University of California, San Diego
Department of Mathematics

Instructions

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

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0. (1 point) Carefully read and complete the instructions at the top of this exam sheet and any additional instructions written on the chalkboard during the exam.

1. (6 points) Let $f(x, y) = x^3y + 12x^2 - 8y$.
   (a) Find all critical points of f.
   (b) classify each critical point of f as a local maximum, local minimum, or saddle point.

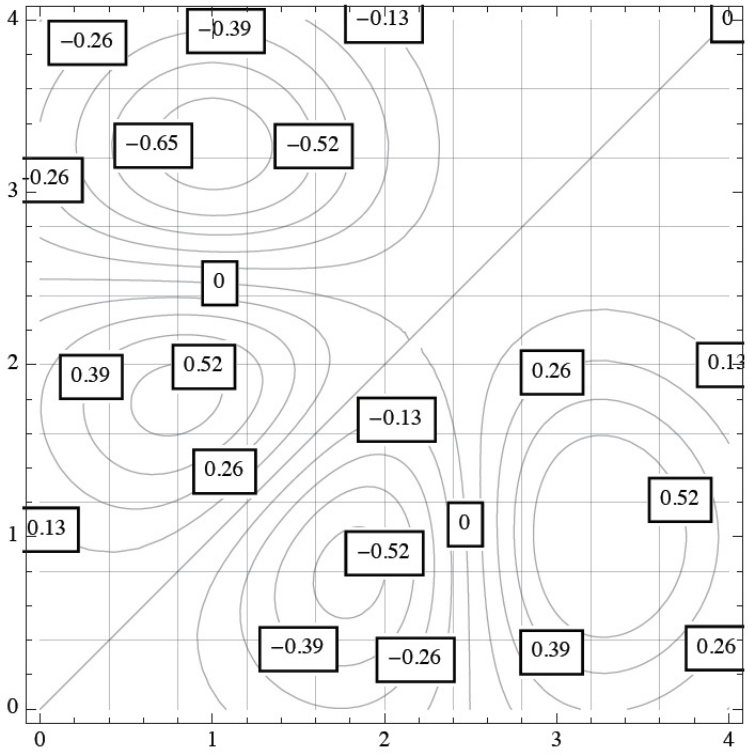
2. (6 points) Find an equation for the plane passing through the points $(1, 1, 5)$, $(1, -3, 1)$, and $(6, 1, 1)$.

3. (6 points) Let $\vec{v} = \vec{i} + \vec{j} - \vec{k}$ and $\vec{w} = 2\vec{i} - \vec{j} + \vec{k}$.
   (a) Compute $\vec{v} \cdot \vec{w}$.
   (b) Compute $\vec{v} \times \vec{w}$.
   (c) Find the angle between $\vec{v}$ and $\vec{w}$. You may express this angle as the inverse cosine (or arccosine) of a number.

4. (6 points) A rectangular box without a top has a volume of 32 cm^3. Find the dimensions of the box having minimal surface area.

5. (6 points) Find the maximum and minimum values of the function $f(x, y) = xy$ subject to the constraint $9x^2 + y^2 = 18$.

6. (6 points) Let f be a function that has the contour diagram given below.
   (a) Find the coordinates (to the nearest 0.2) of the local maxima and local minima of the function f.
   (b) The function f also has at least one saddle point. Find the coordinates (to the nearest 0.2) of the saddle point(s).



7. (6 points) Evaluate the double integral $\iint_R (x^2 + xy)\, dA$, where R is the triangle in the xy-plane having vertices at $(0, 0)$, $(1, 1)$, and $(1, 0)$.

8. (7 points) Evaluate the integral by reversing the order of integration $\int_0^1 \int_{y^2}^1 4y \sin(x^2)\, dx\, dy$.