corresponding to the pre-images of the point under $f$.
(B) Each level curve of $f \circ g$ is an intersection of level curves of $g$ corresponding to the pre-images of the point under $f$.
(C) The level curves of $f \circ g$ are precisely the same as the level curves of $g$.
(D) Each level curve of $g$ is a union of level curves of $f \circ g$.
(E) Each level curve of $g$ is an intersection of level curves of $f \circ g$.

Your answer: ____________________________

(4) Consider the following function $f$ from $\mathbb{R}^2$ to $\mathbb{R}^2$: the function that sends $\langle x, y\rangle$ to $\langle \frac{x+y}{2}, \frac{x-y}{2}\rangle$. What is the image of $\langle x, y\rangle$ under $f \circ f$? *Last time:* 12/21 *correct* – DO NOT DISCUSS.
(A) $\langle x, y\rangle$
(B) $\langle 2x, 2y\rangle$
(C) $\langle x/2, y/2\rangle$

(D) $\langle x + (y/2), y + (x/2) \rangle$
(E) $\langle 2x + y, 2x - y \rangle$

Your answer: ____________________________

(5) (**) Consider the following functions defined on the subset $x > 0$ of the $xy$-plane: $f(x, y) = x^y$. Consider the surface $z = f(x, y)$. What do the intersections of this surface with planes parallel to the $xz$-plane and $yz$-plane look like (ignore the following two special intersections: intersection with the plane $x = 1$ and intersection with the plane $y = 0$, also ignore intersections that turn out to be empty). *Last time:* 5/21 *correct*

(A) Intersections with any plane parallel to the $xz$ or $yz$ plane look like graphs of exponential functions.
(B) Intersections with any plane parallel to the $xz$ or $yz$ plane look like graphs of power functions (only positive inputs allowed).
(C) Intersections with any plane parallel to the $xz$-plane look like graphs of exponential functions, and intersections with any plane parallel to the $yz$-plane look like graphs of power functions (only positive inputs allowed).
(D) Intersections with any plane parallel to the $yz$-plane look like graphs of exponential functions, and intersections with any plane parallel to the $xz$-plane look like graphs of power functions (only positive inputs allowed).
(E) All the intersections are straight lines.

Your answer: ____________________________