Name (last, first):
Student ID:
☐ Write your name and PID on the top of EVERY PAGE.
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☐ Write the solutions to each problem on separate pages. CLEARLY
INDICATE on the top of each page the number of the corresponding
problem. Different parts of the same problem can be written on the
same page (for example, part (a) and part (b)).
\square The exam consists of 4 questions. Your answers must be carefully
justified to receive credit.
☐ This exam will be scanned. Make sure you write ALL SOLUTIONS
on the paper provided. DO NOT REMOVE ANY OF THE PAGES.
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□ No calculators, phones, or other electronic devices are allowed.
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☐ Remember this exam is graded by a human being. Write your solutions
NEATLY AND COHERENTLY, or they risk not receiving full credit.
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☐ You are allowed to use one 8.5 by 11 inch sheet of paper with hand-
written notes (on both sides); no other notes (or books) are allowed.
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- 1. (20 points) Let $f(x,y) = (x+y^2)e^{x^2y^2}$.
 - (a) Find the gradient of the function f at point (0,0). Find the directional derivative of the function f at the point (0,0) in the direction $\vec{v} = \langle 3,4 \rangle$.

(b) Fin the unit vector in the direction of the maximal rate of increase for the function f at the point (0,0). What is the value of the directional derivative in this direction?

2. (20 points) Use the chain rule to find the partial derivative $\frac{\partial z}{\partial v}$ for

$$z = \left(x + \frac{y}{x}\right)^2,$$

where

$$x = u + v,$$
 $y = u - v.$

You may leave your answer as a product of terms, but your answer should not have any derivative operations remaining to be performed. Your final answer should only be a function of u and v.

3. (20 points) Find the tangent plane to the function $f(x,y) = \sqrt{xy^2 + \ln(x) + 1}$ at the point (1,0). [Hint. Recall that $\ln(1) = 0$.]

4. (20 points) Suppose that $\mathbf{r}(t) = \langle e^{\cos(t)}, \sin(1 - e^{-t}), t \rangle$. Find the unit tangent vector to this curve at time t = 0.