Math 241 Exam 2 Spring 2019 **Justin Wyss-Gallifent**

Directions: Do not simplify unless indicated. No calculators are permitted. Show all work as appropriate for the methods taught in this course. Partial credit will be given for any work, words or ideas which are relevant to the problem.

Please put problem 1 on answer sheet 1

1. (a) Sketch the graph of $y = 9 - \sqrt{x^2 + z^2}$. Label two points with their coordinates and name the shape. [8 pts]

   (b) All together on one xy-plane sketch the level curves for $f(x, y) = |y| + x$ for $c = 0, 2, 4$. Label each with its value of c. [12 pts]

Please put problem 2 on answer sheet 2

2. (a) Write down the equation for the cylinder of radius 3 centered around the x-axis. [5 pts]

   (b) Find the symmetric equations of the line perpendicular to the surface $x^2 - y + 8 = z + y^2$ at the point $(1, 2, 3)$. [15 pts]

Please put problem 3 on answer sheet 3

3. (a) Suppose a cone is growing in volume by $2\,\text{cm}^3/\text{sec}$ while its height increases by $0.2\,\text{cm/sec}$. At what rate is the radius increasing at the instant when $r = 10\,\text{cm}$ and $V = 200\pi\,\text{cm}^3$? Hint: $V = \frac{1}{3}\pi r^2 h$ [10 pts]

   (b) Suppose $f(x, y) = xy + y^2$. If $\mathbf{u}$ is a unit vector which makes an angle of $\pi/6$ with ∇f at $(2, -1)$, find $D_{\mathbf{u}} f(2, -1)$. [10 pts]

Please put problem 4 on answer sheet 4

4. Find and categorize the critical points for the function [20 pts]

$$f(x, y) = x^2 y - 2x^2 - y^2$$

   For each critical point calculate if it is a relative maximum, relative minimum or saddle point. There are three nice critical points.

Please put problem 5 on answer sheet 5

5. Use Lagrange Multipliers to find the maximum and minimum of $f(x, y) = 2y + x^2 y$ with the constraint $x^2 + y^2 = 25$. Your system should have six nice solutions. [20 pts]

The End and the TA Section List

Chenzhi	0311 $\leftrightarrow$ 8:00	0321 $\leftrightarrow$ 9:30
Corry	0312 $\leftrightarrow$ 8:00	0322 $\leftrightarrow$ 9:30
Noah	0331 $\leftrightarrow$ 11:00	0341 $\leftrightarrow$ 12:30
Papia	0332 $\leftrightarrow$ 11:00	0342 $\leftrightarrow$ 12:30