

Your Name

Your Signature

Problem	Total Points	Score
1	10	
2	10	
3	10	
4	10	
5	10	
Total	50	

- This exam is closed book and closed notes.
- Only non-graphing scientific calculators are allowed.
- In order to receive credit, you must show your work. You must also justify all conclusions you make. Do not assume something is obvious. If you feel something is clear enough to not necessitate algebra, write a sentence or two explaining your reasoning. Do not do computations in your head. Instead, write them out on the exam paper.
- Place a box around **YOUR FINAL ANSWER** to each question.
- If you are unable to simplify an answer, leave it in a form that can be put in to a calculator. Do not assume that every answer will be simple.
- If you need more room, use the backs of the pages and indicate to the reader that you have done so.
- Raise your hand if you have a question.

1 (10 points) Consider the function

$$f(x, y) = x^4 - 2x^2 + y^2 + 2$$

a) Find the critical points of this function and classify them.

b) Consider the function $\vec{r} = \langle \sqrt{t}, t \rangle$, defined for $t > 0$. Using the chain rule, find the single critical point of f along \vec{r} .

2 (10 points) Find the minimum of $f(x, y, z) = x^2 + y^2 + z^2$ restricted to the surfaces $x + y = 4$ and $y + z = 6$.

- 3 (10 points) Find the integral of the function $f(x, y) = 12x$ on the triangle bounded by the points $(0, 1)$, $(1, 0)$, and $(-1, -1)$.

4 (10 points) Evaluate

$$\int_0^{12} \int_{y/3}^4 \frac{1}{\sqrt{x^2 + 9}} dx dy$$

5 (10 points) Evaluate

$$\iint_D \frac{x}{x^2 + y^2} dA$$

where $4 \leq x^2 + y^2 \leq 9$ and $-x \leq y \leq x$.