1. Write your Name, PID, and Section on the front of your Blue Book.
2. Write the Version of your exam on the front of your Blue Book.
3. No calculators or other electronic devices are allowed during this exam.
4. You may use one page of notes, but no books or other assistance during this exam.
5. Read each question carefully, and answer each question completely.
6. Write your solutions clearly in your Blue Book
   (a) Carefully indicate the number and letter of each question.
   (b) Present your answers in the same order they appear in the exam.
   (c) Start each question on a new page.
7. Show all of your work; no credit will be given for unsupported answers.

1. A particle's position function is $\mathbf{r}(t) = \langle t, \frac{\sqrt{2}}{2}t^2, \frac{t^3}{3}\rangle$.
   (a) (3 points) Find the particle's velocity $\mathbf{v}(t)$ and its acceleration $\mathbf{a}(t)$ as functions of t.
   (b) (2 points) Find the particle's speed $\|\mathbf{v}(t)\|$ as a function of t. (Simplify your answer and get rid of the square root.)
   (c) (2 points) Find the total distance traveled by the particle during the time interval $0 \le t \le 1$.

2. (a) (4 points) Evaluate $\lim_{(x,y)\to(0,0)} \frac{\cos(\sqrt{x^2+y^2})-1}{x^2+y^2}$.
   (b) (4 points) Explain why $\lim_{(x,y)\to(0,0)} \frac{x^2}{x^2+y^2}$ does not exist.

3. Let $f(x,y) = x\ln(x^2+y^2)$.
   (a) (5 points) Find $\nabla f(x,y)$.
   (b) (5 points) Find an equation of the tangent plane of $z = f(x,y)$ at $(\sqrt{3}/2, 1/2, 0)$.
   (c) (2 points) Find the maximum rate of increase of f at $(\sqrt{3}/2, 1/2)$.
   (d) (3 points) Find the directional derivative of f at $(\sqrt{3}/2, 1/2)$ in the direction of $\mathbf{v} = \langle 1, \sqrt{3}\rangle$.

4. (5 points) Let $z = y\sin x$, $x = r\cos\theta$ and $y = r\sin\theta$. Find $\partial z/\partial\theta$. (Leave the answer in terms of both the dependent and the independent variables.)

5. (5 points) Suppose that $z = f(x,y)$ is defined implicitly by the equation

$$F(x,y,z) := -\sin(xz) + e^{yz} - e^{\pi} = 0.$$

Suppose $f(1,1) = \pi$. Find $f_y(1,1)$.

Good luck.