

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 the surface $x^2 + y^2 = 9$. Include some sense of size and position. [7 pts]
Name the shape.
 - (b) Sketch the graph of the surface $y = \sqrt{x^2 + z^2}$. Include some sense of size and position. [7 pts]
Name the shape.
 - (c) Write down the equation for a paraboloid with vertex at $(0, 0, 2)$ opening downwards. [6 pts]
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Please put problem 2 on answer sheet 2

2. (a) All together on one set of axes sketch the level curves of $f(x, y) = x + (y - 1)^2$ for the values $c = -2, 0, 2$. [10 pts]
 - (b) Suppose the location of an object at time t in seconds is given by $\vec{r}(t) = t^2 \mathbf{i} + t^3 \mathbf{j}$. If the temperature of the plane in $^{\circ}C$ at (x, y) is given by $f(x, y) = x^2 + xy$, use the Chain Rule to determine the instantaneous change in temperature with respect to time when the object passes through the point $(4, 8)$. [10 pts]
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Please put problem 3 on answer sheet 3

3. (a) Suppose $f(x, y) = x^3y + y^2$. If \mathbf{u} is a unit vector which makes an angle of $\pi/3$ with ∇f at $(2, -1)$, find $D_{\mathbf{u}}f(2, -1)$. [10 pts]
 - (b) Use tangent plane approximation at $(5, 9)$ to approximate the value of $5.01\sqrt{8.9}$. [10 pts]
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Please put problem 4 on answer sheet 4

4. Find all three (guaranteed to be three!) of the critical points for the function: [20 pts]

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

For each critical point calculate if it is a relative maximum, relative minimum or saddle point.

Please put problem 5 on answer sheet 5

5. Use the method of Lagrange multipliers to find the maximum and minimum values of the function $f(x, y) = y + xy$ subject to the constraint $x^2 + y^2 = 1$. [20 pts]
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The End and the TA/Section List

Stephen S.	0311 \Leftrightarrow 10:00	0321 \Leftrightarrow 11:00
Ke	0312 \Leftrightarrow 10:00	0322 \Leftrightarrow 11:00
S. Gilles	0331 \Leftrightarrow 12:00	0341 \Leftrightarrow 1:00
Chenzhi	0332 \Leftrightarrow 12:00	0342 \Leftrightarrow 1:00