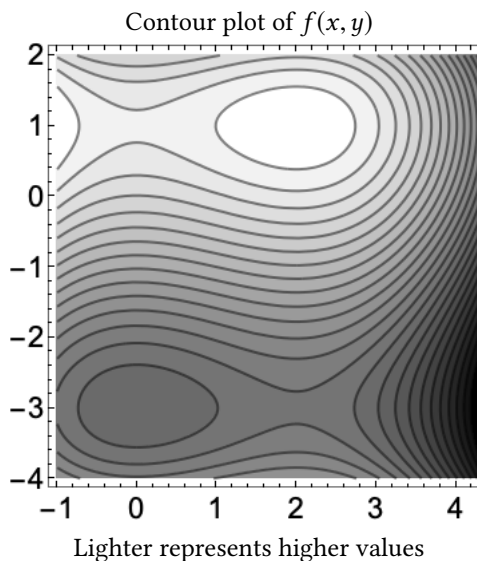


These are only a *few* sample problems to *help* you prepare for the exam. You should also be certain that you completely understand the WeBWorK assignments, Problems Sets, in-class work, and your class notes.

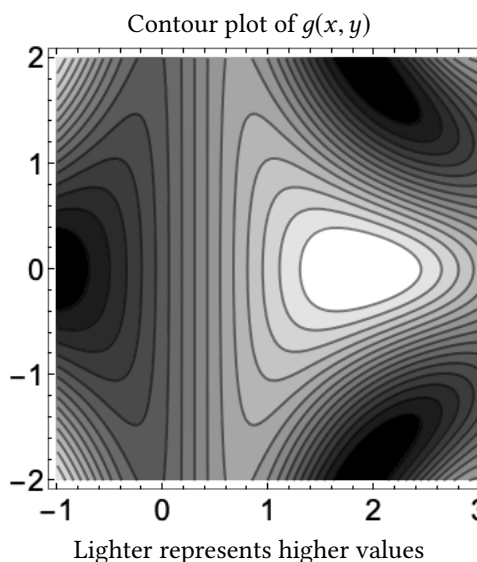
1. Let  $f(x, y) = -\frac{x^3}{3} + x^2 - \frac{y^3}{3} - y^2 + 3y + 3$

- Find and classify the critical points of  $f(x, y)$
- What is the rate of change of  $f(x, y)$  at the point  $(3, -1)$  in the direction of  $\vec{v} = \langle -2, 1 \rangle$ ?
- If you are standing at the point on the surface with  $(x, y) = (3, -1)$  and drop a glass of milk, in what direction will your spilt milk flow?
- Suppose you are standing at the point on the surface with  $(x, y) = (3, -1)$ . Give a direction you could walk to maintain the same altitude (i.e. height above the  $xy$ -plane).  
Is there another direction you could have walked?



2. Use the contour plot of  $g(x, y)$  to answer the following.

- Is  $g_x(2, -1)$  positive, negative or zero? Explain.
- Is  $g_y(2, -1)$  positive, negative or zero? Explain.
- If you are standing at the point on the surface with  $(x, y) = (0, 0)$ , in what direction should you walk to go uphill the fastest? Why?
- Will the directional derivative of  $g(x, y)$  at the point  $(x, y) = (0, 1)$  in the direction of  $v = \langle -1, -1 \rangle$  be positive, negative or zero? Explain.



3. If  $\nabla f = \langle -2x \sin(x^2) + 8xy + 2y^2, 4x^2 + 4xy + 2y + \cos(y) \rangle$ , find  $f(x, y)$ .

4. Evaluate the following integrals.

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

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

5. 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  $x = 9$ . Find the volume of the solid that lies below the graph  $z = f(x, y)$  and above  $R$ .

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

