

These are only a *few* sample problems to *help* you prepare for the exam. You should also be certain that you completely understand the WeBWorK assignments, Problems Sets, in-class work, and your class notes.

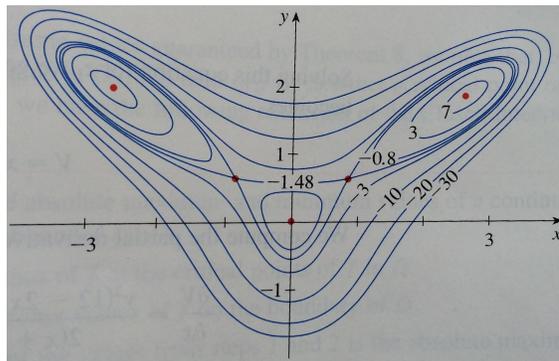
1. The contour plot of $z = f(x, y)$ is shown below.

(a) The following points are critical points of f :

- $p_1 = (0, 0)$
- $p_2 = (-2.644, 1.898)$
- $p_3 = (2.644, 1.898)$
- $p_4 = (-0.856, 0.646)$
- $p_5 = (0.856, 0.646)$

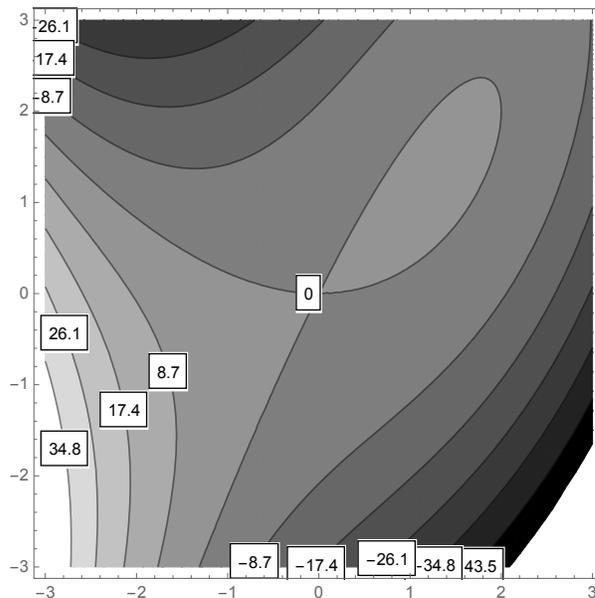
Use the contour plot to classify the critical points.

- (b) If you are standing on the surface at the point $(2, 2)$ and move in the direction $\langle \frac{1}{\sqrt{2}}, -\frac{1}{\sqrt{2}} \rangle$, will the directional derivative be positive, negative or zero?
- (c) What if you are standing at the point $(0, -1)$ and move in the $\langle -1, 0 \rangle$ direction?
- (d) What if you are standing at the point $(0, -1)$ and move in the $\langle 0, 1 \rangle$ direction?



2. Let $f(x, y) = 4xy - x^3 - 2y^2$

- (a) Find and classify the critical points of $f(x, y)$
- (b) What is the rate of change of $f(x, y)$ at the point $(1, 2)$ in the direction of $\vec{v} = \langle 1, 3 \rangle$?
- (c) If you are standing at the point on the surface with $(x, y) = (1, 2)$ and drop your glass of milk, in what direction will your spilt milk flow?



3. Evaluate the following integrals.

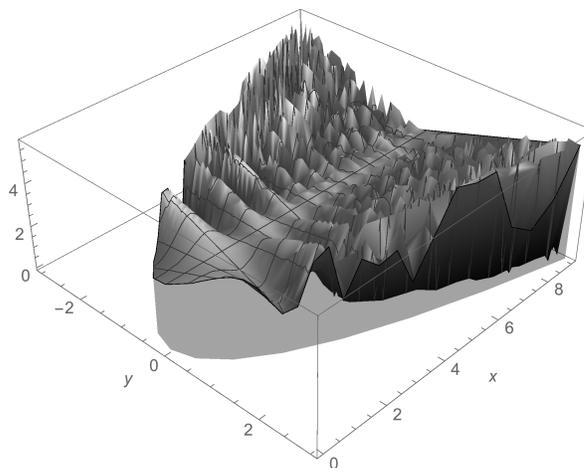
(a) $\int_0^8 \int_{\sqrt[3]{y}}^2 \sin(x^4) \, dx \, dy$

(b) $\int_0^1 \int_{\sqrt[5]{y}}^1 \cos(x^3) \, dx \, dy$

4. Let $f(x, y) = y \cos(x^2) + 3$ and let R be the region in the xy -plane bounded by the graphs $x = y^2$ and $x = 9$.

(a) Find the volume of the solid that lies below the graph $z = f(x, y)$ and above R .

(b) What is the average value of $f(x, y)$ over R ?



5. Find the point on the surface $z^2 = 10 - 2x + x^2 - 6y + y^2$ that is closest to the origin.

6. Find the center of mass of the lamina with density function $\rho(x, y) = x + y$ that occupies the region R bounded the curve $y = x^2$, $x = 2$ and the x -axis