Name________________________ ID____________ Section______

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MATH 253 EXAM 1 Fall 1998

Sections 501-503 P. Yasskin

Multiple Choice: (3 points each)

Problems 1 – 3: Find the plane tangent to the graph of the equation $z\ln(y) - z\ln(x) = e^2$ at the point $(x,y,z) = (1,e,e^2)$. Write the equation of the plane in the form $z = Ax + By + C$ and find the values of A, B and C in problems 1, 2 and 3:

1. $A =$

- **a.** 1
- **b.** e
- **c.** e^2
- **d.** $-e$
- **e.** $-e^2$

2. $B =$

- **a.** 1
- **b.** e
- **c.** e^2
- **d.** $-e$
- **e.** $-e^2$

3. $C =$

- **a.** 1
- **b.** e
- **c.** e^2
- **d.** $-e$
- **e.** $-e^2$

Problems 4 – 6: Find the plane tangent to the graph of the function $f(x,y) = \frac{x-y}{x^2+y^2}$ at the point $(x,y) = (2,1)$. Write the equation of the plane in the form $z = Ax + By + C$ and find the values of A, B and C in problems 4, 5 and 6:

4. $A =$

- **a**. $\frac{1}{25}$
- **b**. $\frac{7}{25}$
- **c**. $-\frac{1}{5}$
- **d**. $-\frac{1}{25}$
- **e**. $-\frac{7}{25}$

5. $B =$

- **a**. $\frac{1}{25}$
- **b**. $\frac{7}{25}$
- **c**. $-\frac{1}{5}$
- **d**. $-\frac{1}{25}$
- **e**. $-\frac{7}{25}$

6. $C =$

- **a**. $\frac{2}{5}$
- **b**. $\frac{1}{5}$
- **c**. 0
- **d**. $-\frac{1}{5}$
- **e**. $-\frac{2}{5}$

7. The dimensions of a closed rectangular box are measured as 80 cm, 60 cm and 50 cm with a possible error of 0.2 cm in each dimension. Use differentials to estimate the maximum error in the calculated surface area of the box.

- **a**. 38 cm^2
- **b**. 95 cm^2
- **c**. 144 cm^2
- **d**. 148 cm^2
- **e**. 152 cm^2

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8. Consider the function $f(x,y) = 3(x+y)^3$. Find the set of **all** points (x,y) where $\vec{\nabla} f = 0$.

- **a**. The point $(x,y) = (0,0)$.
- **b**. The point $(x,y) = (1,-1)$.
- **c**. The line $(x,y) = (t,-t)$.
- **d**. The line $(x,y) = (t,t)$.
- **e**. The circle $x^2 + y^2 = \frac{1}{9}$.

9. (6 points) Suppose $p = p(x,y)$, while $x = x(u,v)$ and $y = y(u,v)$. Further, you know the following information:

$x(1,2) = 3$	$y(1,2) = 4$	$p(1,2) = 5$	$p(3,4) = 6$
$\frac{\partial p}{\partial x}(1,2) = 7$	$\frac{\partial p}{\partial y}(1,2) = 8$	$\frac{\partial p}{\partial x}(3,4) = 9$	$\frac{\partial p}{\partial y}(3,4) = 10$
$\frac{\partial x}{\partial u}(1,2) = 11$	$\frac{\partial x}{\partial v}(1,2) = 12$	$\frac{\partial x}{\partial u}(3,4) = 13$	$\frac{\partial x}{\partial v}(3,4) = 14$
$\frac{\partial y}{\partial u}(1,2) = 15$	$\frac{\partial y}{\partial v}(1,2) = 16$	$\frac{\partial y}{\partial u}(3,4) = 17$	$\frac{\partial y}{\partial v}(3,4) = 18$

Write out the chain rule for $\frac{\partial p}{\partial v}$. Then use it and the above information to compute $\frac{\partial p}{\partial v}(1,2)$.

10. (10 points) Find all critical points of the function $f(x,y) = xy^2 + 3x^2 - 3y^2 - 2x^3$ and classify each as a local maximum, a local minimum or a saddle point.

11. (10 points) Find the dimensions and volume of the largest rectangular box in the first octant with three faces in the coordinate planes and one vertex in the plane $3x + 2y + z = 6$.